23. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH

28.–30. september 2015, Portorož, Slovenija

23rd INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY

28–30 September 2015, Portorož, Slovenia

PROGRAM IN KNJIGA POVZETKOV

PROGRAM AND BOOK OF ABSTRACTS

INŠTITUT ZA KOVINSKE MATERIALE IN TEHNOLOGIJE, LJUBLJANA

23. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH /
23rd INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY

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VSEBINA – CONTENTS

Legenda – Legend:
MM – Kovinski materiali/Metallic materials
CM – Kompozitni materiali/Composite materials
C – Keramika/Ceramic
P – Polimeri/Polymeric materials
MS – Modeliranje in simulacija procesov in tehnologij/Mathematical modeling and computer simulation of processes and technologies
HT – Toplotna obdelava in inženiring površin kovinskih materialov/Heat treatment and surface engineering of metals
CD – Korozija in degradacija materialov/Corrosion and degradation of materials
NN – Nanoznanost in nanotehnologije/Nanosciences and nanotechnologies

YR – Mladi raziskovalci/Young scientists

23. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH,
28. – 30. SEPTEMBER 2015

23rd INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY,
28–30 SEPTEMBER, 2015

	EUROPA „B“	
	Opening ceremony - director IMT	
9:20	PLENARY LECTURE Pereloma	
10:10	INVITED LECTURE Mori	
10:40	**COFFEE BREAK**	
11:10	INVITED LECTURE Savilov	
11:40	INVITED LECTURE Čeh	
12:10	Introduction in Young researcher section	
12:40	**LUNCH**	
	EUROPA „D“	EUROPA „C“
14:00	Zelič - Stambolić	Bulejko - Králíková
14:20	Vančura - Ibrahim	Franco - Dolák
14:40	Burja - Plachcinska	Oprčkal - Kucharska
15:00	Doktor - Kračun	Pőssl - Nepapushev
15:20	Vorel - Borchert	Gosar - Samsuzzaman
15:40	**COFFEE BREAK**	
16:00	Prethaler	Komárková
16:10	Strokova	Kelhar - Kocen
16:30	Kurtjak - He	Hossain - Moskovskikh
16:50	Pečnik - Aničić	Faruque - Sever
17:10	Štefančič - Jasmin	Vrabelj - Paksoy
17:30	Pavelková - Z. Jezovšek	Hatić - Lisiecki
17:50	Jandikova - Lebedev	M. Islam - Maleki
19:30 21:00	**POSTER SECTION - STANDING BUFFET**	

	EUROPA „B“	
9:00	PLENARY LECTURE Hoffmann	
9:50	INVITED LECTURE Pellizzari	
10:20	INVITED LECTURE Medved	
10:50	**COFFEE BREAK**	
	EUROPA „D“	EUROPA „C“
11:20	Ramanathan	Hnizdil
11:35	Hodnik	Łagoda
11:50	Cherneva	Ossowski
12:05	Yilmaz Atay	Wojtaszek
12:20	Jenko	Gryc
12:35	Conradi	Huang
12:50		Pietrusiewicz
13:05		Dośpiał
13:20	**LUNCH**	
14:40	Soucek	
14:55	Walker	
15:10	Sokolar	
15:25	Ramli	
15:40	Gautier	
15:55	Ebeoglugil	
16:10	Skubisz	
16:25	Lenik	
16:40	Pohanka	
18:30- 22:00	**SOCIAL EVENT AT ST. BERNARDIN**	

	EUROPA „D“
9:00	PLENARY LECTURE Juan
9:50	INVITED LECTURE Massler
10:20	INVITED LECTURE Podgornik
10:50	**COFFEE BREAK**
11:20	McGuiness
11:35	Aišman
11:50	Lojen
12:05	Žužek
12:20	Naglič
12:35	Kayar
12:50	Kugler
13:05	Kosec
13:20	**LUNCH**
14:50	Borowski
15:05	Peikrishvili
15:20	Faga
15:35	Adamiak
15:50	Mistik
16:00	**CLOSING CEREMONY**

PROGRAM 23. MEDNARODNE KONFERENCE O MATERIALIH IN TEHNOLOGIJAH
23rd INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY: PROGRAM

PONEDELJEK – MONDAY 28. 9. 2015 – EUROPA »B«	
	Predsedujoči – Chair: M. Godec, B. Podgornik
9:00	**ODPRTJE – OPENING CEREMONY – director IMT Matjaž Godec**
9:20	APPLICATION OF ADVANCED EXPERIMENTAL TECHNIQUES TO ENHANCE UNDERSTANDING OF MECHANICAL BEHAVIOR OF STEELS E.V. Pereloma[1,2] [1]School of Mechanical, Materials and Mechatronics Engineering, University of Wollongong, New South Wales 2522, Australia, [2]Electron Microscopy Centre, University of Wollongong, New South Wales 2500, Australia
10:10	DAMAGE SEQUENCES OF AUSTENITIC STAINLESS STEELS IN CHLORIDE SOLUTIONS UNDER CYCLIC LOADING G. Mori[1], A. Visser[1], R. Fluch[2], M. Kapp[2], H. Leitner[2], B. Holper[3], M. Panzenböck[4] [1]Chair of General and Analytical Chemistry, Montanuniversitaet Leoben, Franz Josef-Strasse 18, 8700 Leoben, Austria, [2]Böhler Edelstahl GmbH & Co KG, Mariazeller Strasse 25, 8605 Kapfenberg, Austria, [3]Schoeller Bleckmann Oilfield Technology GmbH, Hauptstrasse 2, 2630 Ternitz, Austria, [4]Department of Physical Metallurgy and Materials Testing, Montanuniversitaet Leoben, Franz Josef Strasse 18, 8700 Leoben, Austria
10:40	**COFFEE BREAK**
11:10	COMPACTING OF NANOSTRUCTURED CARBON MATERIALS: CHEMICAL AND PHYSICAL APPROACHES Savilov S.V.[1], Ivanov A.S.[1], Suslova E.V.[1], Lu L.[2], Aldoshin S.M.[1], Lunin V.V.[1] [1]M.V. Lomonosov Moscow State University, Moscow, Russian Federation, [2]National University of Singapore, Singapore
11:40	HIGH-RESOLUTION STEM IMAGING OF OXIDE MATERIALS FOR THERMOELECTRIC APPLICATIONS Miran Čeh[1,2], Marja Jerič[1,3], Sašo Šturm[1], Mateja Košir[1], Slavko Bernik[1], Cleva Ow-Yang[4], Mehmet Ali Gülgün[4] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Ljubljana, Slovenia, [2]Center for Electron Microscopy and Microanalysis, Jožef Stefan Institute, Ljubljana, Slovenia, [3]Jožef Stefan International Postgraduate School, Ljubljana, Slovenia, [4]Materials Science & Engineering, Sabanci University, Tuzla, Istanbul, Turkey
12:10	**Introduction for young researchers – presenting and publishing your work**
12:40	**LUNCH**
	EUROPA »D«
	Predsedujoči – Chair: B. Podgornik
14:00	INVESTIGATION OF NON-METALLIC RARE-EARTH INCLUSIONS IN RE MODIFIED OCR12 TOOL STEEL Klemen Zelič, Črtomir Donik, Jaka Burja, Matjaž Godec Institute Of Metals And Technology, Lepi pot 11, Ljubljana, Slovenia
14:10	CONTINUOUS CASTING OF NITINOL Aleš Stambolić[1,2], Ivan Anžel[3], Gorazd Lojen[3], Aleksandra Kocijan[1], Rebeka Rudolf[3,4], Monika Jenko[1,2] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana, Slovenia, [3]University of Maribor, Faculty of Mechanical Engineering, Smetanova 17, 2000 Maribor, Slovenia, [4]Zlatarna Celje d.d., Kersnikova 19, 3000 Celje, Slovenia

14:20	STUDY OF EFFECTS OF FORGING TEMPERATURE AND DEFORMATION ON MICROSTRUCTURE OF CLOSED-DIE-FORGED STEEL PART USING MATERIAL TECHNOLOGICAL MODELING Filip Vančura, Ivan Vorel, Bohuslav Mašek University of West Bohemia, Univerzitni 8, 306 14 Pilsen, Czech Republic
14:30	NEW CONCEPT FOR MANUFACTURING CLOSED DIE FORGINGS OF HIGH STRENGTH STEELS Bublíková Dagmar, Mašek Bohuslav, Ibrahim Khodr University of West Bohemia, Research Centre of Forming Technology, Univerzitní 8, 306 14 Plzeň
14:40	CHROMIUM OXIDE PRECIPITATION IN CaO-SiO_2-Cr_2O_3 SYSTEM Jaka Burja[1], Franc Tehovnik[1], Franci Vode[1], Matjaž Godec[1], Jožef Medved[2] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, [2]Faculty of Natural Sciences and Engineering, Aškerčeva cesta 12, 1000 Ljubljana
14:50	EFFECT OF SULPHIDE INCLUSIONS ON THE PITTING CORROSION BEHAVIOR OF HIGH-Mn STEELS IN CHLORIDE AND ALKALINE SOLUTIONS Adam Grajcar, Aleksandra Płachcińska Silesian University of Technology, Institute of Engineering Materials and Biomaterials, 44-100 Gliwice, 18a Konarskiego Street, Poland
15:00	COMPRESSIVE PROPERTIES OF AUXETIC STRUCTURES WITH CONTROLLED STIFFNESS OF STRUT JOINTS Tomáš Doktor, Tomáš Fíla, Petr Koudelka, Ondřej Jiroušek Czech Technical University in Prague, Faculty of Transportation Sciences, Konviktská 20, 110 00 Prague 1, Czech Republic
15:10	MICROSCOPIC CHARACTERIZATION OF NANOPARTICLES IN STEEL Ana Kračun[1,2], Matjaž Torkar[1], Jaka Burja[1], Bojan Podgornik[1] [1]Institute of Metals and Technology, Ljubljana, [2]International postgraduate school Jožef Stefan, Ljubljana
15:20	ELECTRON BEAM WELDING OF 42SiCr HIGH-STRENGTH STEEL Ivan Vorel, Jana Čubrová, Štěpán Jeníček, Bohuslav Mašek University of West Bohemia, Research Centre of Forming Technology,Univerzitní 22, 306 14 Plzeň
15:30	KEY NITRIDING PARAMETERS INFLUENCING CORROSION RESISTANCE OF MARTENSITIC CHROMIUM STEELS M. Borchert[1], G. Mori[1], M. Bischof[2], A. Tomandl[2] [1]General and Analytical Chemistry, Montanuniversitaet Leoben, Franz-Josef-Strasse 18, 8700 Leoben, Austria, [2]Hilti Corporation, Feldkircherstrasse 100, 9494 Schaan, Liechtenstein
15:40	**COFFEE BREAK**
	Predsedujoči – Chair: B. Podgornik
16:00	PERFORMANCE OF AMINE AND IMIDAZOLINE BASED INHIBITORS IN A HIGH VELOCITY LABORATORY TEST RIG A. Prethaler[1], G. Mori[1], E. Rosenberg[2], M. Rückemann[2] [1]General and Analytical Chemistry, Montanuniversität Leoben, Franz-Josef-Str. 18, 8700 Leoben, Austria, [2]Institute for Chemical Technologies and Analytics, Technical University of Vienna, Getreidemarkt 9, 1060 Vienna, Austria
16:20	ADSORPTION PROPERTIES OF SINTERED CARBON STRUCTURED NANOMATERIALS Strokova Natalia[1], Savilov Serguei[1], Lunin Valery[1], Lu Li[2], Aldoshin Serguei[3] [1]Chemistry Department, M.V. Lomonosov Moscow State University, Leninskie gory, 1-3, Moscow, 119991, Russia, [2]Department of Mechanical Engineering, National University of Singapore, Block EA, #07-08, 9 Engineering Drive 1, 117575, Singapore, [3]Faculty of Fundamental Physical and Chemical Engineering, M.V. Lomonosov Moscow State University, Leninskiye Gory, 1, GSP-1, Moscow, 119991, Russia

16:30	GALLIUM-BASED ANTIBACTERIAL PROTECTION OF HYDROXYAPATITE Mario Kurtjak, Marija Vukomanović, Danilo Suvorov Jožef Stefan Institute, Advanced Materials Department – K9, Jamova cesta 39, 1000 Ljubljana
16:40	A SELECTIVE GROWTH APPROACH TO PREPARE SUPERHYDROPHOBIC SURFACES ON COPPER SUBSTRATES Zhiwei He, Jianying He, Zhiliang Zhang NTNU Nanomechanical Lab, Norwegian University of Science and Technology (NTNU), Trondheim 7491, Norway
16:50	DIELECTRIC PROPERTIES OF THE SOLUTION-DERIVED $Ba_{0.5}Sr_{0.5}TiO_3$ THIN FILMS Tanja Pečnik[1,2], Sebastjan Glinšek[1,3], Brigita Kmet[1], Barbara Malič[1] [1]Electronic Ceramics Department, Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia [2]Jozef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia [3]CEA Grenoble, Leti, Minatec Campus, 17 Rue des Martyrs, F-38054 Grenoble, France
17:00	HYDROTHERMAL GROWTH OF VANADIUM PENTOXIDE NANOWIRES FROM AN AMMONIUM METAVANADATE PRECURSOR SOLUTION Nemanja Aničić, Marija Vukomanovic, Danilo Suvorov Jozef Stefan Institute, Jamova 39 Ljubljana, Slovenia
17:10	ELECTRON MICROSCOPY INVESTIGATION OF CEMENT-BASED MATERIALS MODIFIED BY THE ADDITION OF A-ALUMINA NANOPARTICLES [1]Mateja Štefančič, [2]Nina Daneu, [1]Ana Mladenovič [1]Slovenian National Building and Civil Engineering Institute, Dimičeva 12, 1000 Ljubljana, Slovenia, [2]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia
17:20	GROWTH AND NANOSCALE INDENTATION OF ZnO NANOWIRES A. Jasmin[1,2,3], M. Lorusso[2], M. Fontana[1], S. Porro[2] [1]Istituto Italiano di Tecnologia, Center for Space Human Robotics, C.so Trento 21, 10129, Torino, Italy, [2]Dipartimento di Scienza Applicata e Tecnologia, Politecnico di Torino, C.so Duca degli Abruzzi 24, 10129, Torino, Italy, [3]University of the Philippines Baguio, Gov. Pack Road, Baguio City 2600, Philippines
17:30	BIODEGRADABLE POLYESTER URETHANE BASED MATRICES FOR NANOFIBRES FABRICATIONS Alena Pavelková, Pavel Kucharczyk, Vladimir Sedlařík Centre of Polymer Systems, University Institute, Tomas Bata University in Zlin, Tř. Tomaše Bati 5678, 76001 Zlín, Czech Republic
17:40	SOLVOTHERMALY SYNTHESIZED WEB-LIKE TiO_2/Au STRUCTURES Tina Zabukovec Jezovšek[1,2], Marjan Bele[1], Miran Gaberšček[1], Goran Dražić[1,2] [1]Laboratory for materials chemistry, National Institute of Chemistry, Ljubljana, Slovenia, [2]Josef Stefan International Postgraduate School
17:50	ANTIMICROBIAL MODIFICATION OF POLYOLEFINS WITH SILVER NANOPARTICLES IMMOBILIZED BY ON ZINC STEARATE Gabriela Jandíková, Petr Stloukal, Vladimír Sedlařík Centre of Polymer Systems, University Institute, Tomas Bata University in Zlin, Tř. Tomaše Bati 5678, 76001 Zlín, Czech Republic
18:00	STUDY, CALCULATION AND ANALYSIS OF CHANGES IN CHEMICAL REACTION PROPAGATION VELOCITY IN MULTILAYERED THERMITE STRUCTURES E. A. Lebedev[1], M. I. Vorobiev[1], Y. P. Shaman[2], D. G. Gromov[1], A. S. Shuliatyev[1], Yu. I. Shilyaeva[1] [1]National Research University of Electronic Technology, Shokin sq., bld. 1, Zelenograd, Moscow, Russia, [2]Scientific Manufacturing Complex “Technological Centre”, 5 pas. 4806, Zelenograd, Moscow, Russia

19:30	**POSTER SECTION – STANDING BUFFET**
21:00	

PONEDELJEK – MONDAY 28. 9. 2015 – EUROPA »C«	
	Predsedujoči – Chair: M. Čeh
14:00	INFLUENCE OF CHEMICAL ADDITIVES AND CURING CONDITIONS ON MECHANICAL PROPERTIES AND CARBONATION RESISTANCE OF ALKALI-ACTIVATED SLAG COMPOSITES Pavel Bulejko[1], Vlastimil Bílek[2] [1]Brno University of Technology, Faculty of Mechanical Engineering, Heat Transfer and Fluid Flow Laboratory, Technická 2896/2, 616 69 Brno, Czech Republic, [2]Brno University of Technology, Faculty of Chemistry, Material Research Centre, Purkyňova 118, 612 00 Brno, Czech Republic
14:10	EXPERIMENTAL DETERMINATION OF THE INFLUENCE OF WATER/CEMENT RATIO VALUE ON THE RESISTANCE OF CONCRETE TO THE ACTION OF WATER AND CHEMICAL THAWING AGENTS Dalibor Kocáb, Tereza Komárková, Monika Králíková, Petr Misák, Bronislava Moravcová Brno University of Technology, Faculty of Civil Engineering, Department of Building Testing, Veveří 95, 602 00 Brno, Czech Republic
14:20	HIGH TEMPERATURE SURFACE NATURE AND TRIBOLOGY RESPONSES OF ELECTROLESS COMPOSITE Ni-P/SiC DEPOSIT M. Franco[1], W. Sha[1], S. Malinov[2], G. Aldiç[3], H. Çimenoğlu[3] [1]School of Planning, Architecture and Civil Engineering, Queen's University Belfast, Belfast BT7 1NN, UK, [2]School of Mechanical and Aerospace Engineering, Queen's University Belfast, Belfast BT7 1NN, UK, [3]Department of Metallurgical and Materials Engineering, Istanbul Technical University, 34469 Maslak, Istanbul, Turkey
14:30	EVALUATION OF THE GRINDABILITY OF RECYCLED GLASS IN THE PRODUCTION OF BLENDED CEMENTS Karel Dvořák[1], Dušan Dolák[1], Dalibor Všianský[2], Petr Dobrovolný[1] [1]Brno University of Technology, Faculty of civil engineering, Veveří 331/95, 602 00 Brno, Czech Republic, [2]Masaryk University, Faculty of Science, Kotlářská 267/2, 611 37 Brno, Czech Republic
14:40	LIFE+ RusaLCA – AN INNOVATIVE PROTOTYPE SYSTEM FOR THE REMEDIATION OF MUNICIPAL WASTE WATER Ana Mladenovič[1], Primož Oprčkal[1], Peter Nadrah[1], Adrijana Sever Škapin[1], Janez Ščančar[2], Radmila Milačič[2], Janja Vidmar[2], Alenka Mauko Pranjič[1] [1]Slovenian National Building and Civil Engineering Institute, Dimičeva ulica 12, 1000 Ljubljana, [2]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana
14:50	THE EFFECT OF DIFFERENT CURRENT TYPES ON THE MICROSTRUCTURE AND CORROSION PROPERTIES OF Ni/nAnOAl_2O_3 COMPOSITE COATINGS Beata Kucharska, Agnieszka Krawczynska, Krzysztof Rozniatowski, Karol Poplawski, Jerzy Robert Sobiecki Warsaw University of Technology, Woloska 141, 01-407 Warszawa,Poland
15:00	STATISTICAL VIEW OF EVALUATING CONCRETE SURFACE LAYER PERMEABILITY TESTS IN CONNECTION WITH CHANGES IN CONCRETE FORMULA Petr Misák, Tomáš Stavař, Iva Rozsypalová, Dalibor Kocáb, Petr Pőssl Brno University of Technology, Faculty of Civil Engineering, Department of Building Testing, Veveří 95, 602 00 Brno, Czech Republic
15:10	REACTIVE NANOSTRUCTURED FOILS BY MEANS OF HIGH-ENERGY BALL MILLING AND SUBSEQUENT COLD ROLLING A.A. Nepapushev[1], A.S. Rogachev[1,2], A.S. Mukasyan[1,3] [1]National University of Science and Technology «MISIS», Moscow, Leninskiy prospekt 4, 119049, Russia, [2]Institute of Structural Macrokinetics and Materials Science, Russian Academy of Sciences, Chernogolovka, Moscow Region, Acad. Osipyan street 8, 142432, Russia, [3]Department of Chemical & Biomolecular Eng., University of Notre Dame, Notre Dame, IN, 46556, USA

15:20	CHARACTERIZATION OF TIME-DEPENDENT PROPERTIES OF THE COMPOSITE MATERIAL Žiga Gosar ELVEZ d.o.o., Ulica Antona Tomšiča 35, 1294 Višnja Gora, Slovenija Mednarodna podiplomska šola Jožefa Stefana, Jamova cesta 39, 1000 Ljubljana
15:30	CERAMIC FIFFLED BIO-PLASTIC COMPOSITE PATCH ANTENNAS AT 2.45 GHZ ISM BAND FOR BIOMEDICAL APPLICATIONS M. Samsuzzaman, M. T. Islam, M.R.I Faruque Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia
15:40	**COFFEE BREAK**
	Predsedujoči – Chair: M. Čeh
16:00	METHODOLOGY FOR NON-DESTRUCTIVE EVALUATION OF CONCENTRATION AND ORIENTATION OF STEEL FIBERS IN STEEL-FIBER-REINFORCED CONCRETE Tereza Komárková, Martin Friedl Brno University of Technology, Faculty of civil Engineering, Veveří 331/95, 602 00 Brno Brno University of Technology, Faculty of Electrical Engineering and Communication Brno University of Technology, Technická 3058/10, 616 00 Brno
16:10	Zn AND Zn-ALLOY BONDED Nd-Fe-B MAGNETS Paul McGuiness, Spomenka Kobe, Luka Kelhar Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia
16:20	MEASURING VISCOELASTICITY OF HYDROGEL-BAG COMPOSITES Rok Kocen[1,2], Ana Gantar[1,2], Christian Hellmich[3], Michael Gasik[4], Saša Novak[1,2] [1]Jožef Stefan Institute, Department for Nanostructured Materials, Jamova c. 39, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova c. 39, 1000 Ljubljana, Slovenia, [3]Institute for Mechanics of Materials and Structures, Vienna University of Technology, Austria, [4]School of Chemical Technology, Aalto University, Finland
16:30	METAMATERIAL EMBEDDED WIDE-BAND ANTENNA FOR MICROWAVE C-BAND RADAR APPLICATION M. I. Hossain, M. R. I. Faruque, M. T. Islam Universiti Kebangsaan Malaysia, 43600 UKM, bangi, Selangor, Malaysia
16:40	SPARK PLASMA SINTERING OF SILICON CARBIDE SHS-POWDER D.O. Moskovskikh[1], A.S. Rogachev[1,3], A.S. Mukasyan[1,2] [1]National University of Science and Technology «MISIS», Moscow, Leninskiy prospekt 4, 119049, Russia, [2]Department of Chemical & Biomolecular Eng., University of Notre Dame, Notre Dame, IN, 46556, USA, [3]Institute of Structural Macrokinetics and Materials Science, Russian Academy of Sciences, Chernogolovka, Moscow Region, Acad. Osipyan street 8, 142432, Russia
16:50	A NEW WIDEBAND NEGATIVE REFRACTIVE INDEX METAMATERIAL [1]Sikder Sunbeam Islam, [1]Mohammd Rashed Iqbal Faruque, [2]Mohammad Tariqul Islam [1]Space Science Centre (ANGKASA), [2]Department of Electrical, Electronic & Systems Engineering, Universiti Kebangsaan Malaysia, 43600 UKM, Bangi, Selangor, Malaysia
17:00	HIGH TEMPERATURE DENSIFICATION INDUCED INTERCALATION OF Ti IN $Ti_{1+x}S_2$ THERMOELECTRICS Tilen Sever, Boštjan Jančar, Danilo Suvorov Advanced Materials Department, Jozef Stefan Institute, Jamova 39, 1000, Ljubljana, Slovenia
17:10	ELECTROCALORIC EFFECT IN $0.9Pb(Mg_{1/3}Nb_{2/3})O_3$-$0.1PbTiO_3$ BULK CERAMICS WITH GRAIN SIZES IN MICRON RANGE Marko Vrabelj[1,2], Hana Uršič[1,2], Zdravko Kutnjak[1,2], Brigita Rožič[1], Silvo Drnovšek[1], Andreja Benčan[1,2], Vid Bobnar[1,2], Lovro Fulanović[1,2], Barbara Malič[1,2] [1]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia

17:20	FORMATION OF CORROSION-RESISTANT ALUMINA COATING ON 6061 ALUMINUM ALLOY BY THE COMBINATION OF MICRO ARC OXIDATION AND SEALING TREATMENTS Merve Koca, Ozge Gokce, Sanaz Mohammadzadeh, Ahmet Hilmi Paksoy, Faiz Muhaffel, Huseyin Cimenoglu Istanbul Technical University, Metallurgical and Materials Engineering Department, 34469, Istanbul, TURKEY
17:30	IMPLEMENTATION OF AN UPWIND SCHEME IN A DIFFUSE APPROXIMATE METHOD Vanja Hatić[1], Božidar Šarler[1,2] [1]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia, [2]University of Nova Gorica, Vipavska 13, SI-5000 Nova Gorica, Slovenia
17:40	PREDICTION OF FRACTURE FORMATION IN OPEN DIE FORGING OF HEAVY COMPONENTS MADE OF ULTRA HIGH STRENGTH STEEL Łukasz Lisiecki, Piotr Skubisz AGH University of Science and Technology, Mickiewicza Av. 30 30-059 Kraków, Poland
17:50	PLANAR ANTENNA ON RT/DUROID 5870 MATERIAL FOR UWB APPLICATIONS [1]Md. Moinul Islam, [2]Mohammad Tariqul Islam, [1]Mohammad Rashed Iqbal Faruque [1]Space Science Centre (ANGKASA), Universiti Kebangsaan Malaysia, 43600 UKM, Bangi, Selangor, Malaysia, [2]Department of Electrical, Electronic and Systems Engineering, Universiti Kebangsaan Malaysia, 43600 UKM, Bangi, Selangor, Malaysia
18:00	MODELING OF SHOT PEENING EFFECTS ON THE SURFACE PROPERTIES OF (TiB + TiC) / Ti–6Al–4V COMPOSITE EMPLOYING ARTIFICIAL NEURAL NETWORKS Erfan Maleki, Abolghasem Zabihollah Mechanical Engineering Department, Sharif University of Technology-International Campus, Kish Island, Iran
19:30-21:00	**POSTER SECTION - COCTAIL PARTY**

TOREK – TUESDAY 29. 9. 2015 – EUROPA »B«	
	Predsedujoči – Chair: M. Godec, J. Medved
9:00	RECENT RESULTS AND TRENDS IN HEAT TREATMENT AND SURFACE ENGINEERING Franz Hoffmann Stiftung Institut für Werkstofftechnik, Bremen, Germany
9:50	DESIGN OF NOVEL TOOL STEELS BY MECHANICAL MILLING AND SPARK PLASMA SINTERING M. Pellizzari[1], A. Fedrizzi[1], T. Gebremariam Kotecho[1], F. Deirmina[1], M. Zadra[2] [1]University of Trento, Dpt. Industrial Engineering, Via Sommarive 9, 38123 Trento, [2]K4sint, Pergine Valsugana, Trento, Italy
10:20	ADVANCED ALUMINIUM ALLOYS FOR HIGH TEMPERATURE APLICATION Jožef Medved, Primož Mrvar, Maja Vončina University of Ljubljana, Faculty of Natural Sciences and Engineering, Department of Materials and Metallurgy, Aškerčeva 12, 1000 Ljubljana, Slovenia
10:50	**COFFEE BREAK**
	EUROPA »D« **Predsedujoči – Chair: M. Jenko, S. Savilov**
11:20	NANOSTRUCTURED RUTHENIUM OXIDE ELECTRODES FOR SUPERCAPACITOR APPLICATIONS Ramanathan Arunachalam[1], Mahmoud Al Ahmad[2], J. Maharaja[3], S. Mohan[3], Ashraf Talib Al-Hinai[4] [1]Department of Mechanical and Industrial Engg., Sultan Qaboos University, Muscat, Sultanate of Oman, [2]Department of Electrical Engineering, United Arab Emirates (UAE) University, Al-Ain, UAE, [3]EMFT Division, Central Electrochemical Research Institute, Karaikudi, India, [4]Department of Chemistry, Sultan Qaboos University, Muscat, Sultanate of Oman
11:35	ADVANCED ELECTROCHEMICAL CHARACTERIZATION OF NANOPARTICLES AS ELECTROCATALYSTS FOR FUEL CELL Nejc Hodnik[1,2], Primož Jovanovič[2], Andraž Pavlišič[2], Milena Zorko[2], Barbara Jozinović[2], Marjan Bele[2], Miran Gaberšček[2], Karl Mayrhofer[1] [1]Max-Planck-Institut für Eisenforschung GmbH, Max-Planck Str. 1, 40237 Düsseldorf Germany, [2]National Institute of Chemistry, Hajdrihova 19, 1000 Ljubljana, Slovenia
11:50	INVESTIGATION OF MECHANICAL PROPERTIES OF ELECTROCHEMICALLY DEPOSITED Au-In ALLOY FILMS VIA NANOINDENTATION Sabina Cherneva[1], Martin Georgiev[2], Rumen Iankov[1], Dimitar Stoychev[2] [1]Institute of Mechanics, Bulgarian Academy of Sciences, Acad. G. Bonchev str., Bl.4, Sofia-1113, Bulgaria, [2]Institute of Physical Chemistry, Bulgarian Academy of Sciences, Acad. G. Bonchev str., Bl.11, Sofia-1113, Bulgaria
12:05	ANTIBACTERIAL SURFACE TREATMENTS APPLIED TO WOODEN MATERIALS WITH NANO Ag PARTICLES AND TiO_2 Hüsnügül Yilmaz Atay Faculty of Engineering, Muğla Sıtkı Koçman University, Kötekli Muğla, 48000, Turkey
12:20	Transmission Electron Microscopy Comparative Study of $(K_{0.50}Na_{0.50})NbO_3$ Synthesized from Nano and Micron-sized Nb_2O_5 Mahdi Feizpour[1], Darja Jenko[2], Touradj Ebadzadeh[1], Matjaž Godec[2], Barbara Malič[3] [1]Ceramics Department, Materials and Energy Research Center, Karaj, Iran, [2]Laboratory of Applied Surface Science, Institute of Metals and Technology, Ljubljana, Slovenia, [3]Electronic Ceramics Department, Jožef Stefan Institute, Ljubljana, Slovenia
12:35	FABRICATION OF SUPERHYDROPHOBIC AND SUPERHYDROPHILIC SURFACES ON AISI 316L SUBSTRATE M. Conradi, A. Kocijan Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

13:20	**LUNCH BREAK**
	Predsedujoči – Chair: M. Čeh, A. Juan
14:40	DEPOSITION OF HARD YET MODERATELY DUCTILE Mo_2BC COATINGS BY PULSED-DC MAGNETRON SPUTTERING Pavel Soucek[1], Petr Vasina[1], Vilma Bursikova[1], Lukas Zabransky[1], Jiri Bursik[2], Vratislav Perina[3] [1]Department of Physical Electronics, Faculty of Science, Masaryk University, Brno, Czech Republic, [2]Institute of Physics of Materials, Academy of Sciences of the Czech Republic, Brno, Czech Republic, [3]Nuclear Physics Institute, Academy of Sciences of the Czech Republic, v.v.i., Rez, Czech Republic
14:55	RARE-EARTH MODIFICATION OF $BiFeO_3$ CERAMICS AND THEIR COMPOSITION-STRUCTURE-PROPERTY RELATIONSHIPS J. Walker[1], A. Bencan[1], H. Ursic[1], B. Malic[1], H. Simons[2], V. Nagarajan[5], T. Rojac[1] [1]Electronic Ceramics Department, Jozef Stefan Institute, Jamova Cesta 39, SI-1000 Ljubljana, Slovenia, [2]DTU Physics, Technical University Denmark, Building 308, Kgs. Lyngby, Denmark, DK-2800
15:10	NON-TRADITIONAL WHITEWARES BASED ON CALCIUM ALUMINATE CEMENT Radomir Sokolar Brno University of Technology, Faculty of Civil Engineering, Veveri 95, 602 00 Brno, Czech Republic
15:25	HEAT TREATMENT EFFECTS ON THE PHASE AND MORPHOLOGY OF $Ba(Ce,Zr)O_3$ SOLID SOLUTION Nurul Wahida Othman[1], Nafisah Osman[2], Azliana Ramli[2], Suhaida Dila Safian[2], Razali Idris[2] [1]Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia, [2]Faculty of Applied Sciences, Universiti Teknologi MARA, 02600 Arau, Perlis, Malaysia
15:40	ANALYSIS OF TRIBOLOGICAL BEHAVIOR OF NANOCOMPOSITE COATING FOR DIE CASTING APPLICATION Giovanna Gautier, Maria Giulia Faga CNR IMAMOTER, Strada delle Cacce 73, Torino, Italia
15:55	ERBIUM DOPED $Pb(Mg_{1/3}Nb_{2/3})O_3$ (PMN) FOR COATING CAPACITOR M. Faruk Ebeoglugil[1,3], Erdal Celik[2,3], Damla Erekler[1] [1]Dumlupinar University, Dept. of Mat. Science and Engineering, Evliya Celebi Campus, 43100 Kütahya-Turkey, [2]Dokuz Eylul University, Dept. of Metal. and Materials Engineering, Tinaztepe Campus, 35160 Buca, Izmir-Turkey, [3]Center for Production and App.of Electronic Mat. (EMUM), Dokuz Eylul University, 35160, Buca, Izmir, Turkey
16:10	EFFECT OF DIRECT COOLING CONDITIONS ON MICROSTRUCTURE AND PROPERTIES OF HOT-FORGED HSLA STEELS FOR MINING APPLICATIONS Piotr Skubisz, Łukasz Lisiecki, Tadeusz Skowronek, Artur Żak AGH University of Science and Technology, Department of Metals Engineering and Industrial Computers Science, 30 Mickiewicz Ave, Cracow, Poland, Ferrous Metals Institute, 12-14 K. Miarki, Gliwice, Poland
16:25	USING THE FEM IN THE PROCESSES OF CHANGES AND DESTRUCTION OF THE SURFACE LAYER SUBJECTED TO ELASTIC AND PLASTIC STRAIN Aneta Duda, Sylwester Korga, Klaudiusz Lenik Lublin University of Technology, Fundamentals of Technology, 38 Nadbystrzycka Str, 20-618 Lublin, Poland
16:40	OVERCOOLING IN OVERLAPPING AREAS DURING HYDRAULIC DESCALING Michal Pohanka, Helena Votavová Brno University of Technology, Faculty of Mechanical Engineering, Technická 2, 616 69 Brno, Czech Republic
18:30-22:00	**SOCIAL EVENT AT ST. BERNARDIN**

13:00	**EUROPA »C«**
	Predsedujoči – Chair: G. Mori, O. Massler
11:20	HEAT TREATMENT OF RAILS Milan Hnizdil, Petr Kotrbacek, Marek Stransky, Jaroslav Horsky Brno University of Technology, Faculty of Mechanical Engineering, Heat transfer and fluid flow laboratory, Technicka 2896/2, 616 69, Brno, Czech Republic, EU
11:35	RECYCLING OF AZ61 AND AZ80 MAGNESIUM ALLOYS MACHINING CHIPS THROUGH LOW-TEMPERATURE CONSOLIDATION Paweł Ostachowski[1], Andrzej Korbel[1], Włodzimierz Bochniak[1], Marek Łagoda[1], Romana Śliwa[2] [1]AGH-University of Science and Technology, Faculty of Non-Ferrous Metals, A. Mickiewicza 30Av, 30-059 Cracow, Poland, [2]Rzeszow University of Technology, Powstańców Warszawy 12Av. 35-959 Rzeszów, Poland
11:50	MULTIPLEX SURFACE TREATMENT OF Ti6Al4V ALLOY TO IMPROVE WEAR RESISTANCE AND TRIBOLOGICAL PROPERTIES UNDER DRY SLIDING WEAR CONDITIONS Maciej Ossowski[1], Maciej Spychalski[1], Maciej Dubek[1], Rafal Przybyla[2], Jerzy Grygorczuk[2], Tadeusz Wierzchon[1] [1]Faculty of Materials and Science Engineering, Warsaw University of Technology, Woloska 141, 02-507, Poland, [2]Space Research Centre Polish Academy of Science, Poland, Bartycka 18A, 00-716 Warsaw, Poland
12:05	THE INFLUENCE OF HOT DEFORMATION ON THE MICROSTRUCTURE AND SELECTED PROPERTIES OF Ti6Al4V ALLOY OBTAINED FROM P/M AND BY CASTING Marek Wojtaszek[1], Tomasz Śleboda[1], Grzegorz Korpała[2] [1]AGH University of Science and Technology,Faculty of Metals Engineering and Industrial Computer Science, Al. A. Mickiewicza 30, 30-059 Krakow, Poland, [2]A Technische Universität Bergakademie Freiberg, Institut für Metallformung, Bernhard-von-Cotta-Str. 4, 09599 Freiberg, Germany
12:20	THE REFINEMENT OF SOLIDUS AND LIQUIDUS TEMPERATURES FOR BEARING STEEL BY HIGH-TEMPERATURE THERMAL ANALYSIS METHODS Karel Gryc[1], Michaela Strouhalová[1], Bedřich Smetana[2], Monika Kawuloková[2], Simona Zlá[2], Aleš Kalup[2], Ladislav Socha[1], Markéta Tkadlečková[1], Karel Michalek[1], Pavel Machovčák[3], Aleš Opler[3] [1]VŠB-Technical University of Ostrava, Faculty of Metallurgy and Materials Engineering, Department of Metallurgy and Foundry, and Regional Materials Science and Technology Centre, 17. listopadu 15, 708 33 Ostrava-Poruba, Czech Republic, [2]VŠB – Technical University of Ostrava, Faculty of Metallurgy and Materials Engineering, Department of Physical Chemistry and Theory of Technological Processes and Regional Materials Science and Technology Centre, 17. listopadu 15, 708 33 Ostrava-Poruba, Czech Republic, [3]VÍTKOVICE HEAVY MACHINERY, a.s., Ruská 2887/101, Vítkovice, 703 00 Ostrava, Czech Republic
12:35	HIGH TEMPERATURE TENSILE DEFORMATION OF Fe-28Al-0.5Zr-0.5Mo-0.5Nb-0.5B ALLOY Yuanding Huang, Norbert Hort Institute of Materials research, Helmholtz-Zentrum Geesthacht, Max-Planck-Str. 1, 21502 Geesthacht, Germany
12:50	INFLUENCE OF ISOTHERMAL ANNEALING ON THE STRUCTURE AND MAGNETIC PROPERTIES OF FeCoBYMo BULK AMORPHOUS ALLOY Paweł Pietrusiewicz[1], Marcin Nabiałek[1], Jacek Olszewski[1], Sabina Lesz[2] [1]Institute of Physics, Czestochowa University of Technology, 19 Armii Krajowej Av., 42-200 Czestochowa, Poland, [2]Institute of Engineering Materials and Biomaterials, Silesian Technical University, Konarskiego St. 18a, 44-100 Gliwice, Poland

13:05	INFLUENCE OF SOLIDIFICATION SPEED ON STRUCTURE AND MAGNETIC PROPERTIES OF $Re_{10}Fe_{81}Zr_1B_6$ ALLOY IN THE AS-CAST STATE M. Dośpiał, M. Nabiałek Institute of Physics, Czestochowa University of Technology, 19 Armii Krajowej Av., 42-200 Czestochowa, Poland
18:30-22:00	**SOCIAL EVENT AT ST. BERNARDIN**

SREDA – WEDNESDAY 30. 9. 2015 – EUROPA »D«	
	Predsedujoči – Chair: D. S. Petrovič, M. Torkar
9:00	DENSITY FUNCTIONAL THEORY AND MATERIALS SCIENCE: THE CASES OF ALLOYS AND CARBIDES Alfredo Juan Departamento de Fisica & IFISUR (UNS-CONICET), Av. Alem 1253, 8000 Bahia Blanca, Argentina
9:50	ENGINEERED COATINGS FOR WEAR AND CORROSION PROTECTION OF MACHINE COMPONENTS AND TOOLS Orlaw Massler, Robert Isenring, Thomas De Martin De Martin Surface Technology AG, Froheggstrasse 34, CH-9545 Wängi, Switzerland
10:20	IMPORTANCE OF FRACTURE TOUGHNESS ON THE PERFORMANCE OF COATED TOOL STEEL Bojan Podgornik Institute of Metals and Technology, Lepi pot 11, Ljubljana, Slovenia
10:50	**COFFEE BREAK**
	Predsedujoči – Chair: D. S. Petrovič, M. Torkar
11:20	TRACEABLE MAGNETIC MEASUREMENTS Paul McGuiness Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
11:35	MINI-THIXOFORMING OF LOW-CARBON HIGH-ALLOY STEEL David Aišman, Hana Jirkova, Katerina Rubesova University of West Bohemia in Pilsen, Research Centre of Forming Technology – FORTECH, Univerzitni 22, 30614 Pilsen, Czech Republic
11:50	MICROSTRUCTURE OF A Nb-BEARING Ni-Cr-Mo DENTAL ALLOY Franc Zupanič[1], Carlos A. Nunes[2], Gilberto C. Coelho[2], Paula L. Cury[2], Gorazd Lojen[1], Christian Gspan[3], Tonica Bončina[1] [1]University of Maribor, Faculty of Mechanical Engineering, Smetanova ul. 17, SI-2000 Maribor, Slovenia, [2]University of Sao Paulo, Department of Materials Engineering – School of Engineering, Estrada Municipal do Campinho, s/n, Caixa Postal 116, 12602-810, Lorena, São Paulo, Brazil, [3]Institut für Elektronenmikroskopie und Nanoanalytik 8010 Graz, Steyrergasse 17/III, Austria
12:05	INFLUENCE OF HEAT TREATMENT ON MECHANICAL PROPERTIES OF X12CrMoWVNbN10-1-1 STEEL Borut Žužek[1], Fevzi Kafexhiu[1], Jaka Burja[1], Boštjan Arh[1], Bojan Podgornik[1], Vlado Perovnik[2], Tatjana Večko Pirtovšek[2] [1]Institute of Metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Metal Ravne d.o.o., Koroška cesta 14, 2390 Ravne na Koroškem, Slovenia
12:20	INFLUENCE OF Cu, Mg AND Si ON FORMATION OF METASTABLE QUASICRYSTALS IN Al-Mn BASED ALLOYS Iztok Naglič[1], Zoran Samardžija[2], Spomenka Kobe[2], Blaž Leskovar[1], Kemal Delijić[3], Boštjan Markoli[1] [1]University of Ljubljana, Faculty of Natural Sciences and Engineering, Department of Materials and Metallurgy, Aškerčeva cesta 12, 1000 Ljubljana, Slovenia, [2]Jožef Stefan Institute, Department for Nanostructured Materials, Jamova cesta 39, 1000 Ljubljana, Slovenia, [3]University of Montenegro, Faculty of Metallurgy and Technology, Cetinjski put, 81000 Podgorica, Montenegro
12:35	USING OF ULTRASONIC SEWING ON POLYESTER BASED MULTIAXIEL FABRICS AND INVESTIGATION OF ITS EFFECTS ON THE MECHANICAL PROPERTIES OF THE COMPOSITES Mahmut KAYAR, S. Ilker MISTIK, E. Dilara KOÇAK, Sabih OVALI Marmara University Faculty of Technology Department of Textile Engineering, Istanbul, Turkey

12:50	TIME DEPENDENCE OF OCCURRENCE OF TYPICAL DAMAGES ON BEARING SURFACE OF NITRIDED DIES FOR AL HOT EXTRUSION AS INDICATOR FOR INCREASING OF SERVICE TIMES I. Peruš[1], M. Terčelj[1], P. Cvahte[2], G. Kugler[1] [1]Faculty of Natural Sciences and Engineering, University of Ljubljana, Aškerčeva cesta 12, 1000 Ljubljana, Slovenia, [2]Impol, Partizanska ulica 38, 2310 Slovenska Bistrica, Slovenia
13:05	BRASS AS A SOURCE OF LEAD IN DRINKING WATER Mirjam Bajt Leban, Tadeja Kosec Slovenian National Building and Civil Engineering Institute
13:35	**LUNCH**
	Predsedujoči – Chair: M. Conradi, D. Jenko
14:50	INFLUENCE OF NITRIDED AND CARBONITRIDED LAYERS ON THE FUNCTIONAL PROPERTIES OF CARBON COATINGS PRODUCED ON AUSTENITIC STEEL UNDER DC GLOW-DISCHARGE CONDITIONS Tomasz Borowski, Krzysztof Kulikowski, Agnieszka Brojanowska, Krzysztof Rożniatowski, Maciej Dubek, Maciej Ossowski, Tadeusz Wierzchoń Warsaw University of Technology, Faculty of Materials Science and Engineering, 141 Woloska Str., 02-507 Warsaw, Poland
15:05	LIQUID PHASE EXPLOSIVE FABRICATION OF SUPERCONDUCTING MgB_2 COMPOSITES A. Peikrishvili[1,3], G. Mamniashvili[2], B. Godibadze[3], T. Gegechkori[2], E. Chagelishvili[3] [1]F. Tavadze Institute of Metallurgy and Materials Science, 15 kazbegi Av. 0130, Tbilisi, Georgia, [2]Andronikashvili Institute of Physics Ivane Javakhishvili Tbilisi State University, 6 Tamarashvili St., 0177, Tbilisi, Georgia, [3]G.Tsulukidze Mining Institute, 7, Mindeli St., 0186, Tbilisi, Georgia
15:20	FRICTION ADDITIVES FOR PAD MATERIALS: EFFECT OF THE COMPOSITION ON FRICTION AND WEAR PROPERTIES Maria Giulia Faga[1], Giovanna Gautier[1], Agusti Sin[2], Federico Lupone[2], Alessandro Angeleri[2] [1]CNR IMAMOTER, Strada delle Cacce 73, Torino, Italia, [2]ITT Motion Technology, Italy
15:35	THE EFFECT OF TITANIUM ALUMINIDES REINFORCEMENT PARTICLES ON MICROSTRUCTURE AND PROPERTIES CHANGES OF AMC'S Marcin Adamiak[1], Błażej Tomiczek[1], Artur Czupryński[2], Jacek Górka[2] Silesian University of Technology, [1]Institute of Engineering Materials and Biomaterials, [2]Department of Welding Engineering, Konarskiego 18A Str., 44-100 Gliwice, Poland
15:50	INVESTIGATION OF SOUND AND HEAT ABSORBANCE PROPERTIES OF BASALT FIBER-PUMICE REINFORCED THERMOPLASTIC COMPOSITES S. Ilker Mistik, Sabih Ovali Marmara University Faculty of Technology Department of Textile Engineering, 34722, Kadikoy, Istanbul, Turkey
16:05	**CLOSING CEREMONY**

POSTRSKA SEKCIJA – POSTER SESSION
PONEDELJEK – MONDAY 28. 9. 2015 (19:30 – 21:00)

YR1	BIO-PLASTIC COMPOSITE MATERIAL MICROSTRIP-FED PRINTED ANTENNA FOR WIRELESS COMMUNICATION Touhidul Alam[1], Mohammad Rashed Iqbal Faruque[1], Mohammad Tariqul Islam[2] [1]Space Science Center(ANGKASA), Universiti Kebangsan Malaysia, 43600UKM, Bangi, Selangor, Malaysia, [2]Department of Electrical, Electronic and Systems Engineering, Universiti Kebangsan Malaysia, 43600UKM, Bangi, Selangor, Malaysia
YR2	INFLUENCE OF Na_2SiF_6 IN ELECTROLYTE ON THE STRUCTURE AND MECHANICAL PROPERTIES OF MICRO ARC OXIDATION COATINGS ON AM 60 MAGNESIUM ALLOY Aysun Ayday Sakarya University, Faculty of Engineering, Department of Metallurgical and Materials Engineering, Sakarya, 54187, Turkey
YR3	NUMERICAL MODEL OF AIRFOIL SEGMENT FOR IMPACT LOADING IDENTIFICATION Jan Bartošek, Tomas Kroupa, Robert Zemcik European Centre of Excellence NTIS – New Technologies for Information Society, Faculty of Applied Sciences, University of West Bohemia, Univerzitni 8, 306 14, Plzen, Czech Republic
YR4	EFFECT OF FLY ASH AND SHRINKAGE REDUCING ADDITIVES ON PROPERTIES OF ALKALI ACTIVATED SLAG BASED MORTARS Vlastimil Bílek Jr., Lukáš Kalina, Jan Koplík, Miroslava Hajdúchová, Radoslav Novotný Brno University of Technology, Faculty of Chemistry, Materials Research Centre, Purkyňova 118, 612 00 Brno, Czech Republic
YR5	THE EVALUATION OF FINITE ELEMENT ANALYSES OF THREE-POINT BENDING TEST BY THE EXAMPLE OF ALUMINUM ALLOY A. Aman[1], S. Majcherek[1], C. Engel[1] S. Hirsch[2], S. Birr[1] [1]Packaging Group, Institute of Micro- and Sensor Technology, D 31106, Magdeburg University, Universitätsplatz-2, Germany, [2]Department of Electrical Engineering, Brandenburg University of Applied Sciences, Magdeburger Straße 50, 14770 Brandenburg an der Havel, Germany
YR6	INFLUENCE OF THE SURFACE ROUGHNESS ON THE COOLING INTENSITY DURING SPRAY COOLING Martin Chabičovský, Miroslav Raudenský Heat Transfer and Fluid Flow Laboratory, Faculty of Mechanical Engineering, Brno University of Technology, Technická 2, 616 69 Brno, Czech Republic
YR7	TIME-LAPSE MICRO-TOMOGRAPHY ANALYSIS OF DEFORMATION RESPONSE OF GELLAN GUM BASED SCAFFOLD Daniel Kytýř[1,2], Nela Fenclová[1,2], Petr Zlámal[1,2], Ivana Kumpová[1], Tomáš Fíla[1,2], Ana Gantar[3], Saša Novak[3] [1]Institute of Theoretical and Applied Mechanics, CAS, v. v. i, Prosecká 76, 190 00 Prague, Czech Republic, [2]Czech Technical University in Prague, Faculty of Transportation Sciences, Konviktská 20, 110 00 Prague 1, Czech Republic, [3]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia
YR8	PULSED-LASER DEPOSITION OF HETEROSTRUCTURED OXIDE THIN FILMS FOR PIEZOELECTRIC MEMS APPLICATIONS Urška Gabor[1,2], Matjaž Spreitzer[1], Danilo Suvorov[1] [1]Advanced Materials Department, Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia

YR9	SPARK PLASMA SINTERING AS AN INNOVATION METHOD OF SINTERING $(Cu_{47}Ti_{34}Zr_{11}Ni_8)_{95}Al_5$ AMORPHOUS POWDER Ryszard Nowosielski[1], Aleksandra Guwer[1], Przemysław Zackiewicz[2] [1]Silesian University of Technology, Faculty of Mechanical Engineering, Institute of Engineering, Materials and Biomaterials, Konarskiego Street 18A, 44-100 Gliwice, Poland, [2]Institute of Non-Ferrous Metals, ul. Sowinskiego 5, 44-100 Gliwice, Poland
YR10	POSSIBILITY OF ATTRITION IRON CONTENT MEASUREMENT VIA OBJECTIVE COLOUR DETERMINATION P. Kejík, T. Svěrák, O. Krištof, P. Bulejko, K. Sikorová VUT v Brně, Fakulta strojního inženýrství, Laboratoř sdílení tepla a proudění, Technická 2896/2, 616 69 Brno
YR11	EXPERIMENTAL STUDY ON THE CYCLIC & STATIC BEHAVIOR OF NEW ODS ALLOYS Bohuslav Masek[1], Omid Khalaj[1], Hana Jirkova[1], Jiri Svoboda[2] [1]The Research Centre of Forming Technology, University of West Bohemia, Univerzitní 22, 306 14, Pilsen, Czech Republic, [2]Institute of Physics of Materials, Academy of Sciences Czech Republic, Zizkova 22, 616 62, Brno, Czech Republic
YR12	STRUCTURE AND PROPERTIES OF BULK METALLIC GLASSES BASED ON MAGNESIUM Anna Kiljan, Rafał Babilas, Ryszard Nowosielski Silesian University of Technology, Faculty of Mechanical Engineering, Institute of Engineering Materials and Biomaterials, Konarskiego 18A Street, 44-100 Gliwice, Poland
YR13	EFFECT OF MECHANICAL ACTIVATION ON FORMATION AND CHARACTERIZATION OF MAGNESIUM ALUMINATE SPINEL Derya Kırsever, Nilgün Kaya Karabulut, Nuray Canikoğlu and H.Özkan Toplan Sakarya University, Metallurgy and Materials Engineering, 54187 Sakarya, Turkey
YR14	SINGLE-CORE AND MULTI-CORE FePt NANOPARTICLES AS MRI CONTRAST AGENTS Nina Kostevšek[1,2], Sašo Šturm[1], Igor Serša[3], Ana Sepe[3], Spomenka Kobe[1], Kristina Žužek Rožman[1] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, Ljubljana, Slovenia, [3]Department for Condensed Matter Physics, Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia
YR15	THE SIZE EFFECT OF HEAT TRANSFER SURFACES ON BOILING TO A SPRINKLED TUBE BUNDLE Petr Kracík, Jiří Pospíšil Institute of Power Engineering, Brno University of Technology, Faculty of Mechanical Engineering, Technická 2896/2, 616 69 Brno, The Czech Republic
YR16	EFFECT OF DEFLOCCULANTS ADDITION ON RHEOLOGICAL PROPERTIES OF CERAMIC SLURRIES FOR SHELL MOULDS FABRICATION P. Wisniewski, M. Malek, J. Mizera, K.J. Kurzydlowski Faculty of Materials Science and Engineering, Warsaw University of Technology
YR17	OPTIMIZING THE REACTIVITY OF THE RAW MATERIAL MIXTURE FOR PORTLAND CLINKER FIRING Marcela Fridrichová, Dominik Gazdič, Karel Dvořák, Radek Magrla Brno University of Technology, Faculty of civil engineering, Veveří 331/95, 602 00 Brno, Czech Republic
YR18	EXAMINATION METHODS OF WATERPROOFING INJECTION SCREENS IN VARIOUS BUILDING MATERIALS Rostislav Drochytka, Pavel Dohnálek, Jindřich Melichar Brno University of Technology, Faculty of civil engineering, Veveří 331/95, 602 00 Brno, Czech Republic
YR19	STUDY OF BEHAVIOR OF FIBROUS BASED INSULATION MATERIALS WITH HIGHER MOISTURE CONTENT Jiří Zach, Vítězslav Novák, Jitka Hroudová Brno University of Technology, Faculty Of Civil Engineering, Veveří 331/95, 602 00 Brno, Czech Republic

YR20	MECHANICAL PROPERTIES OF POLYAMIDE/CARBON FIBER FABRIC COMPOSITES Cristina-Elisabeta Pelin (Ban)[1,2], George Pelin[1,2], Adriana Ştefan[1], Ecaterina Andronescu[2], I. Dincă[1], A. Ficai[2], Roxana Truşcă[3] [1]National Institute for Aerospace Research "Elie Carafoli" Bucharest- Materials Unit, 220 Iuliu Maniu Blvd, 061126, Bucharest, Romania, [2]Polytechnic University of Bucharest, Faculty of Applied Chemistry and Materials Science, 1-7 Polizu St., 011061, Bucharest, Romania, [3]S.C. METAV Research & Development S.A., 31 C.A. Rosetti St., 020011, Bucharest, Romania
YR21	RESEARCH AND DEVELOPMENT OF PARTICULAR INSULATING MATERIALS BASED ON NATURAL FIBERS Martina Reif, Jitka Hroudová, Jiří Zach Brno University of Technology, Faculty of Civil Engineering, Admas Centre, Veveří 331/95, 602 00 Brno, Czech Republic
YR22	POLYVINYL ALCOHOL: PREPARATION OF A POLYMER INK FOR PATTERNING OF SUBSTRATES BY PIEZOELECTRIC DROP-ON-DEMAND INKJET PRINTER Pavol Suly[1,2], Petr Krcmar[1,2], Jan Maslik[1,2], Pavel Urbanek[2], Ivo Kuritka[1,2] [1]Polymer Centre, Tomas Bata University in Zlín, Faculty of Technology, Namesti T. G. Masaryka 275, 762 72 Zlin, Czech Republic, [2]Centre of Polymer Systems, Tomas Bata University in Zlín, Tr. Tomase Bati 5678, 760 01 Zlin, Czech Republic
YR23	THE EVALUATION OF DEGREE DEGRADATION BY USING IMPACT-ECHO METHOD IN CIVIL ENGINEERING Daniela Štefková, Kristýna Timčaková,Libor Topolář Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, Brno 602 00
YR24	RHEOLOGICAL PROPERTIES OF ALUMINA CERAMIC SLURRIES FOR CERAMIC SHELL MOULDS FABRICATION Joanna Szymanska, Pawel Wisniewski, Marcin Malek, Jaroslaw Mizera Faculty of Materials Science and Engineering, Warsaw University of Technology, Woloska 141 Street, 02-507 Warsaw
YR25	THE POSSIBILITIES OF NUS AND IMPACT-ECHO METHODS FOR STEEL CORROSION MONITORING IN CONCRETE Kristýna Timčaková-Šamárková, Michal Matysík, Zdeněk Chobola Brno University of Technology, Faculty of Civil Engineering, Veveri 331/95, 602 00 Brno, Czech Republic
YR26	EFFECT OF HOLDING TIME ON THE PRODUCTION OF Nb-NbAl3 METALLIC INTERMETALLIC COMPOSITES VIA ELECTRIC CURRENT ACTIVATED SINTERING Muhammed Aybey, Tuba Yener, Mediha Ipek, Sakin Zeytin Sakarya University, Engineering Faculty, Department of Metallurgy and Materials Engineering, Esentepe Campus, 54187, Adapazari, Sakarya, Turkey
YR27	THE INFLUENCE OF NITRIDING ON MICROSTRUCTURE AND PROPERTIES OF NICKEL BASED SUPERALLOY Ni-Cr-Co-Mo-2Ti-1,5Al Malgorzata Zagorska, Ryszard Sitek, Jaroslaw Mizera, Krzysztof Jan Kurzydłowski Faculty of Materials Science and Engineering, Warsaw University of Technology, Woloska 141, 02-507 Warsaw, Poland
YR28	METAL PARTICLES SIZE INFLUENCE ON GRADED STRUCTURE IN COMPOSITE Al_2O_3-Ni Justyna Zygmuntowicz, Aleksandra Miazga, Katarzyna Konopka, Waldemar Kaszuwara Faculty of Materials Science and Engineering, 141 Wołoska St, 02-507 Warsaw, Poland
YR29	Wear Resistance of Nanostructured Austempered Ductile Iron Kamil Wasiluk[1], Emilia Skołek[1], Krzysztof Kulikowski[1], Dawid Myszka[2] [1]Warsaw University of Technology, Faculty of Materials Science and Engineering, [2]Warsaw University of Technology, Faculty of Production Engineering

1	HEATING RATE DEPENDENCE OF THE PHASE TRANSFORMATION TEMPERATURE OF STEEL SAMPLES Boštjan Arh, Jaka Burja, Fevzi Kafexhiu, Bojan Podgornik Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
2	APPLICATION OF PLACKETT-BURMAN DESIGN TO DETERMINE THE EFFECT OF PRODUCTION PARAMETERS ON THE HARDNESS OF BIMETAL ABRASION PLATES Robert Bęczkowski, Marek Gucwa Institute of Mechanical Technology, Czestochowa University of Technology, 21 Armii Krajowej Av., 42-201 Czestochowa, Poland
3	NEURAL NETWORK APPROXIMATION STRATEGIES FOR WIDE RANGE FUNCTIONS Igor Belič IMT, Lepi pot 11, 1000 Ljubljana
4	EXPERIMENTAL INVESTIGATION OF CUTTING TOOL PERFORMANCE IN END MILLING OF CARBON FIBER-REINFORCED PLASTICS Bilek Ondrej, Rusnakova Sona, Zaludek Milan Tomas Bata University in Zlin, Faculty of Technology, Department of Production Engineering, Nam. T. G. M. 5555, 760 01 Zlin – CZ
5	STRUCTURE AND PROPERTIES OF HIGH-MN STEELS AFTER HOT AND COLD PLASTIC DEFORMATIONS Leszek Adam Dobrzański, Wojciech Borek, Janusz Mazurkiewicz Division of Materials Processing Technology, Management and Computer Techniques in Materials Science, Institute of Engineering Materials and Biomaterials, Silesian University of Technology, Konarskiego 18A, 44-100 Gliwice, Poland
6	GREEN SYNTHESIS OF TINE OXIDE NANOPARTICULES FOR PHOTOCATALYTIC AND ANTI-BACTERIAL APPLICATIONS F. Yakhlef[1], S. Boudjadar[1], B. Boudine[2], Z. Takkouk[3] [1]Laboratory of Ceramics, Department of Physics, Frères Mentouri University – Constantine 25000, Algeria, Crystallography, Department of Physics, Frères Mentouri University – Constantine 25000, Algeria, [3]Laboratory of study of materials, Department of Physics, University of Jijel –Jijel 18000, Algeria
7	THE FABRICATION AND PROPERTIES OF SIC REINFORCED COPPER MATRIX COMPOSITE CONTACT MATERIAL Gozde Celebi Efe, Mediha İpek, Sakin Zeytin, Cuma Bindal Sakarya University, Engineering Faculty, Department of Metallurgy and Materials Engineering, Esentepe Campus, 54187 Sakarya-Turkey
8	ARTIFICIAL AGGREGATE FROM SINTERED COAL ASH Vit Cerny Brno University of Technology, Faculty of Civil Engineering, Veveri 95, 602 00 Brno, Czech Republic
9	DENSIFICATION AND ELECTRIC PROPERTIES OF $BiFeO_3$-$BaTiO_3$ CERAMICS D.S. Kim[1], J.H. Kim[1], J.S. Kim[2], C.I. Cheon[1] [1]Department of Materials Science & Engineering and [2]Department of Digital Display Engineering, Hoseo University, Baebang, Asan, Chungnam, 336-795, Korea
10	ROOM TEMPERATURE LIQUID PETROLEUM GAS (LPG) SENSORS BASED On □-Fe_2O_3/SWCNTs THIN FILMS Buawon Chaitongrat, S. Chaisitsak Department of Electronics Engineering, Faculty of Engineering, King Mongkut's Institute of Technology Ladkrabang, Bangkok, 10520 Thailand
11	SELECTIVE LEACHING AND SURFACE PROPERTIES OF TiNiFe SHAPE MEMORY ALLOYS Shih-Hang Chang, Jyun-Sian Liou, Bo-Yen Huang Department of Chemical and Materials Engineering, National I-Lan University, 1, Sec. 1, Shen-Lung Road, I-Lan, 260, Taiwan

12	MOLASSES AS A BINDER FOR CARBON-GRAPHITE MATERIALS Jan Chłopek, Marta Grzyb, Karol Gryń, Barbara Szaraniec AGH University of Science and Technology, Department of Biomaterials, Mickiewicza 30, 30-059 Krakow, Poland
13	PROPERTIES OF FLAME SPRAYED COATINGS ON THE OF Al_2O_3 MATRIX AND ZrO_2 MATRIX Artur Czupryński Silesian University of Technology, Mechanical Engineering Faculty, The Welding Department, Konarskiego 18A, 44-100 Gliwice, Poland
14	STUDY OF CEMENTITE MORPHOLOGY DURING SPHEROIDISATION BY ASR PROCESS Jaromír Dlouhý, Daniela Hauserová, Zbyšek Nový COMTES FHT A.S., Průmyslová 995, 334 41, Dobřany, Czech Republic
15	INFLUENCE OF SOLIDIFICATION SPEED ON STRUCTURE AND MAGNETIC PROPERTIES OF $Re_{10}Fe_{81}Zr_1B_6$ ALLOY IN THE AS-CAST STATE M. Dośpiał, M. Nabiałek Institute of Physics, Czestochowa University of Technology, 19 Armii Krajowej Av., 42-200 Czestochowa, Poland
16	DEVELOPMENT OF NEW WELDING MATERIALS FOR REPAIR WELDING OF SIZABLE FORGING DIES Michal Duchek, Pavel Suchmann, Miroslav Majer COMTES FHT a.s., Průmyslová 995, 334 41 Dobřany, CZECH PRECISION FORGE a.s, Tylova 1/57, 316 00 Plzeň
17	THE DEVELOPMENT OF NEW TYPES OF SECONDARY PROTECTION FOR CONCRETE STRUCTURES EXPOSED IN EXTREME CONDITIONS Amos Dufka, Tomáš Melichar, Jiří Bydžovský, Jan Vaněrek Brno University of Technology, Faculty of Civil Enginering, Institute of Technology of Building Materials and Components, Veveří 331/95, 602 00 Brno, Czech Republic
18	THE EFFECT OF THE TECHNOLOGY OF HIGH-SPEED GRINDING ON PROPERTIES OF FLY ASH Karel Dvořák, Iveta Hájková Brno University of Technology, Faculty of civil engineering, Veveří 331/95, 602 00 Brno, Czech Republic
19	BISMUTH AND LEAD OXIDE-CODOPED BOROPHOSPHATE THIN FILMS OBTAINED BY RF MAGNETRON SPUTTERING, FOR MAGNETO-OPTICAL APPLICATIONS B. A. Sava[1], M. Elisa[1,2], L. Boroica[1], R. Medianu[1], R. C. C. Monteiro[3], V. Kuncser[4], M. Valeanu[4], R. Iordanescu[2], I. D. Feraru[2] [1]Laser Department, National Institute of Laser, Plasma and Radiation Physics, Magurele, Romania, [2]Department for Optospintronics, National Institute of R&D for Optoelectronics INOE 2000, Magurele, Romania, [3]Department of Materials Science, CENIMAT/I3N, Faculty of Sciences and Technology, New University of Lisbon, Caparica, Portugal, [4]Laboratory of Magnetism and Superconductivity, National Institute of Materials Physics, Magurele, Romania
20	STEEL MACHINABILITY MODELLING WITH GENETIC PROGRAMMING AND GRAVITATIONAL SEARCH ALGORITHM Primož Gajšek, Sebastjan Štarkel, Miha Kovačič Štore Steel, 3220 Štore, Slovenia
21	VALORIZATION OF BRICK WASTES IN THE REALIZATION OF CONCRETE BLOCKS Youcef Ghernouti1, Bahia Rabehi1, Tayeb bouziani2, Rabah Chaid1 [1]Research Unit: Materials, Processes and Environment, University M'Hamed Bougara of Boumerdes, Boumerdes, Algeria, [2]Structures Rehabilitation and Materials Laboratory (SREML), University Amar Telidji of Laghouat, Algeria
22	EBSD ANALYSIS OF Ni-SUPERALLOYS Matjaž Godec, Jaka Burja, Bojan Podgornik, Franc Tehovnik Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana

23	THE INFLUENCE OF STRUCTURE DEFECTS ON THE MAGNETIC PROPERTIES OF MASSIVE AMORPHOUS $Fe_{60}Co_{10}Mo_2W_xY_8B_{20-x}$ (x = 1, 2) ALLOYS MADE BY INJECTION CASTING METHOD S. Garus, K. Błoch, M. Nabiałek, J. Gondro Institute of Physics, Faculty of Production Engineering and Materials Technology, Czestochowa University of Technology, al. Armii Krajowej 19, 42-200 Czestochowa, Poland
24	STRUCTURE AND PROPERTIES OF HIGH TEMPERATURE HEAT AFFECTED ZONE OF THERMO-MECHANICALLY TREATED S700MC STEEL WITH HIGH YIELD STRENGTH Jacek Górka Silesian University of Technology, Mechanical Engineering Faculty, The Chair of Welding, Konarskiego 18a, 44-100 Gliwice, Poland
25	EFFECT OF GAS ATMOSPHERE ON NON-METALLIC INCLUSIONS IN LASER-WELDED TRIP STEEL WITH Al AND Si ADDITIONS Adam Grajcar[1], Maciej Różański[2], Małgorzata Kamińska[3], Barbara Grzegorczyk[1] [1]Silesian University of Technology, Institute of Engineering Materials and Biomaterials, 44-100 Gliwice,18a Konarskiego Street, Poland, [2]Institute of Welding, 16-18 Bl. Czesława Street, 44-100 Gliwice, Poland, [3]Institute of Non Ferrous Metals, 5 Sowinskiego Street, 44-100 Gliwice, Poland
26	CVD SYNTHESIS OF CARBON NANOTUBES ON THE Co-Ti-N AND Ni-Ti-N ALLOY THIN FILMS Dmitry Gromov, Sergey Dubkov, Alexey Trifonov, Alexandr Pavlov, Sergey Skorik, Alexey Shulyat'ev, Yuri Shaman National Research University of Electronic Technology, Zelenograd, Moscow, Russia
27	ANALYSIS OF STRUCTURAL DEFECTS INFLUENCE ON MAGNETIZATION PROCESS IN AND ABOVE OF RAYLEIGH REGION Konrad Gruszka Czestochowa University of Technology, Faculty of Production Engineering and Materials Technology, Institute of Physics, 19 Armii Krajowej Av., 42-200 Czestochowa, Poland
28	RELATION BETWEEN FIXATION TIGHTENING TORQUE AND TENSILE STRENGTH – DEFORMATION ANALYSIS OF COMPOSITE MULTIHOLE PLATES FOR OSTEOSYNTHESIS Karol Gryn, Barbara Szaraniec, Anna Morawska-Chochol, Kamil Dudzinski, Jan Chlopek Department of Biomaterials, Faculty of Materials Science and Ceramics, AGH University of Science and Technology, 30 Mickiewicza Ave., 30-059 Krakow, Poland
29	MODELLING OF MICROSTRUCTURE OF MULTICOMPONENT ALUMINIUM ALLOYS BY THE NOVEL POINT AUTOMATA METHOD Agnieszka Zuzanna Guštin[1], Božidar Šarler[1,2] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia [2]University of Nova Gorica, Vipavska 13, 5000 Nova Gorica, Slovenia
30	STRUCTURE AND PROPERTIES OF HIGH CHROMIUM HARDFACING COATINGS Marek Gucwa[1], Robert Bęczkowski[1], Marcin Dośpiał[2] [1]Institute of Mechanical Technology, Czestochowa University of Technology, 21 Armii Krajowej Av., 42-201 Czestochowa, Poland, [2]Institute of Physics, Czestochowa University of Technology, 19 Armii Krajowej Av., 42-200 Czestochowa, Poland
31	INVESTIGATION OF MECHANICAL PROPERTIES OF CORK/RUBBER COMPOSITE Radek Kottner[1], Jiří Kocáb[2], Jan Heczko[2], Jan Krystek[1] [1]European Centre of Excellence, NTIS – New Technologies for Information Society, Faculty of Applied Sciences, University of West Bohemia, Univerzitní 8, 306 14 Plzeň, Czech Republic, [2]Department of Mechanics, Faculty of Applied Sciences, University of West Bohemia, Univerzitní 8, 306 14 Plzeň, Czech Republic

32	CHARACTERIZATION OF HETEROGENEOUS ARC WELDS THROUGH MINIATURE TENSILE TESTING AND VICKERS HARDNESS MAPPING Stijn Hertelé[1], Nenad Gubeljak[2], Primož Štefane[2], Patricia Verleysen[3], Wim De Waele[1] [1]Ghent University, Soete Laboratory, Technologiepark Zwijnaarde 903, 9052 Zwijnaarde, Belgium, [2]University of Maribor, Laboratory for Machine Parts and Structures, Smetanova 17, 2000 Maribor, Slovenia, [3]Ghent University, Department of Materials Science and Engineering, Technologiepark Zwijnaarde 903, 9052 Zwijnaarde, Belgium
33	SURFACE MODIFICATION OF NiTi SHAPE MEMORY ALLOY Monika Jenko[1], Tadej Kokalj[1,2], Miran Mozetič[3] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana [2]KUL, Division of Mechatronics, Biostatistics and Sensors, Willem de Croylaan 42, 3001 Leuven [3]Jozef Stefan Institute, Jamova 39, 1000 Ljubljana
34	SOL-GEL-DERIVED TiO_2 NANOLAYERS – A WAY FOR POTENTIATION OF VAPOUR PHASE HYDROGEN PEROXIDE DECONTAMINATION Petr Kacer[1], Jiri Kovarik[1], Eva Cermakova[1], Jakub Pekarek[1], Marek Kuzma[2] [1]Institute of Chemical Technology Prague, Technicka 5, 166 28 Prague 6, Czech Republic, [2]Institute of Microbiology, Videnska 1083, 142 20, Prague 4, Czech Republic
35	CREEP AND WEAR RATE OF WELD HAZ FOR TWO GRADES OF 9–12 % Cr STEELS Fevzi Kafexhiu[1], Franc Vodopivec[1], Jelena Vojvodič Tuma[1], Bojan Podgornik[1], Igor Velkavrh[2] [1]Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]V-Research GmbH, Stadtstraße 33, 6850 Dornbirn, Austria
36	THE PHENOMENON OF REDUCED PLASTICITY OF LOW-ALLOYED COPPER ALLOYS Wojciech Ozgowicz[1], Elżbieta Kalinowska-Ozgowicz[2], Barbara Grzegorczyk[1], Klaudiusz Lenik[2], Aneta Duda[2] [1]Silesian University of Technology, Mechanical Engineering Faculty, Institute of Engineering Materials and Biomaterials 18A Konarskiego Str., 44-100 Gliwice, Poland, [2]Lublin University of Technology, Fundamentals of Technology Faculty, 38 Nadbystrzycka Str., 20-618 Lublin, Poland
37	THE MICROSTRUCTURE OF METASTABLE AUSTENITE IN X5CRNI18-10 STEEL AFTER ITS STRAIN-INDUCED MARTENSITIC TRANSFORMATION Agnieszka Kurc-Lisiecka[1],Wojciech Ozgowicz[2], Elżbieta Kalinowska-Ozgowicz[3], Wojciech Maziarz[4] [1]Rail Transport Department, University of Dąbrowa Górnicza,1C Cieplaka Str., 41-300Dąbrowa Górnicza, Poland, [2]Institute of Engineering Materials and Biomaterials, Silesian University of Technology, 18a Konarskiego Str., 44-100 Gliwice, Poland, [3]Fundamentals of Technology Faculty, Lublin University of Technology, 38 Nadbystrzycka Str., 20-618 Lublin, Poland, [4]Institute of Metallurgy and Materials Science, Polish Academy of Sciences, 25 Reymonta Str., 30-059 Krakow, Poland
38	FABRICATION AND CHARACTERIZATION OF Al_2Ca-CONTAINED Al-2.5Mg, 4.5Mg SHEET MATERIALS Bong-H. Kim, Young-O. Yoon, Shae-K. Kim Korea Institute of Industrial Technology, 156 Gaetbeol-ro, Yeonsu-gu, Incheon 406-840 Korea
39	COMPARATIVE STUDY OF TENSILE PROPERTIES OF AS-EXTRUDED AND AS-ROLLED Al-7.5Mg ALLOYS CONTAINING Al_2Ca Bong-H. Kim, Young-O. Yoon, Shae-K. Kim Korea Institute of Industrial Technology, 156 Gaetbeol-ro, Yeonsu-gu, Incheon 406-840 Korea
40	EFFECT OF Al_2C ON HOT COMPRESSION BEHAVIOR OF Al-5Mg ALLOYS Bong-H. Kim, Young-O. Yoon, Shae-K. Kim Korea Institute of Industrial Technology, 156 Gaetbeol-ro, Yeonsu-gu, Incheon 406-840 Korea
41	BIODEGRADABLE Fe-BASED ALLOYS Aleksandra Kocijan, Irena Paulin, Črtomir Donik, Matej Hočevar, Klemen Zelič, Matjaž Godec Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia

42	CHARACTERISATION OF THE PORE-FORMING PROCESS IN GEOPOLYMER-BASED FOAMS BY MEANS OF X-RAY MICRO-TOMOGRAPHY (MICRO-CT) Lidija Korat, Vilma Ducman Slovenian National Building and Civil Engineering Institute, Dimičeva 12, Ljubljana, Slovenia
43	DEVELOPMENT OF ALUMINIUM ALLOYS FOR AEROSOL CANS [1]Jože Turk, [2]Jožef Medved, [2]Maja Vončina, [1]Stanislav Kores [1]TALUM d.d., Tovarniška cesta 10, 2325 Kidričevo, Slovenia, [2]University of Ljubljana, Faculty of Natural Science and Engineering, Department for Materials and Metallurgy, Aškerčeva 12, 1000 Ljubljana, Slovenia
44	INVESTIGATION OF MATERIAL PARAMETERS OF EPOXY RESIN USING UNIAXIAL STATIC TENSILE CYCLIC TESTS Tomáš Kroupa, Hana Srbová, Jan Klesa University of West Bohemia in Pilsen, Univerzitní 22, 306 14 Plzeň, Czech Republic
45	MECHANICAL AND STRUCTURAL PROPERTIES OF MULTILAYERS COMPOSITE STEEL PREPARED BY HOT ROLLING Tomáš Kubina, Jan Nacházel COMTES FHT a.s., Dobrany, Czech Republic
46	COMPOSITE FILLINGS – MONITORING THE POLYMERISATION REACTION Danica Kunaver[1], Matevž Kunaver[2] [1]Public helth center – Vič-Rudnik, [2]Faculty for electrotechnics, University of Ljubljana
47	LASER WELDING OF NEW GRADE OF ADVANCED HIGH STRENGTH STEEL DOMEX 960 Agnieszka Kurc-Lisiecka[1], Aleksander Lisiecki[2] [1]University of Dąbrowa Górnicza, Rail Transport Department, Cieplaka 1c, 41-300 Dąbrowa Górnicza, Poland, [2]Silesian University of Technology, Faculty of Mechanical Engineering, Welding Department, Konarskiego 18A, 44-100 Gliwice, Poland
48	IMPACT TOUGHNESS OF WMD AFTER MAG WELDING WITH MICRO-JET COOLING Tomasz Węgrzyn[1], Jan Piwnik[2], Aleksander Borek[3], Agnieszka Kurc-Lisiecka[4] [1]Silesian University of Technology, Transport Faculty, Krasińkiego 8, 40-019 Katowice, Poland, [2]Bialystok University of Technology, Mechanical Faculty, Wiejska 45c, 16-351 Białystok, Poland, [3]Plasma System, Towarowa 14, 41-103 Siemianowice Śląskie, Poland, [4]University of Dąbrowa Górnicza, Rail Transport Department, Cieplaka 1c, 41-300 Dąbrowa Górnicza, Poland
49	COMPARISON OF ALUMINIUM-MATRIX COMPOSITE SURFACES PRODUCED USING LASER FEEDING OF CERAMIC POWDERS Krzysztof Labisz, Tomasz Tański, Mariusz Krupiński, Wojciech Pakieła Institute of Engineering Materials and Biomaterials, Silesian University of Technology, ul. Konarskiego 18a, 44-100 Gliwice, Poland
50	ARCHAEOMETALLURGICAL METALLOGRAPHY Nataša Lipovšek[1], Matjaž Knap[2], Jakob Lamut[2] [1]Institute of Metals and Technology, Lepi pot 11, Si-1000 Ljubljana Slovenia, [2]OMM NTF, University of Ljubljana, Aškerčeva 12, SI-1000 Ljubljana, Slovenia
51	EROSION WEAR RESISTANCE OF TITANIUM MATRIX COMPOSITE Ti/TiN PRODUCED BY DIODE LASER GAS NITRIDING Aleksander Lisiecki[1], Agnieszka Kurc-Lisiecka[2] [1]Silesian University of Technology, Faculty of Mechanical Engineering, Welding Department, Konarskiego 18A, 44-100 Gliwice, Poland, [2]University of Dąbrowa Górnicza, Rail Transport Department, Cieplaka 1c, 41-300 Dąbrowa Górnicza, Poland
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53	SEM, AES AND XPS INVESTIGATIONS OF NON-TREATED AND LASER-TREATED AlZnMgSi THIN FILMS Djordje Mandrino[1], David Nolan[2], Matjaž Godec[1] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]BlueScope Steel Limited, Old Port Road, PORT KEMBLA, NSW2505, Australia
54	TRIPLEX COATINGS BEHAVIOR IN EXTREME THERMAL CONDITIONS Sorin Dimitriu[1], Victor Manoliu[2], Gheorghe Ionescu[2], Adriana Stefan[2], Mihai Botan[3], Alina Dragomirescu[2] [1]„Politehnica" University of Bucharest-ROMANIA, [2]National Institute for Aerospace Research „Elie Carafoli" – INCAS-220 Iuliu Maniu Bd., Bucharest 6, ROMANIA, [3]Dunarea de Jos University Galati – ROMANIA
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RECENT RESULTS AND TRENDS IN HEAT TREATMENT AND SURFACE ENGINEERING

Franz Hoffmann
Stiftung Institut für Werkstofftechnik, Bremen, Germany
E-mail: hoffman@iwt-bremen.de

Since centuries heat treatment of metals is done to set the needed properties for the use of tools, utility goods, and machine parts. Up to the middle of the 19th century heat treatment had been a kind of secret science and a series of myths of different nations describes the manufacturing of fabulous swords which got their properties by secret heat treatment procedures. Then in the 19th century scientist like Martens started to explain academically metallurgical phenomena. Since this time heat treatment started to be a scientific discipline.

By the better understanding of the physical processes, the possibility of the evolution of existing processes increased and the foundation for the development of new heat treatment processes was laid.

The talk deals with the situation today with the focus on particular fields of heat treatment technologies, like quenching technologies, nitriding, nitrocarburizing, carburizing, and carbonitriding as important thermo-chemical heat treatment processes, sensors in heat treatment, development of materials in respect of their behavior and performance during and after the heat treatment. Developments on the field of nitriding and carbonitriding will be the main focus of the reflections. Especially the combination of sensor technologies and thermo-chemical processes are promising options.

DENSITY FUNCTIONAL THEORY AND MATERIALS SCIENCE: THE CASES OF ALLOYS AND CARBIDES

Alfredo Juan
Departamento de Fisica & IFISUR (UNS-CONICET), Av. Alem 1253, 8000 Bahia Blanca, Argentina
E-mail: cajuan@uns.edu.ar

Alloys, intermetallic compounds and transition metal carbides are widely used as catalysts. These are complex materials and about 20% of manufacturing in the industrialized world is dependent on catalysis. Most catalysts used in industry are solids, and the catalysis takes place on the surface of nanoparticles of the active material or in the particle/support interface. Density functional theory (DFT) calculations can provide insight into the atomic-scale reaction mechanisms helping to interpret a large amount of experimental data collected during decades. This presentation shows how DFT and bonding analysis can be used to describe the state of the surface during chemical reactions and the geometrical and electronic changes in both the surface and the adsorbated species. Our research has recently focused on the adsorption of hydrogen and acetylene on the intermetallic compound PdGa. Another example, where calculations match experiments, is the adsorption and dissociation of CO on Mo_2C. This carbide is poison resistant and presents an electronic structure similar to Pt metals. We analyze the charge re-arrangements after CO adsoption on a K doped surface, predict vibration frequencies and compare them with work function change and EELS data. Finally we will analyze the Se adsorption at different coverages on DO_3 FeSiAl(110) and the electronic structure of FeSiAl alloys and its relationship with soft magnetic properties. In our approach the models are built from experimental information in cooperation with the groups of Prof. M. Jenko (IMT) and Prof. Deck (Hungary).

APPLICATION OF ADVANCED EXPERIMENTAL TECHNIQUES TO ENHANCE UNDERSTANDING OF MECHANICAL BEHAVIOR OF STEELS

E.V. Pereloma[1,2]
[1]School of Mechanical, Materials and Mechatronics Engineering, University of Wollongong, New South Wales 2522, Australia
[2]Electron Microscopy Centre, University of Wollongong, New South Wales 2500, Australia
E-mail: elenap@uow.edu.au

There has been a significant interest in the design of new high strength steels with complex microstructures and the manipulation of their properties at the nanoscale. During different stages of steel processing and in-service, changes occur not only at micro scale, but also at the atomic level. The latter ones could be the key factors controlling the mechanical properties and behaviour of steels. Thus, understanding the effects of alloying additions on the nanoscale level is essential for tailoring the steel composition and properties for a specific product requirement.

Development of modern characterisation techniques, such as atom probe tomography and high resolution scanning transmission electron microscopy opened pathways for nanoscale analysis. These powerful techniques have been used for the direct experimental observations of early stages of phase transformations, clustering, fine precipitation, atmospheres around dislocations and segregation at interfaces. In addition, both correlative microscopy and/or combination of several techniques approaches provide a useful tool for obtaining a complete picture of material at different levels.

In this talk, the examples of understanding the mechanical behavior of steels based on the key evidence provided by atom probe tomography will be presented. The bake hardening and retained austenite stability of transformation-induced plasticity steel, as well as ageing behavior of maraging steel, will be addressed.

HIGH-RESOLUTION STEM IMAGING OF OXIDE MATERIALS FOR THERMOELECTRIC APPLICATIONS

Miran Čeh[1,2], Marja Jerič[1,3], Sašo Šturm[1], Mateja Košir[1], Slavko Bernik[1], Cleva Ow-Yang[4], Mehmet Ali Gülgün[4]
[1]Department for Nanostructured Materials, Jožef Stefan Institute, Ljubljana, Slovenia
[2]Center for Electron Microscopy and Microanalysis, Jožef Stefan Institute, Ljubljana, Slovenia
[3]Jožef Stefan International Postgraduate School, Ljubljana, Slovenia
[4]Materials Science & Engineering, Sabanci University, Tuzla, Istanbul, Turkey
E-mail: miran.ceh@ijs.si

High-resolution scanning transmission electron microscopy (STEM) with EDS/EELS has become a powerful technique to assess information on the structure and chemical composition of investigated materials on the atomic scale. The STEM images are recorded in a FEG (S)TEM, preferably with a probe Cs corrector. When using HAADF detector, the images are recorded at large inner angles of the annular detector so that thermal diffuse scattering (TDS) becomes the prevailing contribution to the image intensity. Contrary, the ABF images are recorded with the BF detector at small inner and outer angles of the BF detector. In this way light elements can be observed as well. In our work we investigated the structure and the chemical composition of Ruddlesden–Popper[1,2] (RP) type planar faults in doped $Sr(Ti,Nb)O_3$ and inversion boundaries in doped ZnO[3,4] thermoelectric materials. All results were obtained in a Jeol ARM-200F with a CFEG and Cs probe corrector. HAADF imaging was performed at angles from 70 to 175 mrad, while ABF imaging from 11 to 23 mrad. RP faults in doped $Sr(Ti,Nb)O_3$ formed either a 3-D network structures or more or less ordered sequences of polytypic RP phases in the perovskite matrix. While measured intensities of individual Sr atomic columns along a single fault did not scatter significantly, the $(Ti,Nb)O_6$ atom columns exhibited large scatter in measured intensities, thus indicating significant variation in Nb and Ti content within a single mixed atom column. Quantitative analysis of measured HAADF intensities showed that the content of Nb on B sites in perovskite solid solution varied from 5 to 35 at %. In In_2O_3-doped ZnO ceramics, pure indium monolayers were readily observed by HAADF. These basal inversion domain boundaries (IDB's) were parallel to the $\{0001\}$ ZnO lattice planes and separated domains with different orientation (head-to-head; tail-to-tail). Pyramidal IDB's (p-IDB) were much more clearly resolved by ADF as opposed to basal IDB's (b-IDB) due to an increased contribution of diffraction contrast and/or strain.

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ENGINEERED COATINGS FOR WEAR AND CORROSION PROTECTION OF MACHINE COMPONENTS AND TOOLS

Orlaw Massler, Robert Isenring, Thomas De Martin
De Martin Surface Technology AG, Froheggstrasse 34, CH-9545 Wängi, Switzerland
E-mail: o.massler@demartin.com

Surface Technology for Engineered Surfaces

Modern engineering surfaces depend on the integrity and performance on many levels. Friction, wear and corrosive mechanisms lead to early failure and performance gaps, resulting in high cost for running, maintenance and repair. In order to find the most suitable solution for a given situation, it is imperative to identify the problem to be solved and the active physical and chemical mechanisms. Hereby, it is most effective to divide bulk and surface requirements of a tool or component and implement the surface functionality already in the design phase. A simple process for an effective surface engineering is being presented.

Friction, Wear and Corrosion

In many cases, the surfaces are faced with a complex mix of different types of wear, frictional and corrosive processes, limiting performance and productive life. It is mostly sufficient to identify the dominating processes and find suitable countermeasures. The various wear mechanisms, friction effects and some important corrosive and their characteristics are being explained.

Coatings and Materials

Once the focus is set on the surface behavior, which has to be improved, the suitable surface treatment has to be chosen. Some typical materials and processes are being explained

- Galvanic coatings
- Electroless and dispersion coatings
- PVD and PACVD coatings
- Hybrid Solutions

Some applications from the area of forming tools and machine components will be presented.

Finally, some basic principles for the designs of parts to be coated and requirements are being presented.

ADVANCED ALUMINIUM ALLOYS FOR HIGH TEMPERATURE APLICATION

Jožef Medved, Primož Mrvar, Maja Vončina
University of Ljubljana, Faculty of Natural Sciences and Engineering, Department of Materials and Metallurgy, Aškerčeva 12, 1000 Ljubljana, Slovenia
E-mail: jozef.medved@omm.ntf.uni-lj.si

New aluminium alloys, which exhibit an optimal combination of strength, fatigue resistance, formability and corrosion resistance are desirable for the aluminium industry. One of the most attractive systems for new aluminium alloy is Al–Zn–Mg–Cu system, which is the basic system for development of the strongest wrought alloys of AA7075 type. Alloying elements such as chromium, manganese, and zirconium are added for the control of grain and subgrain structures, which also contribute to the strength.

Paper represents thermodynamic modeling of advanced aluminum alloys with better mechanical properties for high temperature applications. For better visual representation and interpretation of solidification path of studied alloys the thermodynamic predictions are needed for the study of the effect of additions to the thermodynamic stability, crystallization and precipitation kinetics of lightweight alloys. The purpose of this study was to analyze the influence of diferent (Ce, Nd, Zr) addition to the aluminium alloys from thermodynamic point of view.

DAMAGE SEQUENCES OF AUSTENITIC STAINLESS STEELS IN CHLORIDE SOLUTIONS UNDER CYCLIC LOADING

G. Mori[1], A. Visser[1], R. Fluch[2], M. Kapp[2], H. Leitner[2], B. Holper[3], M. Panzenböck[4]
[1]Chair of General and Analytical Chemistry, Montanuniversitaet Leoben, Franz Josef-Strasse 18, 8700 Leoben, Austria
[2]Böhler Edelstahl GmbH & Co KG, Mariazeller Strasse 25, 8605 Kapfenberg, Austria
[3]Schoeller Bleckmann Oilfield Technology GmbH, Hauptstrasse 2, 2630 Ternitz, Austria
[4]Department of Physical Metallurgy and Materials Testing, Montanuniversitaet Leoben, Franz Josef Strasse 18, 8700 Leoben, Austria
E-mail: gregor.mori@unileoben.ac.at

Austenitic stainless steels have been tested under cyclic loading in both corrosive and inert media. S/N curves have been compiled to show the effect of environmental conditions such as chloride content, temperature and pH-value on fatigue limit and damage. Also S/N curves at two different R-values are compared.
Furthermore fracture surfaces have been carefully analysed using a scanning electron microscope (SEM). Different damage mechanisms have been identified. These are pure fatigue, corrosion fatigue, pitting followed by fatigue and stress corrosion cracking followed by fatigue.
The relations between these damage sequences and their change from one to the other with changing conditions is discussed and shall contribute to an improved understanding of corrosion fatigue behaviour of austenitic stainless steels in chloride solutions.

DESIGN OF NOVEL TOOL STEELS BY MECHANICAL MILLING AND SPARK PLASMA SINTERING

M. Pellizzari[1], A. Fedrizzi[1], T. Gebremariam Kotecho[1], F. Deirmina[1], M. Zadra[2]
[1]University of Trento, Dpt. Industrial Engineering, Via Sommarive 9, 38123 Trento
[2]K4sint, Pergine Valsugana, Trento, Italy
E-mail: massimo.pellizzari@unitn.it

Power metallurgy is a well consolidated route to produce tool steels. The conventional process, involving the consolidation of atomized powders by Hot Isostatic Pressing (HIP) followed by thermomechanical processing (extrusion, forging…) and final heat treatment leads to a finer microstructure and improved properties than similar wrought grades obtained from ingots.
Tool steels microstructure can be further refined by mechanical milling. The repeated impacts between powder particles and the balls/vial cause the their fragmentation and induce a high defects density. The crystallite size is progressively reduced down to nanometric scale and considerably strain hardening is observed. During sintering recrystallization is generally easier that in unmilled powders, according to the higher internal energy of the system. Sintering techniques assisted by pulsed current, like Spark Plasma Sintering (SPS), permits to get near full dense materials at lower temperature and for shorter time than HIP. This allows to preserve parts of the benefits induced by mechanical milling, leading to a very fine microstructure of the consolidated steels. Present results highlight a final grain size close to 1μm for AISI H13 hot work tool steel and even finer for AISI M3:2 high speed steel.
The process described above has been extended to the production of a *hybrid tool steel* obtained by mechanical milling and spark plasma co-sintering blends of these two grades. The results highlight the possibility to modulate the properties (hardness, fracture toughness) of the new steel according to the relative amount of the two base powders.
Finally, the same powder metallurgical route has been used for the production of particle reinforced tool steel. A tool steel powder has been mechanically alloyed with TiC particles showing that a remarkable increase in wear resistance can be obtained. Properties like density, hardness and fracture toughness are strictly related to distribution of TiC particles, which must be tuned by proper selection of processing parameters.

IMPORTANCE OF FRACTURE TOUGHNESS ON THE PERFORMANCE OF COATED TOOL STEEL

Bojan Podgornik
Institute of Metals and Technology, Lepi pot 11, Ljubljana, Slovenia
E-mail: bojan.podgornik@imt.si

In forging, stamping, punching and fine blanking applications tools are exposed to very demanding contact conditions, including high impact loads, high contact pressures, elevated temperatures and wear. Thus tool surface is subjected to complex combination of mechanical, thermal and tribological loads, which lead to fatigue, chipping, plastic deformation, galling and wear of the tool. As the market, especially automotive industry focus toward the use of new light-weight high-strength materials, which are more and more difficult to form, also requirements on tool properties including fatigue and wear resistance are becoming more demanding. One way of improving tool performance, already very successfully proven in cutting tool operations is application of hard wear resistant coatings. However, beside complex shape of forming tools and high tendency of commercial hard coatings to galling, limited load-carrying capacity and impact loading resistance greatly restrict the use of hard coatings in forming applications. Load-carrying capacity of the substrate can be simply improved by increasing substrate hardness. However, under dynamic impact loading resistance to crack initiation and propagation is even more important than wear resistance, with high hardness and high fracture toughness not being properties easily obtained simultaneously. On the other hand, processes including vacuum heat treatment, plasma nitriding and deep cryogenic treatment allow optimization of the tool steel microstructure in respect of obtaining higher fracture toughness while maintaining high hardness.

The aim of the lecture is to highlight the importance of substrate fracture toughness and hardness vs. fracture toughness ration on the performance of tool steel, especially when coated. By using different combinations and parameters of vacuum heat treatment, deep cryogenic treatment and plasma nitriding, resulting in different hardness vs. fracture toughness ratios effect of fracture toughness and the potential for improving load-carrying properties and wear resistance of PVD and PACVD coated tool steel will be discussed, including the effect of coating type (monolayer, multilayer, nanocomposite). At the conference load-carrying capacity evaluation method and results showing the potential of different substrate pre-treatment procedures to tailor mechanical, tribological and load-carrying properties of coated tool steel will also be presented.

COMPACTING OF NANOSTRUCTURED CARBON MATERIALS: CHEMICAL AND PHYSICAL APPROACHES

Savilov S.V.[1], Ivanov A.S.[1], Suslova E.V.[1], Lu L.[2], Aldoshin S.M.[1], Lunin V.V.[1]
[1]M.V. Lomonosov Moscow State University, Moscow, Russian Federation
[2]National University of Singapore, Singapore
E-mail: savilov@chem.msu.ru

Nanoscale carbon structures, being quite new class of materials, demonstrate wide perspectives to be used in various areas of power, chemical and metallurgical industry as well as electronics. It is caused by variety of their chemical and physical properties together with possibility to influence on them by different types of treatment. For most applications, especially for energy storage: batteries and supercapacitors, carbon nanomaterials must have ppm level of impurities and be compacted to maximal density. Nevertheless such properties as high specific surface area, electroconductivity, mesoporosity, heteroatoms content must be kept. For these purposes spark plasma sintering technique which is widely used in metallurgy and ceramic industry might be an excellent solution. Being simple in practical realization, providing high vacuum level and inert gas filling during sintering, SPS technique allow to compact carbon materials up to 2.0 g/cm^3 density, remove any functional groups from surface of nanotubes and flakes, decrease of defects amount. Present work considers the change of porosity and density of the compacted samples on the condition of sintering and the nature of the material. Different experimental approaches to the treatment of the started carbon nanosized forms for metal nanoparticles and functional groups removal are described. High importance of these factors for application of sintered materials in non-aqueous supercapacitors electrodes is shown and discussed.

As reference approaches the chemical ways of compacting of carbon nanomaterials were utilized. Their value for obtaining of the 3D networks within the bulk samples is demonstrated, what is important for design of metal nanoparticles decorated carbon nanotubes. It takes place due to carbon atoms with uncompensated valences connection via C-C or C-O- bonds when reacted with divynilsulphone. This way opens the wide perspectives of obtaining new composite materials based on uniformly decorated by metals and oxides structured carbon forms.

THE EFFECT OF TITANIUM ALUMINIDES REINFORCEMENT PARTICLES ON MICROSTRUCTURE AND PROPERTIES CHANGES OF AMC'S

Marcin Adamiak[1], Błażej Tomiczek[1], Artur Czupryński[2], Jacek Górka[2]
Silesian University of Technology,
[1]Institute of Engineering Materials and Biomaterials
[2]Department of Welding Engineering, Konarskiego 18A Str., 44-100 Gliwice, Poland
E-mail:marcin.adamiak@polsl.pl

Powder metallurgy (PM) combined with (MA) offers innumerable advantages over casting metallurgy, making possible to improve the existing properties but also conferring new properties. Results presented in this paper were obtained in such processes. Experiment have been developed to improve the characteristics of aluminium matrix composites, because of produced fine and uniform dispersions of reinforcement's particles. Applying mechanical alloying route of composite powders production, makes it possible to obtain diminution of reinforcing particles size as well as homogenous reinforcement particles distribution. As was expected mechanical milling process has improved the reinforcement distributions throughout the whole particle. Extruded composites are characterized by a very homogeneous distribution of intermetallic particles and the absence of any reaction and with good cohesion at the matrix/particle interfaces. Observed changes in the microstructure, influence on the mechanical properties of composite particles obtained.

MINI-THIXOFORMING OF LOW-CARBON HIGH-ALLOY STEEL

David Aišman, Hana Jirkova, Katerina Rubesova
University of West Bohemia in Pilsen, Research Centre of Forming Technology – FORTECH, Univerzitni 22, 30614 Pilsen, Czech Republic
E-mail: daisman@vctt.zcu.cz

Semi-solid processing allows novel microstructures to be produced even in conventional materials. This is thanks to the peculiar conditions of the process and the rapid solidification. Despite that, semi-solid processing is not widely used in practice due to its technological complexity. Mini-thixoforming is an innovative method of processing metals in the region between their solidus and liquidus temperatures. With its small volume of metal feedstock it is a very precise and highly dynamic process. Consequently, it can be employed for materials with a very narrow freezing range which, until now, were impossible to thixoform conventionally. The present experiment focused on one of such materials: the low-carbon high-alloy age-hardenable X5CrNiCuNb16-4 steel. Owing to the low carbon level, the relevant temperature interval was 1380 – 1420 °C which, together with the need for strict control, posed a technological challenge. Once the semi-solid processing parameters were optimized, the die cavity was filled as required and the final products showed good surface quality. The resulting single-phase microstructure consisted of ferrite. Hence, given the 17 % level of dissolved chromium, there is a potential for excellent corrosion resistance and, possibly, for subsequent age hardening of the material.

BIO-PLASTIC COMPOSITE MATERIAL MICROSTRIP-FED PRINTED ANTENNA FOR WIRELESS COMMUNICATION

Touhidul Alam[1], Mohammad Rashed Iqbal Faruque[1], Mohammad Tariqul Islam[2]
[1]Space Science Center(ANGKASA), Universiti Kebangsan Malaysia, 43600UKM, Bangi, Selangor, Malaysia
[2]Department of Electrical, Electronic and Systems Engineering, Universiti Kebangsan Malaysia, 43600UKM, Bangi, Selangor, Malaysia
E-mail: touhid13@yahoo.com

This paper presents a printed antenna printed on bio-plastic substrate material to ensure biological compatibility between human and wireless devices. The proposed antenna achieved multi band characteristics, which can cover GSM 1800, UMTS (1.92–2.17 GHZ), LTE band 40 (2.3-2.4 GHz) frequency bands. A fractal-shape printed patch antenna is designed for dual-band application in [1], which achieved impedance bandwidths of 44 % (0.65–1.05 GHz) and 20 % (2.35–2.85 GHz). U-shaped compact antenna with coupling feed was proposed for multi-band wireless application [2]. The reported antenna is incorporated with two distinct monopole radiators with meander-line type ground plane. The wireless antenna has been designed and simulated by commercially available EM simulation software CST Microwave Studio. The parametric analysis of the antenna geometry has been investigated. Moreover, the electromagnetic absorption rate of the proposed wireless antenna has also been analyzed with the human head phantom. The experimental results validate the simulated one. The proposed antenna has escorted with various attractive features and the overall performances of the proposed antenna make it worthy of the multiband wireless application.

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HYDROTHERMAL GROWTH OF VANADIUM PENTOXIDE NANOWIRES FROM AN AMMONIUM METAVANADATE PRECURSOR SOLUTION

Nemanja Aničić, Marija Vukomanovic, Danilo Suvorov
Jozef Stefan Institute, Jamova 39 Ljubljana, Slovenia
E-mail: nemanja.anicic@ijs.si

Vanadium pentoxide nanowires were hydrothermally synthesized from peroxovanadate[1] and a vanadyl sulfate precursor[2]. The particle growth includes, in both cases, the condensation of vanadate ions at 180 °C, which is anisotropic due to the different rates of the olation and oxolation reactions[3]. Although the ammonium metavanadate solution contains vanadate ions and is used as a precursor for the preparation of 1D vanadium pentoxide xerogels[4], the synthesis of nanowires has not been reported. The aim of this study was to synthesize vanadium pentoxide nanowires from an ammonium metavanadate solution. The temperature and the exposure time of the hydrothermal treatment, together with the precursor's pH, were varied. The results indicate that the influences of the temperature, time and precursor pH interlace. Below pH ~2, the growth of 1D nanostructures is observed, and the time and the temperature of the hydrothermal treatment determine whether monoclinic vanadium pentoxide xerogel or orthorhombic vanadium pentoxide nanowires are created. However, relatively harsh conditions are necessary to produce the nanowires (exposure to 240 °C for 24 h, precursor's pH = 0.8). Above pH ~2, 3D microparticles are obtained. In this contribution, the structural peculiarities of the obtained materials will be described and a general growth mechanism for the vanadium pentoxide nanowires will be proposed.

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HEATING RATE DEPENDENCE OF THE PHASE TRANSFORMATION TEMPERATURE OF STEEL SAMPLES

Boštjan Arh, Jaka Burja, Fevzi Kafexhiu, Bojan Podgornik
Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
E-mail: bostjan.arh@imt.si

The heat treatment of carbon steel consists of heating to a certain temperature and controlled cooling. The process of heating is called austenitisation. The structure of carbon steels is changed during this process, the room temperature structure of ferrite and pearlite is transformed into the high temperature austenite structure. The phase transformation is a diffusion driven reaction (the diffusion of iron and carbon) and is therefore time – temperature dependent. The reactions have a certain temperature interval, that is also dependent on the heating rate, the faster the heating the larger the interval. The temperature and the type of transformation also depend on the steel's chemical composition. Proeutectoid steels have a stable ferrite-austenite area in the phase diagram above the A_1 temperature, while the stable phases above A_1 are cementite Fe_3C in hypereutectoid steels. The end temperature of reactions being A_3 in proeutectoid and A_{cm} in hypereutectoid steels.
The influence of the heating rate on the transformation temperature of spring steel 60SiCr7 is studied in this work. The experiments are done by using a quenching dilatometer that measures the linear thermal dilatation in steel specimens and therefore enables the recording of phase transformations due to dimensional changes.

LOW DENSITY POLYETHYLENE (LDPE)/ CEMENT COMPOSITES FOR SUSTAINABLE BRICK APPLICATIONS

Fares D Alsewailem
King Abdulaziz City for Science and Technology (KACST), P.O.Box 6086, Riyadh 11442, Saudi Arabia

With the increase in the amount of plastic waste globally on a daily basis, modern communities have to provide practical and strategic ways to recycle such materials. Several methods are currently available to deal with plastic waste. In this work, plastic waste in forms of post consumer high density polyethylene (HDPE) jugs, containers, etc. were converted to long term usage applications as bricks for buildings. This method offers an environmentally friendly and sustainable solution to the massive usage of concrete in making bricks for buildings. Dust emitted from cement factories may also be harmful to human health. The method suggested here is a practical and environmentally sound solution to this problem where bricks can be made from the mixtures of plastics waste (HDPE) as a major phase and concrete as minor phase. The bricks made by this method are clean, stiff, and have good properties in comparison to concrete, such as specific gravity and thermal insulation. Furthermore, and most importantly, such bricks are recyclable while conventional building bricks are not.

NANOSTRUCTURED RUTHENIUM OXIDE ELECTRODES FOR SUPERCAPACITOR APPLICATIONS

Ramanathan Arunachalam[1], Mahmoud Al Ahmad[2], J. Maharaja[3], S. Mohan[3], Ashraf Talib Al-Hinai[4]
[1]Department of Mechanical and Industrial Engg., Sultan Qaboos University, Muscat, Sultanate of Oman
[2]Department of Electrical Engineering, United Arab Emirates (UAE) University, Al-Ain, UAE
[3]EMFT Division, Central Electrochemical Research Institute, Karaikudi, India
[4]Department of Chemistry, Sultan Qaboos University, Muscat, Sultanate of Oman
E-mail: arunrm@squ.edu.om

With development of science and technology, the consumption of energy throughout the world has increased many folds. Although there are several ways of generating energy efficiently, the storage technology available is not able to match them. Among the competing technologies for energy storage, Supercapacitors (SC) are promising. Transition metal oxides appeal especially for pseudcapacitor type SCs. Among the transition metal oxides, ruthenium oxide (RuO_2) has been widely researched and known for its superior electrochemical characteristics[1]. Although, RuO_2 could be deposited using several processes, invariably it is very expensive and this has limited its application as an electrode material for SCs.

This research attempts to develop RuO_2 thin films on stainless steel substrate through Pulse Electro Deposition (PED) using a low concentration bath. Preliminary experiments on PED of RuO_2 at different duty cycles and different frequencies have been carried out. The surface morphology of the thin film was examined using Scanning Electron Microscopy (SEM). From figure 1, it is obvious that the RuO_2 structure is nano spherical in nature.

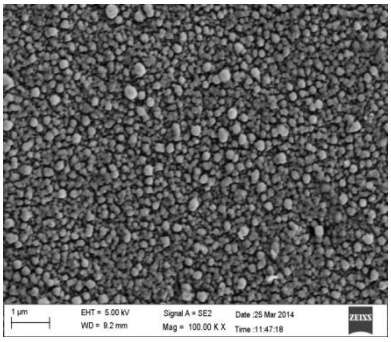

Figure 1. SEM image revealing nanospherical surface morphology

The cyclic voltammetry study of the film shows the specific capacitance to be in the range of 600 Fg^{-1}. Thus from the studies it can be concluded that RuO_2 thin film deposition using PED could be a viable process to economically produce electrode materials for SCs.

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INFLUENCE OF NA_2SiF_6 IN ELECTROLYTE ON THE STRUCTURE AND MECHANICAL PROPERTIES OF MICRO ARC OXIDATION COATINGS ON AM 60 MAGNESIUM ALLOY

Aysun Ayday
Sakarya University, Faculty of Engineering, Department of Metallurgical and Materials Engineering, Sakarya, 54187, Turkey
E-mail: aayday@sakarya.edu.tr

Mg alloys are the lightest metal structural materials in widespread industrial application. Due to their unique combination of low density and mechanical properties, such as high specific strength, good electrical and thermal conductivity, recyclability and high vibration absorption [1,2]. They are many industrial application such as aerospace, automobile and communications. However, poor corrosion resistance is a significant factor limiting their development [1-3]. There are numerous methods to improve the corrosion resistance of Mg alloys, such as electroless plating, conversion films, laser surface melting and organic coatings [3,4]. Micro-arc oxidation (MAO) is another efficient method to improve the properties of Mg alloys by producing ceramic films on their surface.

Oxide coatings were formed by micro arc oxidation (MAO) on AM60 magnesium alloy substrate. The effect of Na_2SiF_6 in electrolytic solution on the micro arc oxidation process and the structure and mechanical properties of the oxide coatings were investigated. The results showed that the MAO coating produced in the electrolyte with Na_2SiF_6 was thicker and more uniform than that produced in the electrolyte without Na_2SiF_6. The pore diameter and surface roughness of the MAO coating were declined by the addition of Na_2SiF_6, while the coating density was increased. Furthermore, the coating formed in the electrolytic solution with Na_2SiF_6 had a higher surface hardness and the results of corrosion behavior showed better resistance than that formed in the solution without Na_2SiF_6.

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NUMERICAL MODEL OF AIRFOIL SEGMENT FOR IMPACT LOADING IDENTIFICATION

Jan Bartošek, Tomas Kroupa, Robert Zemcik
European Centre of Excellence NTIS – New Technologies for Information Society, Faculty of Applied Sciences, University of West Bohemia, Univerzitni 8, 306 14, Plzen, Czech Republic
E-mail: bartose4@kme.zcu.cz

Problem of impact loading identification and impact localization was studied on the composite airfoil segment made of glass-epoxy composite and on numerical model. The airfoil segment was loaded by impactor and response was measured by sensors. Two types of sensors were used; piezoelectric transducers which were bonded to surface and non-contact laser displacement sensors. The sensor response to loading in individual impact point was characterized by transfer function which was determined from measurement. Transfer functions were used in inverse process to estimate impact force and impact location from sensor responses. Identification errors for different impact locations and sensor types was determined and discussed.
Numerical model of the airfoil segment was created in finite element software and measured responses on impact loading were compared to results from numerical simulation. Numerical model was then utilized within the identification process and identification errors from numerical identification was compared to experimental one. Optimal sensor distribution for impact loading identification was then determined using numerical model. Finally, sensors were moved to their optimal locations and improvement in impact force estimation was verified by experiment.

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APPLICATION OF PLACKETT-BURMAN DESIGN TO DETERMINE THE EFFECT OF PRODUCTION PARAMETERS ON THE HARDNESS OF BIMETAL ABRASION PLATES

Robert Bęczkowski, Marek Gucwa
Institute of Mechanical Technology, Czestochowa University of Technology, 21 Armii Krajowej Av., 42-201 Czestochowa, Poland
E-mail: rbeczkowski@spaw.pcz.pl

The development of new materials and technologies used in welding process directed towards improving tribological properties of deposited coatings designed for protection against wear.
A wide variety of commercial materials are available for production of special bimetal plates with high abrasive resistance. Chromium cored wires belong to welding materials that are often used to deposit cladding with high hardness. Studies of microstructures of high chromium deposited claddings with different welding technologies indicates that it is possible to obtain complex type carbides $(Cr,Fe)_3C$, $(Cr,Fe)_7C_3$ and $(Cr,Fe)_{23}C_6$ depending on chemical composition of welding materials used.
This article deals with the problem of determining the important parameters for the deposition of cladding with flux-cored self shielding with respect to the hardness of the resulting clad. The use of a core wire in the production of clad with different chemical composition and good quality has a great potential. The problem is to determine which of the surfacing parameters have a significant impact on the final characteristics clad. The application of Plackett-Burman design allowed for statistical evaluation of the significance of the impact of selected parameters on the resulting hardness surfacing.

NEURAL NETWORK APPROXIMATION STRATEGIES FOR WIDE RANGE FUNCTIONS

Igor Belič
IMT, Lepi pot 11, 1000 Ljubljana
E-mail: igor.belic@imt.si

Neural networks are not well suited to perform the approximation of wide range functions that are obtained from various measurements, spectral analysis, etc. The quality of approximation (approximation error) of small values is poor compared to the large ones. In the previous work it was proposed to solve the problem in two separate ways: a) The Log/anti Log strategy. The idea is to perform the $\log_{10}$ of the data where neural networks operate in log space. b) The segmentation strategy where the input and output spaces are split into several smaller segments and the neural network training is performed for each segment separately. This also means that each segment is approximated by the separate neural network. This method gives much better approximation results but it also requires bigger training set. It is also a good practice to allow the segments overlapping in order to achieve good results on segment borders.

This contribution focuses on the newly proposed strategy where the neural network function approximation runs in a multi-stage architecture. The idea is that the neural network of the first stage performs the approximation with the given tolerance. When, through the neural network training process, the approximation fulfils the pre-set tolerance, the difference between the original function and the obtained model (the error) is calculated. The second stage neural network is trained to approximate the obtained error with the pre-set tolerance. If the problem requires, the error of the second stage can again represent the input function of the third stage etc.

The proposed strategy was successfully applied at the Auger electron spectroscopy for the definition of the spectral background. All three strategies were compared.

THE DETECTION OF THE MASS SPECTRUM COMPONENTS CLOSE TO THE NOISE LEVEL

Igor Belič, Janez Šetina
Inštitut za kovinske material in tehnologije, Lepi pot 11, 1000 Ljubljana
igor.belič@imt.si; janez.setina@imt.si

At mass spectrometry the reliable detection of very low quantities of spectrum components is a challenge. The main problem is posed by the always present noise. Usually the problem can be dealt with by using the integration techniques which normally require large observation times. Our goal is to find the technique which will be able to give us reliable information on the close to noise mass spectra components. The special requirement is to use a low number of recorded mass spectra (preferably one). The technique that holds the potential to provide us with the wanted information is the correlation function. Before using the technique on recorded mass spectra, the technique was tested within the simulated environment.

In our work the Kr mass spectrum containing main Kr isotope peaks for ^{78}Kr, ^{80}Kr, ^{82}Kr, ^{83}Kr, ^{84}Kr , ^{86}Kr was used. The experimental setup uses the normalized Kr mass spectrum where ^{84}Kr peak is set to 1. The white noise sequence with the maximum amplitude 1 is generated. The Kr spectrum multiplied by the amplitude constant is added to the noise. Through the experiments the amplitude constant varies form 0,05 to 2, using step 0,05. For each amplitude constant several tests with different white noise sequences were probed.

The first step was to establish the Kr spectrum autocorrelation function. Further on the obtained autocorrelation function shape is searched for in the correlation function of the Kr spectrum buried in the noise.

We have found out that from the amplitude constant 0,25 on, the typical autocorrelation function can be reliably recognized therefore the presence of the Kr mass spectrum can be confirmed. The correlation function provides the information on the presence and also it gives the quantity estimate of the Kr spectrum in the observed noisy mass spectrum.

EXPERIMENTAL INVESTIGATION OF CUTTING TOOL PERFORMANCE IN END MILLING OF CARBON FIBER-REINFORCED PLASTICS

Bilek Ondrej, Rusnakova Sona, Zaludek Milan
Tomas Bata University in Zlin, Faculty of Technology, Department of Production Engineering,
Nam. T. G. M. 5555, 760 01 Zlin – CZ
E-mail: bilek@ft.utb.cz

Carbon fiber-reinforced plastics (CFRPs) currently cease to be the exclusive domain of aerospace industries and nowadays find more often application in current engineering (1), namely, automotive and consumer industry. With a growing volume of these materials increases their need for efficient machining. However machinability of CFRPs is a rather complex task due to the heterogeneity and considerable number of parameters influencing the cutting process (2–4). Surface delamination is possible to occur (5), as well as damage from burning during the cutting process. Cutting tool has long been recognized as an important factor (6) influencing surface quality and dimensional accuracy. Hence, in this paper, tool performance is investigated in end milling of carbon fiber reinforced plastics. The effect of tool geometry and coatings on cutting forces and surface quality were experimentally examined, moreover the delamination factor was quantified. The results indicated suitable cutting tools and the effect of tool wear on cutting forces, surface quality and delamination factor for side and slot milling

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EFFECT OF FLY ASH AND SHRINKAGE REDUCING ADDITIVES ON PROPERTIES OF ALKALI ACTIVATED SLAG BASED MORTARS

Vlastimil Bílek Jr., Lukáš Kalina, Jan Koplík, Miroslava Hajdúchová, Radoslav Novotný
Brno University of Technology, Faculty of Chemistry, Materials Research Centre,
Purkyňova 118, 612 00 Brno, Czech Republic
E-mail: xcbilekv@fch.vutbr.cz

This study is aimed at reducing drying shrinkage of alkali activated slag (AAS) through the use of low calcium fly ash (FA) and commercially available shrinkage reducing additives (SRAs) originally developed for OPC based binders, since there are no such admixtures tailored for AAS systems. Generally, all the SRAs tested are based on modified alcohols. All the mortars were based on slag activated by waterglass with water to slag ratio equal 0.40 and siliceous sand to binder ratio 2:1.
In the first step, the effect of partial replacement of slag by FA (25, 50 and 75 wt %) on drying shrinkage and compressive strength was investigated. On the basis of the obtained results mortar with 50 % in the binder was chosen for further experiments, where influence of three types of SRAs on drying shrinkage behavior was examined.
It was observed, that while 25 % of FA did not affect drying shrinkage significantly, 50 % and 75 % of FA in the binder decreased drying shrinkage by 57 % and 78 %, respectively. However, with increasing content of FA, compressive strength markedly decreased. All the tested SRAs had similar effect on drying shrinkage of slag/fly ash (50/50) mortar: at the dose of 0.50 % (by mass of slag) shrinkage was reduced only slightly, whereas 1.0–3.0 % of SRA resulted in the decrease by 49–66 %. Also drying shrinkage rate during the first days of drying was modified. However, all the SRAs reduced compressive strength as compared to the neat slag mortar, especially when its doses were higher than 0.50 %.

THE EVALUATION OF FINITE ELEMENT ANALYSES OF THREE-POINT BENDING TEST BY THE EXAMPLE OF ALUMINUM ALLOY

A. Aman[1], S. Majcherek[1], C. Engel[1] S. Hirsch[2], S. Birr[1]
[1]Packaging Group, Institute of Micro- and Sensor Technology, D 31106, Magdeburg University, Universitätsplatz-2, Germany
[2]Department of Electrical Engineering, Brandenburg University of Applied Sciences, Magdeburger Straße 50, 14770 Brandenburg an der Havel, Germany
Email: Sebastian.Birr@St.Ovgu.de

The focus of this work is the evaluation of finite element analyses of three-point bending tests by means of experiments. Here, the material behavior of aluminum alloy during three-point bending tests was investigated based on two- and three dimensional simulations. The simulations were carried out by FEM-software ANSYS 15. The results of the simulations are represented by numerical methods as solution of partial differential equations. Furthermore, boundary conditions were varied in the simulation to investigate how the results are affected by suitable modelling of three-point bending supports or the pressure piece. For the calculation of analytical solutions and as a reference for the quality of the simulations the tool MATLAB was used. The bending tests were accomplished by experiments and the elongations were determined with the help of strain gauges. Likewise, the issue to be addressed is the challenge of ensuring a secure supply of adequately evaluated results of the Young's modulus in the experiments between the tensile and bending tests. Normally, the difference is about 5 %. The tensile and bending tests differ in their stress distribution along its measuring range. In the tensile test there is a homogenous stress distribution within the measuring range up to the beginning of the necking of the sample whereas in the bending test prevails an inhomogeneous stress distribution over the cross section. A correlation between finite element and experimental results was found by comparing the results from finite element analysis and experimental bending tests as well as tensile tests and strain gauges. With the regard to this correlation during finite element analysis it allows advanced investigation of material properties directly by finite element method instead of time-consuming and error-prone experiments.

KEY NITRIDING PARAMETERS INFLUENCING CORROSION RESISTANCE OF MARTENSITIC CHROMIUM STEELS

M. Borchert[1], G. Mori[1], M. Bischof[2], A. Tomandl[2]
[1]General and Analytical Chemistry, Montanuniversitaet Leoben, Franz-Josef-Strasse 18, 8700 Leoben, Austria
[2]Hilti Corporation, Feldkircherstrasse 100, 9494 Schaan, Liechtenstein
E-mail: marlies.borchert@unileoben.ac.at

Nitrogen alloying has a well-defined and significant improving effect on mechanical properties and corrosion resistance until the solubility limit of nitrogen is reached and nitride precipitation exhibits its deleterious effects on these. High temperature nitriding of martensitic stainless steel at different temperatures in nitrogen gas under various pressures has been investigated. Metal utensils are exposed to corrosive conditions. Therefore pitting and stress corrosion cracking (SCC) tests have been performed simulating environmental exposure. The pitting behavior of nitrided specimens was evaluated using potentiodynamic polarization tests. For the investigation of simultaneous chloride and hydrogen induced SCC Slow Strain Rate Tests (SSRT), Constant Load Tests (CLT) and a recently published "BAM-Test" were conducted. Results show that steel X3CrNiMo13-4 with center hardness of 500 HV2 exhibits better corrosion resistance in all tests when compared to X12CrNiMoV12-3. An increasing nitrogen partial pressure in combination with a high nitriding temperature results in a higher susceptibility to hydrogen induced SCC. The longer nitriding time yields to a thicker nitrogen alloyed layer. Precipitation of nitrides results in a sharp decrease of corrosion resistance. Tempering has to be applied at least once to reduce residual stresses.

STRUCTURE AND PROPERTIES OF HIGH-MN STEELS AFTER HOT AND COLD PLASTIC DEFORMATIONS

Leszek Adam Dobrzański, Wojciech Borek, Janusz Mazurkiewicz
Division of Materials Processing Technology, Management and Computer Techniques in Materials Science, Institute of Engineering Materials and Biomaterials, Silesian University of Technology, Konarskiego 18A, 44-100 Gliwice, Poland
E-mail: wojciech.borek@polsl.pl

The purpose of this study are the investigations of new-developed high-manganese Fe-Mn-(Al, Si) austenitic steels, including selected high-manganese austenitic TWIP steels containing 25–27.5% Mn, 1–4 % Si, 2–3 % Al, and high-manganese TRIP steels containing 17-18 % Mn, about 1 % Si, about 3% Al with a diverse concentration of C, in order to determine and describe structural mechanisms decisive for increasing the store of cold plastic deformation energy of such steels, which makes them suitable for use in the automotive industry for sheets and structural components of cars for, respectively, reinforcement and controlled deformation zones, behaving in a controlled and pre-programmed manner, during dynamic cold plastic deformation occurring, in particular, during cars accidents. Thermo-mechanical treatment on a semi-industrial rolling line was designed and performed with three variants of cooling and simulations of thermo-mechanical treatment consisting of eight and four stages using a Gleeble 3800 metallurgical simulator. The influence of the given treatment variants on the structure of the investigated steels and structural mechanisms decisive for their properties was analysed. Specialist research instrumentation was employed for this purpose such as scanning electron microscopy (SEM), conventional (TEM), X-ray phase analysis, stereological and metallographic tests. Investigated steels were subject to complex structural assessment, including the use of high-resolution transmission electron microscopy (HRTEM). Using HRTEM and special software allowed for visualization and analysis of structural mechanisms deciding upon the properties of the tested materials. Assessment of structural mechanisms in nanoscale allowed for achieve unique cognitive materials on steels and mechanisms of their strengthening. The influence of the established variants of thermo-mechanical treatment with a semi-industrial hot rolling on the mechanical properties of the newly developed steels at room temperature and at elevated and lowered temperature in static and dynamic conditions was also examined.

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INFLUENCE OF NITRIDED AND CARBONITRIDED LAYERS ON THE FUNCTIONAL PROPERTIES OF CARBON COATINGS PRODUCED ON AUSTENITIC STEEL UNDER DC GLOW-DISCHARGE CONDITIONS

Tomasz Borowski, Krzysztof Kulikowski, Agnieszka Brojanowska, Krzysztof Rożniatowski, Maciej Dubek, Maciej Ossowski, Tadeusz Wierzchoń
Warsaw University of Technology, Faculty of Materials Science and Engineering, 141 Woloska Str., 02-507 Warsaw, Poland
E-mail: borowski.tomasz@wp.pl

In most cases, components, which come in contact with each other, are made of steel. The structural applications developed these days are becoming increasingly more demanding with regard to the performance characteristics of this material. The most popular methods for improving the properties of steel is carburisation or nitriding [1]. Unfortunately, when very high surface properties of steel are required, this treatment may be insufficient. Improvement of tribological properties can be achieved by increasing the hardness of the surface, reducing roughness or reducing the coefficient of friction. The formation of composite layers on steel, consisting of a hard nitrided or carbonitirded diffusion layer and an external carbon coating with a low coefficient of friction, seems to be a prospect with significant potential.

An innovative method of producing carbon coating-diffusion layer type composite layers, which may be prepared in a single low temperature process using one device for glow-discharge treatment, is presented. AISI 316L austenitic stainless steel, one of the most popular and most readily available single-phase steels, was used in the tests.

The article describes composite layers produced on AISI 316L stainless steel and defines their morphology, surface roughness and their functional properties such as: resistance to friction-induced wear, coefficient of friction and also corrosion resistance. The layers have been formed in successive processes of: nitriding or carbonitriding in low-temperature plasma followed by deposition of a carbon coating under DC glow-discharge conditions. An evaluation was also made of the impact of the nitrided and carbonitrided layers on the properties and morphology of the carbon coatings formed, by comparing them to coatings formed on unpretreated AISI 316L steel substrates. A study of the surface topography, roughness, coefficient of friction, resistance to friction-induced wear, and corrosion shows the significant importance of the substrate type the carbon coatings are formed on.

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GREEN SYNTHESIS OF TINE OXIDE NANOPARTICULES FOR PHOTOCATALYTIC AND ANTI-BACTERIAL APPLICATIONS

F. Yakhlef[1], S. Boudjadar[1], B. Boudine[2], Z. Takkouk[3]
[1]Laboratory of Ceramics, Department of Physics, Frères Mentouri University – Constantine 25000, Algeria
[2]Laboratory of Crystallography, Department of Physics, Frères Mentouri University – Constantine 25000, Algeria
[3]Laboratory of study of materials, Department of Physics, University of Jijel –Jijel 18000, Algeria
E-mail: sboudjadar@yahoo.fr

The synthesis of nanomaterials using biological precursors has received increasing attention in last decade. The exploitation of natural products (plants extracts) to synthesis nanoparticles is benefit, either in the human health or in the final product coast. The aim of this work is the study of tin oxide nanoparticles synthesis using an eco-friendly 'green synthesis' route. The aqueous extract of Aloe Barbadensis Miller called as aloe Vera and $SnCl_4 \cdot 5H_2O$ were used as a biological solvent and a precursor of material respectively. We studied the effect of aloe vera extract concentration on the structural, physical and chemical properties of tin oxide nanoparticles. The structural and optical properties of as prepared nanoparticles were investigated by X-ray diffraction, Raman spectroscopy and UV-vis absorption spectroscopy, the quality of the samples was examined by IR absorption spectroscopy and room temperature photoluminescence. The XRD patterns show that all the samples have tetragonal rutile structure, with an average crystal size of all samples about 2nm. The formation of a tetragonal rutile structure of SnO_2 was further confirmed by Raman spectra. The increasing of the optical gap deduced from UV-visible spectra due to the grain size effect. FTIR spectra showed typical vibrations of Sn–O–Sn. The reveled photoluminescence measurement shows two main emission peaks. The study provided an economically and environmentally efficient method for preparing tin oxide nanoparticles.

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INFLUENCE OF CHEMICAL ADDITIVES AND CURING CONDITIONS ON MECHANICAL PROPERTIES AND CARBONATION RESISTANCE OF ALKALI-ACTIVATED SLAG COMPOSITES

Pavel Bulejko[1], Vlastimil Bílek[2]
[1]Brno University of Technology, Faculty of Mechanical Engineering, Heat Transfer and Fluid Flow Laboratory, Technická 2896/2, 616 69 Brno, Czech Republic
[2]Brno University of Technology, Faculty of Chemistry, Material Research Centre, Purkyňova 118, 612 00 Brno, Czech Republic
E-mail: bulejko@lptap.fme.vutbr.cz

The main aim of the presented work is to investigate the effect of the addition of air-entraining (AEA) and shrinkage-reducing agents (SRA) on mechanical properties and carbonation resistance of alkali-activated slag (AAS). Materials for the sample preparation were blast furnace slag activated using sodium silicate and AEA or SRA varying in content. Curing of samples was carried out in various conditions (air curing at laboratory conditions and water curing at the same temperature) and influence of these was studied too. The prepared samples (specimens with dimensions of 100 × 20 × 20 mm) where tested on compressive and bending strengths. The experimental results have shown that the addition of AEA had not significant influence on the mechanical properties while the addition of SRA had negative effect. However, the carbonation resistance markedly decreases with increasing amount of both agents. The same stands for the air curing as mechanical strengths are lower compared to those cured in water and the ratio of strength of the air cured composite and that of water cured one decreases with increasing content of SRA.

Some of the results obtained, especially those for carbonation resistance, are inconsistent with those of reported earlier: Bilim et al.[1] did not observed significant difference in carbonation depth of the samples with and without SRA activated by solid sodium silicate. When Bilim et al.[2] used liquid sodium silicate, carbonation resistance of AAS mortars was even somewhat better in the presence of SRA. These differences are caused by the different composition of the mixtures (particularly SiO_2 to Na_2O ratio of activator) and most likely due to the different origin of additives used. Bilim et al. used SRA based on polypropylene glycol in both discussed studies[1,2], while SRA used in the present study was based on 2-methyl-2,4-pentanediol. This indicates a strong dependence in the behavior of AAS on the composition of commercially available SRAs originally developed for Portland cement based systems.

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CHROMIUM OXIDE PRECIPITATION IN $CaO\text{-}SiO_2\text{-}Cr_2O_3$ SYSTEM

Jaka Burja[1], Franc Tehovnik[1], Franci Vode[1], Matjaž Godec[1], Jožef Medved[2]
[1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
[2]Faculty of Natural Sciences and Engineering, Aškerčeva cesta 12, 1000 Ljubljana
E-mail: jaka.burja@imt.si

Chromium is an important alloying element in stainless steel production. During the processing of the steel melt chromium oxidation occurs and chromium oxides end up in the steel slag. The chromium oxides in the steel slag represent both an economic loss for the steelmaking process and an environmental treat due to chromium leaching. The aim of this work is to control chromium oxide precipitation in steel making slags in order to improve the steel making process.

Melted and quenched oxide mixtures with different concentrations of chromium oxides from 1 to 20 wt % were studied at three different CaO/SiO_2 ratios (slag basicity) 0.5, 1 and 1.5. The precipitation of chromium oxide rich phases such as calcium chromite and chromite spinel were observed. The melted samples were quenched, so that the equilibrium solidification is not achieved. The curious nature of chromium oxide solubility in the $CaO\text{-}SiO_2$ system was observed; according to theory only CrO oxides are soluble in the liquid slag and Cr_2O_3 oxides precipitate. During cooling the solubility of chromium oxides in the $CaO\text{-}SiO_2$ system is drastically decreased and the transition from CrO to Cr_2O_3 has to take place, this was confirmed through microscopic analysis. Interestingly, due to the quenching and therefore reduced oxygen diffusion, and pickup from the atmosphere, metal chromium precipitates were found alongside the Cr_2O_3 oxides.

THE FABRICATION AND PROPERTIES OF SiC REINFORCED COPPER MATRIX COMPOSITE CONTACT MATERIAL

Gozde Celebi Efe, Mediha İpek, Sakin Zeytin, Cuma Bindal
Sakarya University, Engineering Faculty, Department of Metallurgy and Materials Engineering, Esentepe Campus, 54187 Sakarya-Turkey
E-mail: gcelebi@sakarya.edu.tr

Pure copper is used extensively for cables, wires, electrical contacts, and a wide variety of other parts that are required to pass electrical current [1]. Cu-based composites were feasible to be used as electrical contact materials in relays, contactors, switches, circuit breaks and other switch gear components [2]. Cu-SiC composites combine both the superior ductility and toughness of copper and the high strength and high modulus of SiC reinforcements [3]. But its application at high temperature is limited due to poor mechanical properties [4, 5].

This study aims at improving mechanical properties of electrical contacts through copper and copper matrix silicon carbide reinforced composite produced by powder metallurgy. Copper powder was produced by cementation method. Pure copper and copper-3 wt % SiC powder mixtures were pressed with an axial pressure of 280 MPa and sintered at 700 °C in atmospheric environment. Following sintering these compacts were compressed immediately with a load of 850 MPa so as to increase the relative density and electrical conductivity. Characterization of coatings was made by microstructural investigations, relative density experiments, electrical conductivity and hardness measurements. XRD analyses have revealed that there are no other phases rather than constituents of feedstock powder mixtures. Electrical conductivity of pure copper was reduced from 91,7 ± 1,8 % IACS to 66,4 ± 0,9 % IACS but hardness of pure copper was increased from 127 ± 1,2 HVN to 142 ± 6,0 with the addition of 3wt % SiC. Contact count experiments were made with these samples for determining contact performance for the counts of 3.000, 6.000, 9.000, 12.000, 15.000 and 18.000 turn on/off. Material loss of contacts increased with increasing counts related with increased copper oxide amount formed on contact surfaces.

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ARTIFICIAL AGGREGATE FROM SINTERED COAL ASH

Vit Cerny
Brno University of Technology, Faculty of Civil Engineering, Veveri 95, 602 00 Brno, Czech Republic
E-mail: cerny.v@fce.vutbr.cz

Fly ashes are one of the most commonly used secondary raw materials not only in the Czech Republic. They are used mostly for reclamations, road constructions, as an additive for cement, for plasters, etc. Using fly ashes for technology of artificial aggregate based on sintering was verified already in the 80s. However, of the various economic and technological reasons production was canceled.

Currently is verified the possibility of producing artificial aggregates based on fly ashes, which are currently produced in the Czech Republic. The study focuses addition to validating the suitability of a wide range of fly ashes, describe the creation of an ash body and optimization of the technology.

Generally we can say that for the sintered aggregate fly ashes are suitable. FBC ashes are not able to create high-quality solid structure with closed porosity. Production is also affected by increased emissions of SO^{2-} and higher values of sulphates in water leachate. In the case of fly ashes is their granularity, the contents of SiO_2, Fe_2O_3 and their content in the amorphous phase crucial. As correction fuel are suitable brown coal tailings, which bringing in addition to the fuel also the proportion of clay that improves the quality of fly ash body. There is recommended to use a granulation plates for gain more solid grains in the production technology. It must be also optimize negative pressure below the grate to maximize performance and minimize the proportion of crushed grains. For ignition is recommended to use a layer of fuel (e.g. coal tailings) to reduce gas consumption and reducing the portion of waste due to thermal shock after weaning ignition head.

INFLUENCE OF THE SURFACE ROUGHNESS ON THE COOLING INTENSITY DURING SPRAY COOLING

Martin Chabičovský, Miroslav Raudenský
Heat Transfer and Fluid Flow Laboratory, Faculty of Mechanical Engineering, Brno University of Technology, Technická 2, 616 69 Brno, Czech Republic
E-mail: chabicovsky@LPTaP.fme.vutbr.cz

The surface roughness plays an important role during spray cooling of hot surfaces in a presence of the boiling. Bubbles are formed in small cavities on the surface during nucleate pool boiling. Enhanced surface roughness causes that more bubbles are formed and it causes increased cooling intensity. The surface with increased roughness has also bigger surface area, which allows higher heat flow between surface and surrounding water.
The influence of the surface roughness during pool boiling was investigated by many authors. The increased surface roughness causes shift of the Leidenfrost temperature to higher temperatures and increases critical heat flux during pool boiling. The influence of the surface roughness during spray cooling of hot surfaces was not still sufficiently investigated and it is not known if the effect of the surface roughness is similar like in a case of the pool boiling.
Experiments for describing the effect of the surface roughness on the cooling intensity were done with water nozzle with flat jet. Test samples were heated in a protective atmosphere at a temperature 730 °C and then cooled to the room temperature. Test samples were made of the austenitic stainless steel to minimize the forming of the scales on the surface. Results shoving influence of the surface roughness on the critical heat flux and on the Leidenfrost temperature are presented.

DENSIFICATION AND ELECTRIC PROPERTIES OF $BiFeO_3$-$BaTiO_3$ CERAMICS

D.S. Kim[1], J.H. Kim[1], J.S. Kim[2], C.I. Cheon[1]
[1]Department of Materials Science & Engineering and [2]Department of Digital Display Engineering, Hoseo University, Baebang, Asan, Chungnam, 336-795, Korea
E-mail: cicheon@hoseo.edu

$Pb(Zr,Ti)O_3$-based piezoelectric ceramics have been widely applied for actuators, sensors, transducers and so on. Recently, many efforts have been made to develop lead-free piezoelectric materials which can replace existing Pb-based materials because of globally increasing environmental interest. There have been remarkable improvements in piezoelectric properties of lead-free ceramics such as $(K,Na)NbO_3$ and $(Bi,Na)TiO_3$, but no one is still comparable to lead-based materials in piezoelectric properties. $BiFeO_3$ has been reported to show excellent ferroelectric properties; a large polarization (~100 $\mu C/cm^2$), a high Curie temperature (~820 °C) and so on. However, it is difficult to prepare a $BiFeO_3$ ceramic with good ferroelectric properties because of its low resistivity and high defect density due to phase evaporation and decomposition during sintering. In recent years, $BiFeO_3$-based binary or ternary ceramics have been studied to resolve these problem of the $BiFeO_3$ ceramic. A $BiFeO_3$-$BaTiO_3$ solid solution demonstrated attractive piezoelectric properties around a morphotropic phase boundary between rhombohedral and pseudo-cubic; a moderate piezoelectric constant, d_{33} = 100~150 pC/N and a high Curie temperature above 400 °C. However, $BiFeO_3$-$BaTiO_3$ ceramics have been reported to display a decrease in a sintered density and a degradation of piezoelectric properties at high sintering temperature due to Bi evaporation. In this work, $0.75BiFeO_3$-$0.25BaTiO_3$ ceramics were prepared by a conventional ceramic process. The samples were sintered at 960~1,040 °C in various atmospheres (air, oxygen, atmosphere). Densification behavior, phase evolution, microstructure development, and a change of piezoelectric properties with the sintering temperature have been investigated. Effects of excess Bi_2O_3 addition and MnO_2 doping have also been examined.

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ROOM TEMPERATURE LIQUID PETROLEUM GAS (LPG) SENSORS BASED ON α-Fe_2O_3/SWCNTS THIN FILMS

Buawon Chaitongrat, S. Chaisitsak
Department of Electronics Engineering, Faculty of Engineering, King Mongkut's Institute of Technology Ladkrabang, Bangkok, 10520 Thailand
E-mail: kcsutich@kmitl.ac.th

The ferrocene-ethanol mist CVD under atmospheric pressure [1] has been successfully used to deposit web-like SWCNTs (single-walled carbon nanotubes) at a low temperature and has the potential for large-scale continuous production. Since it is a continuous process of both catalyst and nanotube formations occurring at the same time and in the same reactor, the catalyst particles (Fe_xO_y, Fe) usually remain attached to the surfaces of SWCNTs. In this work, we report the effect of post-annealing treatment on the properties and LPG sensing characteristics of SWCNTs films. The SWCNTs thin films were deposited by the vertical floating catalyst CVD method using ferrocene-ethanol mist and then transferred directly to a glass substrate via a wet process. Raman spectroscopy and X-ray Photoelectron Spectroscopy (XPS) results reveal that the catalyst particles (major iron and iron oxide Fe_xO_y form) were transformed into hematite (α-Fe_2O_3) nanoparticles after post-annealing in air at 350 °C for 8 hours. Field Emission Scanning Electron Microscope (FESEM) and Transmission Electron Microscopy (TEM) results show that the individual small spherical particles and clusters (~ 5–50 nm in size) of α-Fe_2O_3 were formed on the surface of the tube bundles. The sensing characterizations of the α-Fe_2O_3/SWCNTs nano-composite films were studied by exposing the sensors to LPG at various concentrations under room temperature (27 °C). The results demonstrate that the annealed films (α-Fe_2O_3/SWCNTs-based sensors) exhibited higher sensor response and faster response time of < 60 sec. for 0.5~5 vol % of LPG, compared to the un-annealed films (Fe_xO_y/Fe/SWCNTs-based sensors). The obtained results suggest that the α-Fe_2O_3/SWCNTs thin film based sensors may be a promising candidate for application in LPG monitoring at low-temperature.

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SELECTIVE LEACHING AND SURFACE PROPERTIES OF TINIFE SHAPE MEMORY ALLOYS

Shih-Hang Chang, Jyun-Sian Liou, Bo-Yen Huang
Department of Chemical and Materials Engineering, National I-Lan University, 1, Sec. 1, Shen-Lung Road, I-Lan, 260, Taiwan
E-mail: shchang@niu.edu.tw

This study investigated the selective leaching and surface characteristics of $Ti_{50}Ni_{50-x}Fe_x$ (x = 1, 2, and 3) shape memory alloys (SMAs) by employing inductively coupled plasma mass spectrometry, x-ray diffractometer, electrochemical tests, and X-ray photoelectron spectroscopy. X-ray diffraction results showed that all $Ti_{50}Ni_{50-x}Fe_x$ SMAs used in this study are in parent phase at room temperature, indicating that the surface relief did not influence the following selective leaching tests. Selective leaching results showed that the concentrations of the Ni ion selectively leached from each specimen was considerably higher than that of the Ti and Fe ions, indicating that the Ni ions were more easily released from the surface of the $Ti_{50}Ni_{50-x}Fe_x$ SMAs than Ti and Fe ions. Electrochemical tests revealed that the corrosion resistance properties of $Ti_{50}Ni_{50-x}Fe_x$ SMAs gradually deteriorated with the increase of Fe content in the alloys. X-ray photoelectron spectroscopy results indicated that the Ti atoms near the surface of the $Ti_{50}Ni_{50-x}Fe_x$ SMAs were easily oxidized to passive TiO_2 films, which were highly corrosion-resistant and inhibited the selective leaching rate of Ti atoms. The concentrations of Ni ions selectively leached from $Ti_{50}Ni_{50-x}Fe_x$ SMAs gradually increased with the increase of the Fe content in $Ti_{50}Ni_{50-x}Fe_x$ SMAs because the corrosion resistance properties of $Ti_{50}Ni_{50-x}Fe_x$ SMAs gradually deteriorated with the increase of Fe content in the alloys. The concentrations of Fe ions selectively leached from $Ti_{50}Ni_{50-x}Fe_x$ SMAs were approximately five times higher than those of the Ti ions, suggesting that the Fe_2O_3 and Fe_3O_4 oxides formed on the surface of $Ti_{50}Ni_{50-x}Fe_x$ SMAs may deteriorate the uniformity and protection of the TiO_2 oxide films and leads to the higher selective leaching rates of Fe ions. Although $Ti_{50}Ni_{50-x}Fe_x$ SMAs possess unique properties favorable than other SMAs, the high concentrations of selectively leached Ni and Fe ions may risk their biomedical applications, especially for implantation in human bodies. Therefore, appropriate surface modifications are necessary to prevent the selective leaching of Ni and Fe ions when $Ti_{50}Ni_{50-x}Fe_x$ SMAs are considered as materials for practical biomedical applications.

INVESTIGATION OF MECHANICAL PROPERTIES OF ELECTROCHEMICALLY DEPOSITED Au-In ALLOY FILMS VIA NANOINDENTATION

Sabina Cherneva[1], Martin Georgiev[2], Rumen Iankov[1], Dimitar Stoychev[2]
[1]Institute of Mechanics, Bulgarian Academy of Sciences, Acad. G. Bonchev str., Bl.4, Sofia-1113, Bulgaria
[2]Institute of Physical Chemistry, Bulgarian Academy of Sciences, Acad. G. Bonchev str., Bl.11, Sofia-1113, Bulgaria
E-mail: sabina_cherneva@yahoo.com

Thin Au-In alloy films containing different concentrations of In were electrochemically deposited on CuZn substrate with 500 μm thickness. The thicknesses of obtained films varied from 0.4 to 2.7 μm. Chemical and phase composition, as well as structure of the films were investigated by XRF, XRD and SEM analysis. The mechanical properties of investigated films and substrate were investigated by nanoindentation experiments, using Nanoindenter G200 (Agilent Technologies). As a result of nanoindentation experiments, load–displacement curves were obtained and two mechanical characteristics of the substrate and investigated films – indentation hardness (H_{IT}) and indentation modulus (E_{IT}) – calculated using Oliver & Pharr approximation method. Dependence of indentation modulus and indentation hardness on the depth of indentation and concentration of In, structure and phase composition of the films, was investigated and discussed, as well.

MOLASSES AS A BINDER FOR CARBON-GRAPHITE MATERIALS

Jan Chłopek, Marta Grzyb, Karol Gryń, Barbara Szaraniec
AGH University of Science and Technology, Department of Biomaterials, Mickiewicza 30, 30-059 Krakow, Poland
E-mail: chlopek@agh.edu.pl

This work presents a preliminary study on a plastic carbo-graphite masses which can be formed in a room temperature by tamping. Such material can be used as a tub-lining in the Aluminium Electrolysis Cell. The aim of this research was to prepare a room-temperature-formed carbo-graphite mass homogenised with a inexpensive and ecologicaly friendly molassas instead of highly toxic coal-tar pitch.

For the carbon phases calcined anthracite (Ukraine) and electrographite (SGL Carbon, Raciborz) with a grain saize < 0,4 mm was used. Three types of an organic binder were applied: molasses mixed with 2,5 % of nitric acid, molasses mixed with 5 % of nitric acid and molasses mixed with polivinyl alkohol (PVA). The reference sample was made with conventional and comercially avaliable binder coal-tar pitch.

All materials were used to prepare cylindrical-shape samples (diam. = 50 mm, height 90 mm). They were dried (37 °C/48h) and then heated to 1000 °C.

To determine the properties of the materials, the following parameters were measured: heat conductivity, density, open porosity, compressive strength, specific electrical resistivity.

Molasses and a molasses-nitric acid mixture could be considered as eco-friendly binders for cold ramming pastes. The addition of acid and PVA to molasses improved the moldability of the paste and improved compressive strength. Materials proposed in this articles fulfilled the requirements set for cold ramming pastes. Unfortunately mechanical properties after burning were not sufficient enough. The best results of compressive strength (5,8 MPa) was obtained for the sample with 2.5 % of HNO_3 addition, thus it is necessary to conduct more detailed research on modifying the composition of the material to improve its mechanical properties after burning process.

FABRICATION OF SUPERHYDROPHOBIC AND SUPERHYDROPHILIC SURFACES ON AISI 316L SUBSTRATE

M. Conradi, A. Kocijan
Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
E-mail: marjetka.conradi@imt.si

We report on the systematic study of the qualitative correlation between surface roughness generated by the layer-by-layer (LbL) deposition of dual-size TiO_2 nanoparticles (30 nm and 300 nm), TiO_2 surface functionalization with fluoroalkylsilane and resulting superhydrophobicity or superhydrophilicity of the coating. We compared the wetting properties of coatings prepared with functionalized and non-functionalized dual-size TiO_2 nanoparticles. TiO_2 nanoparticles were spin coated onto epoxy covered AISI 316L substrate. Static water and advancing/receding contact angles measurements were performed to evaluate wetting properties of LbL TiO_2 modified substrate. Surface roughness enhanced with TiO_2 surface functionalized nanoparticles resulted in superhydophobic coatings with contact angles > 160 °, while surface roughness enanced with non-functionalized TiO_2 nanoparticles resulted in superhydrophilic coatings with contact angles < 20 °. This result is on the other hand a nice example od Wenzel's model of surface wettability.

PROPERTIES OF FLAME SPRAYED COATINGS ON THE OF Al_2O_3 MATRIX AND ZrO_2 MATRIX

Artur Czupryński
Silesian University of Technology, Mechanical Engineering Faculty, The Welding Department,
Konarskiego 18A, 44-100 Gliwice, Poland
E-mail: artur.czuprynski@polsl.pl

The article presents the results of the study on exploitation properties of flame sprayed ceramic coatings produced by oxide ceramic material in the form of powder on the aluminum oxide Al_2O_3 matrix with 3 % titanium oxide TiO_2 addition and also on the zirconium oxide (ZrO_2) matrix with 30 % calcium oxide (CaO) on the substrate of unalloyed structural steel of S235JR grade. As a primer powder, metallic powder on the base of Ni-Al-Mo has been applied. Plates with dimensions of 5 x 200 x 300 mm and also front surfaces of ϕ 40 x 50 mm cylinders have been flame sprayed. Spraying of primer coating has been done using RotoTec 80 torch and external specific coating has been done with CastoDyn DS 8000 torch. Investigations of coating properties are based on metallography tests, phase composition research, measurement of microhardness, coating adhesion to the ground research (acc. to EN 582:1996 standard), abrasive wear resistance (acc. to ASTM G65 standard) and erosion wear resistance (acc. to ASTM G76-95 standard) and thermal stroke study. Performed tests have shown that the flame spraying with 97 % Al_2O_3 powder containing 3 % TiO_2 and also by the powder based on zirconium oxide (ZrO_2) containing 30 % calcium oxide (CaO) performed in a wide range of technological parameters allow to obtain high quality ceramic coatings with thickness up to ca. 500 μm on a steel substrate. The primer coating sprayed with the Ni-Al-Mo powder to the steel substrate and external coatings sprayed has the of mechanical bonding character. The coatings are characterized by high adhesion to the substrate and also high erosion and abrasive wear resistance and the resistance for cyclic thermal stroke.

STUDY OF CEMENTITE MORPHOLOGY DURING SPHEROIDISATION BY ASR PROCESS

Jaromír Dlouhý, Daniela Hauserová, Zbyšek Nový
COMTES FHT A.S., Průmyslová 995, 334 41, Dobřany, Czech Republic
E-mail: jaromir.dlouhy@comtesfht.cz

Carbide spheroidisation in steels is morphology change driven by cementite/matrix interphase area minimization. It is intentionally induced during soft annealing of steel semi-products. Accelerated carbide spheroidisation (ASR) process was developed to facilitate this process.
Cementite morphology evolution during ASR of bearing steel 100CrMnSi6-4 is presented in this article. Initial lamellar pearlitic structure was spheroidised by repeated austenitization [1] and divorced pearlitic transformation [2]. Cementite morphology was studied in different stages of the process. It was revealed by deep etching with carbide separation (fig. 1), 3D FIB tomography and conventional metallographic section observation. Data and information acquired by these methods were compared to evaluate possibilities of all methods.
Detailed study of cementite morphology is necessary for spheroidisation mechanism understanding. ASR is quick process in comparison with spheroidisation during long soft annealing and uses non-equilibrium states to achieve rapid morphological change. Thus, it is sensitive to parameters of used temperature regime. The ASR principle understanding will ease significantly ASR parameters tailoring for different materials and semi-product shapes and dimensions.

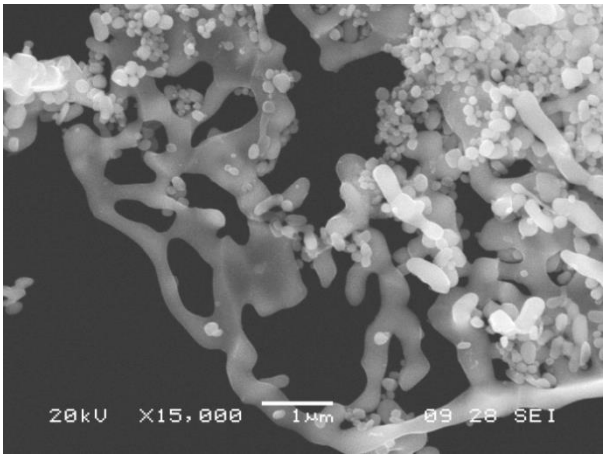

Fig. 1 Cementitic lamellae during spheroidisation.

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COMPRESSIVE PROPERTIES OF AUXETIC STRUCTURES WITH CONTROLLED STIFFNESS OF STRUT JOINTS

Tomáš Doktor, Tomáš Fíla, Petr Koudelka, Ondřej Jiroušek
Czech Technical University in Prague, Faculty of Transportation Sciences, Konviktská 20, 110 00 Prague 1, Czech Republic
E-mail: doktor@fd.cvut.cz

It has been already shown that cellular solids are able to absorb tremendous amounts of deformation energy during impacts with the possibility to introduce strain-rate dependent characteristics into their deformation response. However, certain applications, such as blast and flying debris protection systems, may require material with relatively high strength in addition to excellent deformation absorption capabilities.
Such complex mechanical characteristics can be achieved without alteration of the existing lightweight alloys (such as aluminium based materials) used for the material's production when the microstructure is constructed in such a way to exhibit negative Poisson's ratio [1]. Mechanical characteristics of such auxetic lattices are given not only by overall geometrical arrangement of struts in the unit cell and their connectivity but also by deformation properties of the strut joints. Influence of all these factors on effective mechanical properties in both elastic and plastic regime has to be thoroughly evaluated and taken into account in analytical and numerical optimization.
In this paper we present a parametric study on influence of the strut joint stiffness on the effective deformation response of various auxetic microstructures. Auxetic lattices exhibiting both in-plane and volumetric negative Poisson's ratio were prepared by direct 3D printing from UV curable acrylic material. For every type of lattice sets of specimens with different joint stiffness that was achieved by variable thickness of struts in the vicinity of joints were produced together with reference sets having uniform struts' cross-section. The specimens were subjected to uni-axial compressive loading to densification region of their deformation response. Digital image correlation was applied to measure the full-field displacements on the samples' surface. From the displacement fields, true strain – true stress curves were derived for each sample. Influence of strut joint stiffness on overall mechanical characteristics was then evaluated from comparison of stress-strain curves of individual sample sets as well as their strain fields.

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EVALUATION OF THE GRINDABILITY OF RECYCLED GLASS IN THE PRODUCTION OF BLENDED CEMENTS

Karel Dvořák[1], Dušan Dolák[1], Dalibor Všianský[2], Petr Dobrovolný[1]
[1]Brno University of Technology, Faculty of civil engineering, Veveří 331/95, 602 00 Brno, Czech Republic
[2]Masaryk University, Faculty of Science, Kotlářská 267/2, 611 37 Brno, Czech Republic
E-mail: dolak.d@fce.vutbr.cz

Secondary raw materials are increasingly replacing the natural materials in the production of building materials. The area of cement production is not an exception. The blended cements are still more used in practice. The Portland clinker is usually replaced by hydraulically active substances in this cements. The various types of recycled glass are potentially useful materials because the chemical and mineralogical composition of the glass is very close to traditional puzzolana. Unfortunately, due to considerable abilities to agglomerate, recycled glass which is used as an additive to blended cement composite is not enough reactive and acts only physically mechanically as filler [1]. Grinding of clinker and recycled glass together is an interesting possibility how to avoid the formation of agglomerates consisting of pure glass. This procedure is not very common in practice. Various ingredients of blended cements have widely different grindability and is therefore better to grind them separately, and then homogenize them [2]. The works aim is to compare the co and separate grinding to a combination of Portland clinker and recycled glass. The grindability tests were conducted on feedstock, to cement prepared by homogenizing of pre milled ingredients and to cement prepared by grinding of all the components together. All the components were initially pre milled in a laboratory ball mill at approximately the same specific surface area of 250 m^2/kg according to Blaine. Subsequently, were the individual components and the cement containing 20 % of glass milled in a planetary mill at times 1,2,3 and 5 minutes. The granulometry were determined by the Air Jet sieve MATEST and the milling process was also evaluated by SEM. It was found that for the combination of glass/clinker is grinding of both components together better then to grind them separately, which appears to be advantageous for example for combination slag/clinker. The hardness of both materials is approximately equal to, but there aren´t any agglomerates of pure glass in the mixture in the case of co-grinding and the final mixture is generally more homogenous.

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INFLUENCE OF SOLIDIFICATION SPEED ON STRUCTURE AND MAGNETIC PROPERTIES OF $Re_{10}Fe_{81}Zr_1B_6$ ALLOY IN THE AS-CAST STATE

M. Dośpiał, M. Nabiałek
Institute of Physics, Czestochowa University of Technology, 19 Armii Krajowej Av.,
42-200 Czestochowa, Poland
E-mail: mdospial@wp.pl

The paper presents results of structure and magnetic properties studies of $Nd_{10-x}Tb_xFe_{81}Zr_1B_6$ (where x = 0 or 2) alloy in as-cast state. Samples were produced using melt-spinning method. Solidification speed was controlled by indirect method through changes of linear velocity of copper drum. Basing on magnetic and structural studies it was fund that samples obtained with linear velocity of copper drum equal to 20 m/s had a good hard magnetic properties. Substitution of 2 at % of Nd by Tb leader to grain growth, both in case of α-Fe (respectively 9 nm for x=0 and 24 nm for x=2) and $Re_2Fe_{14}B$ phases (respectively 41 nm for x = 0 and 70 nm for x = 2). The grain growth to sizes higher then exchange interaction distance for sample with Tb addition resulted in bimodal shape of demagnetization curve. For higher linear speeds obtained samples were composed from amorphous matrices with small amounts of crystalline phases and had week soft magnetic properties.

DEVELOPMENT OF NEW WELDING MATERIALS FOR REPAIR WELDING OF SIZABLE FORGING DIES

Michal Duchek, Pavel Suchmann, Miroslav Majer
COMTES FHT a.s., Průmyslová 995, 334 41 Dobřany, CZECH PRECISION FORGE a.s, Tylova 1/57, 316 00 Plzeň
E-mail: michal.duchek@comtesfht.cz

Rebuilding of forging dies is a common practice in most forge shops. Its advantages are obvious: cost savings and, quite often, better mechanical properties than before rebuilding. Most companies specialize in rebuilding small and medium-sized dies where welding specifications are easy to meet. This paper presents the results of a project which explored repair welding of sizable forging dies. Great emphasis was laid on the development of a new type of filler material and appropriate welding procedures. Trial weld deposits were applied to the 1.2714 steel grade which is used by CZECH PRECISION FORGE company for making large forging dies. At the first stage, tests were carried out on test specimens, simulating a crack which was ground away and rewelded. Several locations on these specimens were then examined by metallographic techniques to map the weld quality. Hardness profiles were measured and notch impact tests were performed. At the second stage, real-life forging dies were rebuilt and repaired and then used in real-life operation.

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THE DEVELOPMENT OF NEW TYPES OF SECONDARY PROTECTION FOR CONCRETE STRUCTURES EXPOSED IN EXTREME CONDITIONS

Amos Dufka, Tomáš Melichar, Jiří Bydžovský, Jan Vaněrek
Brno University of Technology, Faculty of Civil Enginering, Institute of Technology of Building Materials and Components, Veveří 331/95, 602 00 Brno, Czech Republic
E-mail: dufka.a@fce.vutbr.cz

The reinforced concrete structures are during their exploitation exposed to influences from outside. Nowadays the reducing effect of these influences is usually provided by the secondary (barrier) protection. At present time are usually used the coatings based on organic substances. However these types of secondary protection have significantly limits in extreme conditions. Material which has a considerable potential to eliminate these disadvantages is the application of secondary protection based on alkali-activated materials respectively geopolymers. In principal, these are materials are produced by polycondensation of alumosilicates in temperatures lower than 100 °C. This polymerisation consists of a chemical reaction of alumino-silicate oxides (Al^{3+} in tetrahedral coordination) and alkaline polysilicates forming polymeric bindings Si – O – Al. Between the base raw materials for these types of secondary protection belong for example furnace and steel slag, certain types of fly ash etc. Of course it is necessary also to use appropriate types of exciters. From the viewpoint of adhesion to the substrate is useful to modify the system by a suitable type of polymer dispersion.

The paper is focused on the development and optimization of secondary protection (coating, plaster) based on alkali-activated materials intended for reinforced concrete structures exposed in chemically highly aggressive environments. The results of long term testing of the new formula of coating in different types of aggressive medium (for example solutions of acids, solution sulfates etc.) will be presented in the article. The evaluation of the effect of aggressive environments will be performed by using complex of mechanical and physical-chemical analyzes.

THE EFFECT OF THE TECHNOLOGY OF HIGH-SPEED GRINDING ON PROPERTIES OF FLY ASH

Karel Dvořák, Iveta Hájková
Brno University of Technology, Faculty of civil engineering, Veveří 331/95, 602 00 Brno, Czech Republic
E-mail: dvorak.k@fce.vutbr.cz

One of the directions in the area of milling that have been intensively examined recently is high-energy milling (HEM). At HEM there are certain phenomena which have not been observed in conventional grinding. These phenomena can be summarized by the term mechanochemical activation [1]. One type of HEM is a high speed grinding (HSG). HSG is characterized by supplying high amounts of energy using a very short and intense power pulses. One of the types of mills what is suitable for HSG is high-speed pin mill with two counter rotors, the disintegrator [2]. This type of the mill is particularly suitable for grinding and activation of fine powder materials [3]. One of the important materials what is widely used in the construction industry is fly ash. In the case of fly ash the use of HSG should lead to increasing of specific surface area and improving its pozzolanic properties. The works aim is to observe the impact of the milling technology of disintegrator DESI 11 on the properties of the fly ash. Selected disintegrator allows the use of rotors with different working tools. In this case, two types of rotors were selected, rotors identified as BR-AR and OR PV rotors. The fly ash has been ground by 1, 2, 3, 5, and 10 passages through the mill for both variants of rotors. The specific surface area according to Blaine and granulometry by the Malvern 2000 laser granulometer was measured on each sample. Pozzolanic activity was also determined by Chapelle test and the influence on the shape of the grains was evaluated by SEM. The results were compared among each other and with the original fly ash. It has been found that after the first pass through the mill there is a big increase in the specific surface area and pozzolanicity. Another passage of ash through the mill didn't increase the specific surface area due to strong aggregation, which gradually changes to the agglomeration. This phenomenon is well observable in the results of laser granulometry and pozzolanic reaction. Based on the results, it can be said that in the case of fly ash may be the HSG a promising technology to improve its properties.

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ERBIUM DOPED $Pb(Mg_{1/3}Nb_{2/3})O_3$ (PMN) FOR COATING CAPACITOR

M. Faruk Ebeoglugil[1,3], Erdal Celik[2,3], Damla Erekler[1]
[1]Dumlupinar University, Dept. of Mat. Science and Engineering, Evliya Celebi Campus, 43100 Kütahya-Turkey
[2]Dokuz Eylul University, Dept. of Metal. and Materials Engineering, Tinaztepe Campus, 35160 Buca, Izmir-Turkey
[3]Center for Production and App.of Electronic Mat. (EMUM), Dokuz Eylul University, 35160, Buca, Izmir, Turkey
E-mail: ereklerdamla@gmail.com

The present article demonstrates synthesis, characterization and electrical properties of relaxor ferroelectric Lead Erbium pentanedionate ($Er(CH_3COCHCOCH_3)_3 \cdot XH_2O$) doped Magnesium Niobate (PMN) and nano scale powders and PMN thin films on n-type Si substrates using sol-gel technique for capacitor applications. With this respect, transparent solutions were prepared from Pb, Mg and Nb based precursors, methyl alcohol and glacial acetic acid (GAA). The obtained solutions were dried at 80 °C for 60 min in air to form gel structure of PMN mixture and heat treated at 530 °C for 3 h and consequently annealed at 950 °C for 2 h in air. After the sintering, the PMN powders were milled for 12 h at room temperature to obtain PMN based nano scale powders. Finally, the powders were dispersed in alcohol and the obtained suspensions were deposited on n-type Si substrates using drop and spin coating systems and then annealed at 730 °C for 1 h in air. Thermal, structural, microstructural, optical and electrical properties of the powder and the coatings were characterized through differential thermal analysis-thermogravimetry (DTA-TG), Fourier transform infrared (FTIR), X-ray diffraction (XRD), scanning electron microscopy (SEM), atomic force microscopy (AFM) high resolution dielectric analyzer machines and Keithley 2400 for current-voltage characterization. The results showed that it was possible to produce the perovskite phase PMN based thin films at 730 °C using sol-gel derived powder precursor suspension method.

BISMUTH AND LEAD OXIDE-CODOPED BOROPHOSPHATE THIN FILMS OBTAINED BY RF MAGNETRON SPUTTERING, FOR MAGNETO-OPTICAL APPLICATIONS

B. A. Sava[1], M. Elisa[1,2], L. Boroica[1], R. Medianu[1], R. C. C. Monteiro[3], V. Kuncser[4], M. Valeanu[4], R. Iordanescu[2], I. D. Feraru[2]

[1]Laser Department, National Institute of Laser, Plasma and Radiation Physics, Magurele, Romania

[2]Department for Optospintronics, National Institute of R&D for Optoelectronics INOE 2000, Magurele, Romania

[3]Department of Materials Science, CENIMAT/I3N, Faculty of Sciences and Technology, New University of Lisbon, Caparica, Portugal

[4]Laboratory of Magnetism and Superconductivity, National Institute of Materials Physics, Magurele, Romania

Email: astatin18@yahoo.com

Thin films based on vitreous borophosphate material co-doped with Bi_2O_3 and PbO have been obtained by rf magnetron sputtering in argon plasma. The glass target was prepared by a wet non-conventional route for raw material processing. The oxide composition of the glass target corresponds to Li_2O-Al_2O_3-ZnO-B_2O_3-P_2O_5-Bi_2O_3-PbO system, where Bi_2O_3 and PbO are the dopant oxides to induce magneto-optical characteristics[1].

The substrates used for deposition were: (i) borosilicate glass, (ii) quartz and (iii) glass and quartz, each of them covered by silver on one face. The deposited films were characterized by UV-Vis-NIR (Ultraviolet-Visible-Near Infrared), Fourier Transform Infrared (FTIR) and Raman spectroscopy, X-Ray-Diffraction (XRD), Atomic Force Microscopy (AFM), Optical Microscopy, Scanning electron microscopy (SEM)/Energy dispersive spectroscopy (EDS), Kerr rotation versus magnetic field and Verdet constant. The dependency of Kerr rotation angle, Θ_{Kerr}, versus magnetic field, is presented in Fig. 1.

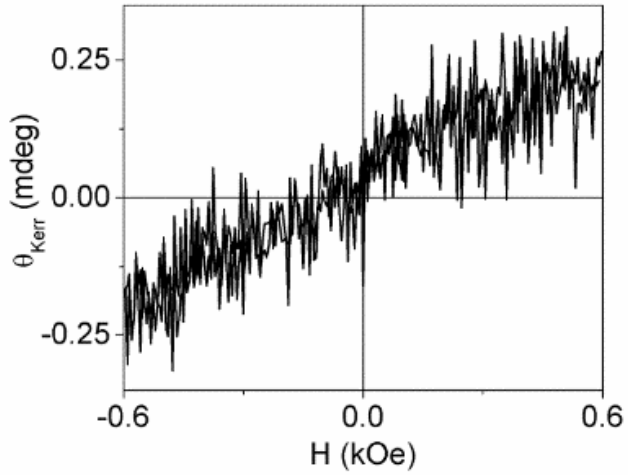

Fig.1. Magneto-optical characterization of the vitreous film deposited on a glass substrate with silver buffer layer

Surprisingly, it is to be noticed a paramagnetic behaviour of the magneto-optical vitreous film, as illustrated in Fig. 1, providing a Verdet constant of 0.060 min/Oe/cm.

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FRICTION ADDITIVES FOR PAD MATERIALS: EFFECT OF THE COMPOSITION ON FRICTION AND WEAR PROPERTIES

Maria Giulia Faga[1], Giovanna Gautier[1], Agusti Sin[2], Federico Lupone[2], Alessandro Angeleri[2]
[1]CNR IMAMOTER, Strada delle Cacce 73, Torino, Italia
[2]ITT Motion Technology, Italy
Email: m.faga@imamoter.cnr.it

Brake pads numbers more than 15 different constituents[1,2], which can be divided in four categories, i.e. inorganic fillers, friction additives (abrasives and lubricants), organic binder, metal and inorganic reinforcing fibres. The "good recipe" is the result of a very long and complex trial and error process where the real mechanism of contribution from each ingredients is still ignored as well as the mutual influence among constituents. With the purpose to disentangle the complexity of the phenomena occurring in the contact between pad and disc, the authors focused the attention on some constituents, i.e. friction additives. The present approach aims to set up a characterization method able to evaluate the effect of the materials composition on friction and wear properties, allowing to obtain a preliminary selection of the raw materials suitable for brake pad application. Titanates, graphite, molybdenum disulfide and magnetite were considered and their influence on friction values and stability was studied as a function of the temperature. A pin-on-disc apparatus was used in different modified set-ups: a) powder vs 100Cr6 steel pin b) pellet vs 100Cr6 pin c) pellet form vs grey cast iron disc. The three combinations allowed to understand the influence of the materials composition on friction coefficient stability and values. Tribometrical characterization was further done on a Friction Assessment Screening Test (FAST) home-machine for final comparison at a higher energy load scale (500 to 1800 rpm with a torque from 5 to 15 Nm).
The results showed that the materials composition affects the friction coefficient and wear resistance under different conditions of energy, load, surface contact and temperature. Furthermore, pads containing graphite and MoS_2 as friction additives showed higher stability and lower friction coefficient against both steel and grey cast iron. The counterface (steel or grey cast iron) does not affect significantly neither friction values nor stability.
Finally, potassium titanate and molybdenum disulfide enhance the pads wear resistance with respect to the other friction additives.

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A NEW WIDEBAND NEGATIVE REFRACTIVE INDEX METAMATERIAL

[1]Sikder Sunbeam Islam, [1]Mohammd Rashed Iqbal Faruque, [2]Mohammad Tariqul Islam
[1]Space Science Centre (ANGKASA)
[2]Department of Electrical, Electronic & Systems Engineering, Universiti Kebangsaan Malaysia, 43600 UKM, Bangi, Selangor, Malaysia
E-mail: sikder_islam@yahoo.co.uk

Metamaterials are artificially constructed material that may have extraordinary electromagnetic properties. This exotic properties have good prospect in many electromagnetic applications like, electromagnetic cloak design, antenna design etc. [1,2].
This paper reveals a design and analysis of a new wideband negative refractive index (NRI) metamaterial unit cell. The proposed metamaterial unit cell exhibits resonance in the C-band and displays negative permttivity and permeability there with wideband NRI property. In the basic design, a square shaped copper resonator with a metal strip, was constracted on FR-4 substrate material. The measured result is presented and it shows good conformity with the simulated result. Moreover, an analysis is done with the same design by replacing the substrate material with popular Rogers RT 6010 instead of FR-4 material and then it behaves as ENG and double negative (DNG) material at two different points at the the region of S- and C-band respectively.

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TIME-LAPSE MICRO-TOMOGRAPHY ANALYSIS OF DEFORMATION RESPONSE OF GELLAN GUM BASED SCAFFOLD

Daniel Kytýř[1,2], Nela Fenclová[1,2], Petr Zlámal[1,2], Ivana Kumpová[1], Tomáš Fíla[1,2], Ana Gantar[3], Saša Novak[3]
[1]Institute of Theoretical and Applied Mechanics, CAS, v. v. i, Prosecká 76, 190 00 Prague, Czech Republic
[2]Czech Technical University in Prague, Faculty of Transportation Sciences, Konviktská 20, 110 00 Prague 1, Czech Republic
[3]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia
E-mail: fenclnel@fd.cvut.cz

Presented work is aimed at mechanical testing of bioactive-glass-reinforced gellan-gum compound (GG-BAG) as a promising material for bone scaffold production. Bone scaffold is structure used for restoration of a trabecular bone after injury or degenerative diseases Full-field analysis of deformation behaviour of the bone scaffold is a key characteristic in the process of its biocompatibility evaluation and is also an important integration parameter for scaffold sizing. In this work experimental technique for full-field evaluation of strain in GG-BAG based scaffold is introduced. High porous (porosity approx. 85 %) GG-BAG structure with 2 % fibre contain were synthesized based on procedure in detail described in [1]. Using micro-lathe the faces of cylindrical were parallelized and compression sample with diameter 6 mm and height 7 mm with weight of 21 mg was prepared for the testing.

In order to acquire precise information about mechanical behaviour of the deformed GG-BAG structure time-lapse micro-tomography measurement (micro-tomography under loading) was carried out using custom designed micro-tomography device and a custom designed loading device specially designed for micro-tomography under loading (stiff frame with low absorption to X-rays). Load applied on specimen was gradually increased using linear stage with accuracy 2 µm and measured using high precise load cell with nominal capacity 50 N.

Micro-tomography was performed after each loading step to get information about the deformed structure of the specimen. X-ray imaging of thin layers of low attenuating material is very challenging therefore photon counting detector was employed for this purpose. Reconstructed data were processed using digital volumetric correlation (DVC) algorithm to provide a detailed description of the evolution of deformation in the complex structure [2] in GG-BAG sample. Experimental procedure together with utilization of single photon counting detector were validated as a good approach for description of deformation behaviour of GG-BAG based scaffolds.

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HIGH TEMPERATURE SURFACE NATURE AND TRIBOLOGY RESPONSES OF ELECTROLESS COMPOSITE Ni-P/SiC DEPOSIT

M. Franco[1], W. Sha[1], S. Malinov[2], G. Aldiç[3], H. Çimenoğlu[3]
[1]School of Planning, Architecture and Civil Engineering, Queen's University Belfast, Belfast BT7 1NN, UK
[2]School of Mechanical and Aerospace Engineering, Queen's University Belfast, Belfast BT7 1NN, UK
[3]Department of Metallurgical and Materials Engineering, Istanbul Technical University, 34469 Maslak, Istanbul, Turkey
E-mail: fmayanglambam01@qub.ac.uk

Electroless Ni-P heat treatment is important due to the microstructure and phase transformations with the formation of Ni_3P[1] accompanied by grain coarsening. Incorporation of second phase particles like hard particles SiC, Al_2O_3 etc. can reinforce the Ni-P matrix and form a composite for engineering applications[2].

Composite coatings of Ni-P/SiC prepared by electroless method were subjected to high temperature X-ray diffraction (XRD) in-situ at 300 °C, 400 °C and 500 °C to investigate the phase evolution. The tribology responses were investigated by pin-on-disc at elevated temperature (200 °C) in-situ monitoring near simulation of engine and compared with a standard material, cast iron. The XRD patterns indicated the evolution of many crystalline phases Ni_xP_y and Ni_xSi_y featured by sharp peaks at high temperatures and the typical amorphous state in as-deposited state. Distinct peak of metallic oxide was not detected despite heating at atmospheric condition. The wear performance of the composite coating is better when compared with the cast iron used in cylinder liners. The friction is lower in both the heat treated and as-deposited states of the composite coating as compared to the reference material.

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PULSED-LASER DEPOSITION OF HETEROSTRUCTURED OXIDE THIN FILMS FOR PIEZOELECTRIC MEMS APPLICATIONS

Urška Gabor[1,2], Matjaž Spreitzer[1], Danilo Suvorov[1]
[1]Advanced Materials Department, Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia
[2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia
E-mail: urska.gabor@ijs.si

Pulsed-laser deposition (PLD) is a physical vapor deposition technique used to produce mostly inorganic functional thin films. It enables a relatively simple preparation of layered heterostructures.[1] The PLD system used in the research is a part of the Center of excellence in Nanoscience and Nanotechnology at Jožef Stefan Institute in Ljubljana. A great advantage of this particular system lies in the possibility to observe the film growth on an atomic level in-situ by means of high-pressure reflection high-energy electron diffraction (RHEED). Two-dimensional film growth is highly desired for the production of these heterostructures. We used PLD to grow $Pb[Mg_{1/3}Nb_{2/3}]O_3$-$PbTiO_3$ (PMN-PT) thin films with compositions in the vicinity of the morphotropic phase boundary (MPB), and on different substrates with the corresponding buffer layers and electrodes. Furthermore, the films were grown in different orientations, according to their suitability for different modes of operation (d_{33} or d_{31}) in piezoelectric microelectromechanical systems (MEMS) for energy-harvesting purposes. High available energy densities, wide dynamic ranges and low power requirements are only some of the numerous advantages of thin-film piezoelectrics in MEMS. However, in order to achieve the highest possible response, high-quality films with specific orientations are required.[2] Thus, optimization of the deposition conditions was performed (temperature, oxygen pressure, laser energy density and frequency, target-to-substrate density, etc.) in an effort to obtain high-quality epitaxial single-phase layers.

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ANALYSIS OF TRIBOLOGICAL BEHAVIOR OF NANOCOMPOSITE COATING FOR DIE CASTING APPLICATION

Giovanna Gautier, Maria Giulia Faga
CNR IMAMOTER, Strada delle Cacce 73, Torino, Italia
Email: g.gautier@imamoter.cnr.it

Dies for forming metal parts are very complex and stressed components because several damages mechanisms, like plastic deformation, thermal fatigue, gross cracking, abrasive and hot wear, and soldering, may occur. These problems can lead to frequent production lines stops. One of the most effective means of retarding the soldering reaction is to modify the characteristics of the die surface through coatings, heat treatments and surface reactions. In particular, hard nanocomposite coatings based on nitrides or carbides of transition metals may protect the surface from erosion and soldering enhancing surface functionality with respect to the present available.
The present research aims at investigating wear resistance to molten aluminum of a ceramic PVD coating and a duplex PVD coating. In order to evaluate wear resistance, a Tribological study was carried on the following samples: H11 substrate, H11+AlSiCrN and H11+nitride treatment+AlSiCrN. Friction and wear resistance were studied by using a CMS high-temperature tribometer, in a pin on disk configuration, using aluminum as counter face. Friction tests were carried out at room temperature, while the wear resistance was evaluated at 450 °C. Wear scars were analyzed by Scanning Electron Microscope, before and after the aluminum removal. Wear depth tracks were also analyzed by means of a non contact profilometer (figure 1a, 1b and 1c). In order to study the elasto-plastic behaviour of the coating, scratch tests at constant load were done. Moreover, with the purpose to evaluate the coating adhesion, a scratch test at increasing load was done. Nitrided layer resulted in a hardness increment, while it induces a decrement of adhesion. A more stable friction coefficient come out using the nitriding step. As far as the wear test, adhesive phenomena were the predominant mechanisms observed. A higher wear resistance was found for the samples coated with AlSiCrN coating.

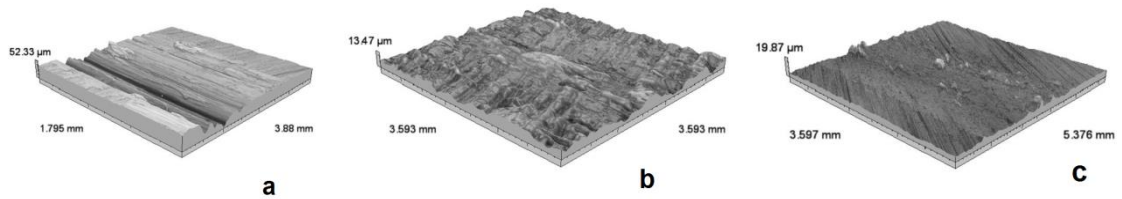

Figure 1: tridimensional analysis of a) H11 wear track, b) AlSiCrN wear track, c) duplex/AlSiCrN

VALORIZATION OF BRICK WASTES IN THE REALIZATION OF CONCRETE BLOCKS

Youcef Ghernouti[1], Bahia Rabehi[1], Tayeb bouziani[2], Rabah Chaid[1]
[1]Research Unit: Materials, Processes and Environment, University M'Hamed Bougara of Boumerdes, Boumerdes, Algeria
[2]Structures Rehabilitation and Materials Laboratory (SREML), University Amar Telidji of Laghouat, Algeria
E-mail: y_ghernouti@yahoo.fr

This work focuses on the valuation of recycled brick waste as aggregates in the realization of concrete blocks. The experimental study has been focused on six types of concrete with a W/C ratio of 0.56, a relatively constant compactness and a slump of zero: a control concrete with natural sand and others concretes with 10 %, 20 %, 30 %, 40 % and 50 % of recycled brick waste with substituting the natural sand, then the physical and mechanical properties of concretes are studied, analyzed and compared.
The obtained results showed that, it is possible to manufacture concrete blocks based on recycled brick waste, the compressive strengths of these concretes are comparable to that of natural sand concrete, with appreciable reduction in weight, the blocks made with 30 % of recycled brick waste have shown a compressive strength 42 % higher than those of the control concrete and a reduction in weight of 11 %.

EBSD ANALYSIS OF Ni-SUPERALLOYS

Matjaž Godec, Jaka Burja, Bojan Podgornik, Franc Tehovnik
Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
e-mail: matjaz.godec@imt.si

Ni-superalloys are well known for their high strength and outstanding corrosion resistance as well as fatigue and creep resistance and are therefore, used in gas turbines and aero engines applications. Microstructure changes during hot rolling of Inconel nickel-chromium superalloy 625 were investigated using FEG SEM. The detailed insight into the recrystallization behaviour during hot rolling were shown using EBSD analysis. During hot rolling the recrystallization starts on grain boundaries, followed by twin grain boundaries and at even higher stress the recrystallization occurs on (TiNb)CN phases insight crystal grains. Further, EDS results explained the complex nature of (TiNb)CN phases.

THE INFLUENCE OF STRUCTURE DEFECTS ON THE MAGNETIC PROPERTIES OF MASSIVE AMORPHOUS $Fe_{60}Co_{10}Mo_2W_XY_8B_{20-X}$ (X = 1, 2) ALLOYS MADE BY INJECTION CASTING METHOD

S. Garus, K. Błoch, M. Nabiałek, J. Gondro
[1]Institute of Physics, Faculty of Production Engineering and Materials Technology, Czestochowa University of Technology, al. Armii Krajowej 19, 42-200 Czestochowa, Poland
E-mail: j.gondro@wp.pl

The paper presents the results of research high-field magnetic properties in relation to the theory of H. Kronmüller [1, 2]. Studies were performed for bulk amorphous alloys of $Fe_{60}Co_{10}Mo_2W_xY_8B_{20-x}$ (x = 1, 2) composition in the form of plates having a thickness of 0.5 mm, prepared by injection of the melted alloy into a water-cooled copper mold. The influence of defects present in the amorphous structure on the magnetization process were investigated at high magnetic fields known as approach to ferromagnetic saturation area. The studies showed that in the investigated samples in the process of magnetization in high magnetic fields, rotation of the magnetization vector was mainly due to the presence of linear defects in the structure (pseudo dislocational dipoles). The density of pseudo dislocational dipoles in sample with 1 % W addition was nearly double than in the seckond alloy.

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STRUCTURE AND PROPERTIES OF HIGH TEMPERATURE HEAT AFFECTED ZONE OF THERMO-MECHANICALLY TREATED S700MC STEEL WITH HIGH YIELD STRENGTH

Jacek Górka
Silesian University of Technology, Mechanical Engineering Faculty, The Chair of Welding, Konarskiego 18a, 44-100 Gliwice, Poland
Email: jacek.gorka@polsl.pl

Steels produced using thermo-mechanical processing are characterised with lower carbon equivalent in comparison with the steels after normalised annealing with the same level of yield stress [1]. Also, in terms of yield stress above 550 MPa thermomechanically rolled steels with accelerated cooling and tempering have a lower carbon equivalent constant than toughened steels [2, 3]. In connection with much lower carbon equivalent, steels produced by rolling with thermo-mechanical treatment should have a much better weldability compared to normalized steels or quenched and tempered with a similar yield stress. The aim of the study was to determine the properties and structure of the high temperature heat affected zone of the S700MC steel heated to a temperature of 1250 °C and cooled at different speeds. The simulation process of thermal cycles was performed using a welding thermal cycles simulator, on samples with the cross-section 10 x 10 x 55 mm, intended in a further step for metallographic microscopic tests, impact test, the measurement of hardness, tensile strength and elongation. The samples were exposed to welding thermal cycles with cooling times $t_{8/5}$ = 3, 5, 10, 15, 30, 60 and 120 seconds and a maximum temperature of temperature cycle T_{max} = 1250 °C. Welding thermal cycle differs significantly from the thermomechanical processing cycle, especially with a very high rate of heating and cooling in the SWC, short time of withstanding at the maximum temperature and often overlapping of two or more cycles during the multi-layer welding. One of the elements in evaluation of steel weldability is the analysis of austenite phase transformation during cooling. In the case of steel hardness test simulated HAZ regions with increasing cooling time from 3 seconds to 120 seconds is slightly reduced by approximately 40 HV, and the impact resistance regardless of the length of the cooling time $t_{8/5}$, is very low and falls to the level of a few J/cm^2. The obtained results of tensile strength, hardness and toughness indicates a secondary role in the control of austenite transformation strength and plastic properties of welded joints and the analysis of phase transitions γ-α can't be the basis for the assessment of the weldability of this steel group.

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CHARACTERIZATION OF TIME-DEPENDENT PROPERTIES OF THE COMPOSITE MATERIAL

Žiga Gosar
ELVEZ d.o.o., Ulica Antona Tomšiča 35, 1294 Višnja Gora, Slovenija
Mednarodna podiplomska šola Jožefa Stefana, Jamova cesta 39, 1000 Ljubljana
E-mail: ziga.gosar@gmail.com

The purpose of the work is to determine the mechanical and thermal properties of composite polymeric materials. The group of samples consisting of a sample of polypropylene, three samples of polypropylene with quartz sand of different granulations and a sample of polypropylene with calcium carbonate. Shares of impurities in base material were identical. The dependence and durability of the material was determined by measuring shear strength, structural analysis of the material (degree of crystallinity) and measurements of differential scanning calorimetry (DSC analysis). The result of a DSC experiment is a curve of heat flux versus temperature or versus time. There are two different conventions: exothermic reactions in the sample shown with a positive or negative peak, depending on the kind of technology used in the experiment. The results show that the added inorganic particles to the primary polymer material change the initial kinetics of the formation process of the structure. This consequently leads to changes in the behavior of the final product. It should be particularly noted that all additives affect the reduction of the compliancy of the shear creep as a function of temperature. Additives similarly affect the dependence of the compliancy of the shear creep as a function of time.

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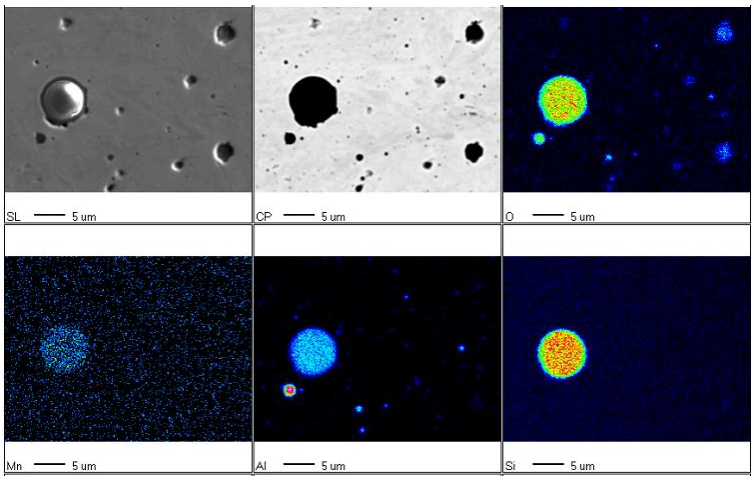
EFFECT OF GAS ATMOSPHERE ON NON-METALLIC INCLUSIONS IN LASER-WELDED TRIP STEEL WITH Al AND Si ADDITIONS

Adam Grajcar[1], Maciej Różański[2], Małgorzata Kamińska[3], Barbara Grzegorczyk[1]
[1]Silesian University of Technology, Institute of Engineering Materials and Biomaterials, 44-100 Gliwice, 18a Konarskiego Street, Poland
[2]Institute of Welding, 16-18 Bl. Czesława Street, 44-100 Gliwice, Poland
[3]Institute of Non Ferrous Metals, 5 Sowinskiego Street, 44-100 Gliwice, Poland
E-mail: adam.grajcar@polsl.pl

Advanced high-strength steels (AHSS) are a new group of modern ferrous alloys dedicated for the automotive industry. They combine successfully superior strength, ductility and crashworthiness due to multiphase microstructures and resulting high work strengthening rates. The special focus concentrates on relationships between chemical composition, heat treatment and mechanical properties of transformation-induced plasticity (TRIP) steels showing a strain-induced transformation of retained austenite into martensite [1, 2]. The weldability of the TRIP steels has not attracted the required attention so far.

The present study aims to characterize the weldability of the thermomechanically processed TRIP steel from a point of view of its tendency to form non-metallic inclusions. Laser welding tests of 2 mm thick sheets were carried out using keyhole welding and a solid-state laser. The tests were performed without a protective atmosphere and using argon atmosphere. The distribution, type and chemical composition of non-metallic inclusions formed in the base metal and fusion zone were analysed in detail. It was found that numerous oxide inclusions of various size and chemical composition (Al, Si, Mn) occur in the fusion zone (Fig. 1). The effect of a gas atmosphere on non-metallic inclusions is addressed.



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CVD SYNTHESIS OF CARBON NANOTUBES ON THE Co-Ti-N AND Ni-Ti-N ALLOY THIN FILMS

Dmitry Gromov, Sergey Dubkov, Alexey Trifonov, Alexandr Pavlov, Sergey Skorik, Alexey Shulyat'ev, Yuri Shaman
National Research University of Electronic Technology, Zelenograd, Moscow, Russia
E-mail: gromadima@gmail.com

Carbon nanotubes attract great attention of scientists and currently is one of the most promising materials, which was discovered in the last 20 years [1]. This material have special mechanical and electrical properties coupled with their chemical inertness. The potential use of carbon nanotubes is diverse and includes the use of this material as a basis for the development of electron emitters, field effect transistors, nanoelectrodes for ultracapacitors, lithium-ion batteries, filter media, superhydrophobic coatings, biosensors, and others [2].

Catalytic chemical vapor deposition is attractive in terms of forming the nanotube arrays on the surface of the substrate, which is an important feature of the technology in IC electronics, sensors, MEMS and so forth. Most known catalysts for this process are Fe, Co, Ni, Pd metals and their alloys. Also there are reports dedicated to the use of these alloys catalysts, with other metals, in which, however, the content of the catalyst is always predominant.

In this work we studied the possibility of using as a catalyst Co-Ti and Ni-Ti alloys for the growth of CNTs thin film with low amount of catalyst (up to 20 at %) and with the addition of a third component – a nitrogen. The attractiveness of using such alloy as a catalyst for CNT is the ability of dosing the catalytic metal, which gives an opportunity to control the process of CNT growth.

It is shown that the multi-walled carbon nanotubes can be grown on the catalyst surface of the alloys Ni-Ti-N and Co-Ti-N (content of catalyst ~20 at %) with traditional method of chemical vapor deposition from acetylene. Adding nitrogen to the composition of these alloys promotes the formation of a TiN compound and extrusion of Ni or Co to the surface on which it has a catalytic effect in CNT growth. It was found that the tubes begin to grow at a temperature of 400 °C. The quality of CNT improves with the increasing of temperature, as shown in researches using Raman spectroscopy.)

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ANALYSIS OF STRUCTURAL DEFECTS INFLUENCE ON MAGNETIZATION PROCESS IN AND ABOVE OF RAYLEIGH REGION

Konrad Gruszka
Czestochowa University of Technology, Faculty of Production Engineering and Materials Technology, Institute of Physics, 19 Armii Krajowej Av., 42-200 Czestochowa, Poland,
E-mail: kgruszka@wip.pcz.pl

The paper presents studies of structural defects influence on magnetization process in low magnetic fields ($H < 0.4\ H_c$) and above Rayleigh range. The investigated $Fe_{62}Co_{10}Y_8B_{20}$ alloy samples were obtained by injection casting method resulting in amorphous structure state, what was confirmed by XRD. The studies were conducted by analysis of disacomodation of magnetic susceptibility process and using Kronmüller's theory in the approach to ferromagnetic saturation area. On the basis of the obtained results, it was found that the main factor responsible for the processes of magnetization at low magnetic fields are point defects, whereas in the case of high magnetic field magnetization process depends mainly on the second type pseudo-dislocation dipoles.

THE REFINEMENT OF SOLIDUS AND LIQUIDUS TEMPERATURES FOR BEARING STEEL BY HIGH-TEMPERATURE THERMAL ANALYSIS METHODS

Karel Gryc[1], Michaela Strouhalová[1], Bedřich Smetana[2], Monika Kawuloková[2], Simona Zlá[2], Aleš Kalup[2], Ladislav Socha[1], Markéta Tkadlečková[1], Karel Michalek[1], Pavel Machovčák[3], Aleš Opler[3]
[1]VŠB-Technical University of Ostrava, Faculty of Metallurgy and Materials Engineering, Department of Metallurgy and Foundry, and Regional Materials Science and Technology Centre, 17. listopadu 15, 708 33 Ostrava-Poruba, Czech Republic
[2]VŠB – Technical University of Ostrava, Faculty of Metallurgy and Materials Engineering, Department of Physical Chemistry and Theory of Technological Processes and Regional Materials Science and Technology Centre, 17. listopadu 15, 708 33 Ostrava-Poruba, Czech Republic
[3]VÍTKOVICE HEAVY MACHINERY, a.s., Ruská 2887/101, Vítkovice, 703 00 Ostrava, Czech Republic
E-mail: karel.gryc@vsb.cz

The first part of presented paper is devoted to comparison of solidus (T_S) and liquidus (T_L) temperatures determined by two methods of thermal analysis for one real steel grade 100CrMo7. Two modern devices for high-temperature analysis were used. A direct thermal analysis (DirTA) was applied on large steel samples (approx. 22 g) under experimental conditions of Netzsch STA 449 F3 Jupiter. The second device, Setaram SETSYS 18_{TM}, was used for differential thermal analysis method (DTA) and small samples (approx. 120–210 mg). Based on evaluation of experimentally obtained curves during heating (DTA) and cooling (DirTA, only T_L), T_S and T_L were acquired. From both used methods, the difference was only 1 °C for T_L. Moreover, the variability of results read from individual measurements in the frame of used methods is very low. This fact indicates the robustness of both used thermos-analytical methods. A comparison of measured T_S and T_L with their values obtained from industrial partner (VHM) and with T_S and T_L acquired from specialized IDS and ThermoCalc software was made, see the table below.

Table: A comparison of T_L and T_S acquired based on experiments or calculations

Source	T_S/ °C	T_L/ °C	ΔT_S/ °C	ΔT_L/ °C
Thermal Analysis	1280	1441	X	X
VHM	1125	1469	-155	28
IDS	1319	1451	39	10
ThermoCalc	1318	1453	38	12

RELATION BETWEEN FIXATION TIGHTENING TORQUE AND TENSILE STRENGTH – DEFORMATION ANALYSIS OF COMPOSITE MULTIHOLE PLATES FOR OSTEOSYNTHESIS

Karol Gryn, Barbara Szaraniec, Anna Morawska-Chochol, Kamil Dudzinski, Jan Chlopek
Department of Biomaterials, Faculty of Materials Science and Ceramics, AGH University of Science and Technology, 30 Mickiewicza Ave., 30-059 Krakow, Poland
E-mail: kgryn@agh.edu.pl

In most cases mechanical description of implants is based only on results obtained from testing materials the implants are made of. Nevertheless, it is known from the literature that not only materials' data needs to be considered but also the geometry of an implant. In this research authors went one step further and extended their interest to the implant fixation procedure. They wanted to find the answer to the questions: "Is there any correlation between the way the implant is fixed to the bone and its mechanical properties?" and "How do these parameters influence the stiffness and rigidity of osteosynthesis? "

This work presents results obtained in research on mechanical testing and analysis of deformation and fracture processes of multihole miniplates for osteosynthesis. They were examined in tests designed to simulate their working conditions. Four-hole "I"-shaped miniplates were made of biodegradable polymers and composites with bioceramic additives (PLA, PL38, PLA/TCP/HAp, PL38/TCP/HAp). Miniplates were firstly tightened with a proper (safe and harmless) tightening torque to the holders and afterwards they were mechanically tested in uniaxial tension test. Different values of tightening torque were applied. As a reference, maximum value of torque was taken, which resulted in damaging miniplates. To verify and learn about the deformation process, FEM (finite elements method) analysis was conducted. Having compared the mechanical testing and FEM results, it occurred that fixation process is crucial and it influences the behavior of polymer and polymer-based composites during deformation. FEM revealed what actually happens "inside" the material – maps of stress and strain showed potentially dangerous cross section. Moreover, it was revealed that applying too much force (too high tightening torque) causes initial deformation of an implant, thus there is the additional stress accumulation around the fixating holes. As a result, the cross section cannot bear as high values of tension as it theoretically should, thus the tensile strength of an implant is lower. From the optimization of fixation procedure it was stated that there is an optimal value of tightening torque which secures the stiffness and rigidity of osteosynthesis and does not cause tensional side effects.

STRUCTURE AND PROPERTIES OF HIGH CHROMIUM HARDFACING COATINGS

Marek Gucwa[1], Robert Bęczkowski[1], Marcin Dośpiał[2]
[1]Institute of Mechanical Technology, Czestochowa University of Technology, 21 Armii Krajowej Av., 42-201 Czestochowa, Poland
[2]Institute of Physics, Czestochowa University of Technology, 19 Armii Krajowej Av., 42-200 Czestochowa, Poland
E-mail: mgucwa@spaw.pcz.pl

The welding technologies are widely used for constitution of protection layer against wear and corrosion. Hardfacing, which is destined for obtaining coating with high hardness, takes special place in these technologies. One of the most effective way of hardfacing is using self shielded flux cored arc welding (FCAW-S). Chemical composition obtained in flux cored wire is much more rich in comparison to this obtained in solid wire. The filling in flux cored wires can be enriched for example with the mixture of hard particles or phases with specified ratio, which is not possible for solid wires. This is the reason why flux cored wires give various possibilities of application of this kind of filler material for improving surface in mining industry, processing of minerals, energetic etc.
In the present paper the high chromium and niobium flux cored wire was used for hardfacing process with similar heat input. The work presents studies of microstructures of obtained coatings and hardness and geometric properties of them. The structural studies were made with using optical microscopy and X-ray diffraction that allowed for identification of carbides and other phases obtained in the structures of deposited materials. Investigated samples exhibit differences in coating structures made with the same heat input 4,07 kJ/mm. There are differences in size, shape and distribution of primary and eutectic carbides in structure. This cause significant changes in hardness of investigated coatings.

MODELLING OF MICROSTRUCTURE OF MULTICOMPONENT ALUMINIUM ALLOYS BY THE NOVEL POINT AUTOMATA METHOD

Agnieszka Zuzanna Guštin[1], Božidar Šarler[1,2]
[1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
[2]University of Nova Gorica, Vipavska 13, 5000 Nova Gorica, Slovenia

In the present work the microscopic grain structure model is presented which is a part of the multiphysics and multiscale model [Košnik, Lorbiecka, Mavrič and, Šarler (2014)] developed to simulate the direct chill (DC) casting processes. The micro numerical model is aimed to propose an easy and effcient way to predict both grain growth and remelting processes of multicomponent aluminium alloys with linearized phase diagram. A novel Point Automata (PA) approach [Lorbiecka and Šarler (2010)] is used to solve the governing micro-structure equations. The PA approach represents a novel approach of the cellular automata (CA) where the ordered arrangement of the cells have been replaced by the random PA points arrangement on the calculated domain. The PA model is composed of Log-Normal nucleation model and Kurtz- Giovanola-Trivedi (KGT) growth part. The model is physically described by the heat conduction, solute redistribution and rules for the phase change kinetics. The post processing calculations of temperature are taken from the multiscale macroscopic model where the basic equations are solved by the meshless diffuse approximate method. The microscopic solute transport equation is solved by the Finite Difference Method (FDM) and the phase change kinetics by the PA approach. PA rules for growth and remelting proces under different thermal and solutal conditions are presented, together with several examples.

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SPARK PLASMA SINTERING AS AN INNOVATION METHOD OF SINTERING $(Cu_{47}Ti_{34}Zr_{11}Ni_8)_{95}Al_5$ AMORPHOUS POWDER

Ryszard Nowosielski[1], Aleksandra Guwer[1], Przemysław Zackiewicz[2]
[1]Silesian University of Technology, Faculty of Mechanical Engineering, Institute of Engineering, Materials and Biomaterials, Konarskiego Street 18A, 44-100 Gliwice, Poland
[2]Institute of Non-Ferrous Metals, ul. Sowinskiego 5, 44-100 Gliwice, Poland
E-mail: aleksandra.guwer@polsl.pl

Modern method of obtaining amorphous materials in powder form is a mechanical alloying (MA)[1]. Unfortunately, it is difficult to find an area, in which the obtained powders could be used. Hence it becomes necessary to consolidate produced powders.

Conventional methods for sintering powders cause a change of structure from amorphous to crystalline. Amorphous materials must be sintered in a temperature range between Tg (glass transition temperature) and Tx (crystallization temperature)[2,3]. An additional process which can assist the consolidation is pressing. Promising new method is the Spark Plasma Sintering (SPS). SPS is characterized by a rapid rise of temperature and a very short time heating, for which responsible is pulses flow at the grain boundaries. In addition, graphite punches provide compression of the material[3].

This paper presents of producing $(Cu_{47}Ti_{34}Zr_{11}Ni_8)_{95}Al_5$ amorphous powders by using MA method. The amorphous powder was obtained after 8 hours of milling. The study confirmed the presence of only starting elements in the composition of the powder. Microhardness of particles were tested on a scale Vicker under a load of 0.97 N. Average measured microhardness of powder was 582 HV.

Then, the obtained powder was treated with cold pressing. Three different of compression pressure: 200 MPa, 400 MPa and 600 MPa were used. Obtained mouldings were sintered by SPS. Both after the pressing and sintering each of sample were examined by XRD. Regardless of used pressing and sintering parameters the compacts retained an amorphous structure. Microhardness was increased. The chemical composition remained unchanged, in the sample occurred only basic elements. Pictures from SEM clearly show that the use of parameters were not sufficient to fully consolidate $(Cu_{47}Ti_{34}Zr_{11}Ni_8)_{95}Al_5$ amorphous powder.

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IMPLEMENTATION OF AN UPWIND SCHEME IN A DIFFUSE APPROXIMATE METHOD

Vanja Hatić[1], Božidar Šarler[1,2]
[1]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia
[2]University of Nova Gorica, Vipavska 13, SI-5000 Nova Gorica, Slovenia
E-mail: vanja.hatic@imt.si

Upwind scheme is a numerical approach that needs to be used when solving convection dominated convective-diffusive transport phenomena [1] in order to suppress the instabilities. Our work is concentrated on solving the transport equations of a two-dimensional flow with a diffuse approximate method type of meshless numerical method [2, 4, 5, 6, 8]. In diffuse approximate method the weighted least squares approximation is used to approximate the fields, on which mathematical operators can be applied. Functions are obtained for each subdomain using a Gaussian weighting function. Since second order partial differential equations are calculated, at least quadratic polynomial basis is needed to construct the approximation. Number of nodes in a computational subdomain depends on the node arrangement type and can vary. We used 11 nodes for solving equations on a regular Cartesian node arrangement. Equations are solved using an explicit time stepping scheme. Implementation of the upwind principle to the diffuse approximate method is yet to be performed, therefore a new approach was proposed and tested.

The basic idea is to adopt the upwind principles when calculating weights of weighted least squares [3, 7, 9]. The Gaussian weighting function must be shifted in each local domain in the direction opposite to the fluid flow velocity. The size of the shift is a function of local diffusivity, magnitude of velocity, and local node distribution.

In the first part of presentation, the diffuse approximate method type of meshless methods will be presented, along with a detailed description of the weighting function. In the second part, numerical examples of one-dimensional and two-dimensional convection-diffusion problems will be described. Test problems are used to show the comparison of the standard, central weighting scheme to the newly proposed upwind scheme.

The developments have been performed to allow for higher electromagnetic fields and enable macrosegregation calculation in our meshless code for electromagnetic direct chill casting.

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A SELECTIVE GROWTH APPROACH TO PREPARE SUPERHYDROPHOBIC SURFACES ON COPPER SUBSTRATES

Zhiwei He, Jianying He, Zhiliang Zhang
NTNU Nanomechanical Lab, Norwegian University of Science and Technology (NTNU), Trondheim 7491, Norway
E-mail: zhiliang.zhang@ntnu.no

Superhydrophobic surfaces with a water contact angle higher than 150 ° and a low contact angle hysteresis have attracted a great of interest in a wide variety of applications, such as anti-icing materials, self-cleaning surfaces, oil/water separation and so on. In this study, we demonstrate a selective growth approach to fabricate superhydrophobic CuO surface on the copper substrate via a simple solution-immersion process. First, ordered copper microholes were achieved on copper substrate by both photolithography and argon ion beam etching with photoresist as a mask. Then, the above copper substrate was immersed in an alkaline solution for an appropriate time (e.g., 30–45 min), and CuO nanoneedles were successfully obtained. Interestingly, these CuO nanoneedles only grew inside copper microholes in the solution due to the delay of both residual photoresist and a carbon layer produced by argon ion beam etching outside copper microholes on the substrate. What's more, this hierarchical micro/nanostructured CuO surface possesses a water contact angle of 152 ° and a low water adhesion force of 15 μN, which indicates its superhydrophbocity and promising applications in various fields.

INVESTIGATION OF MECHANICAL PROPERTIES OF CORK/RUBBER COMPOSITE

Radek Kottner[1], Jiří Kocáb[2], Jan Heczko[2], Jan Krystek[1]
[1]European Centre of Excellence, NTIS – New Technologies for Information Society, Faculty of Applied Sciences, University of West Bohemia, Univerzitní 8, 306 14 Plzeň, Czech Republic
[2]Department of Mechanics, Faculty of Applied Sciences, University of West Bohemia, Univerzitní 8, 306 14 Plzeň, Czech Republic
E-mail: jheczko@ntis.zcu.cz

Cork/rubber composites are often used to damp vibration before it is radiated as noise and before it is transmitted to other system components. The improvement of damping properties of carbon fibre reinforced plastics using ACM87 (AMORIM cork/rubber composite) layers, when subjected to small strain deformations, was proved e.g.[2-4]. This work was focused on the investigation of mechanical properties of the ACM87 composite when subjected to large strain. Experimental samples were tested under tension, compression, and shear loading. The aim of the work was to get material data that are necessary for the identification of parameters of a large strain viscoelastic constitutive model, such as e.g. the Bergstrom-Boyce model[1]. Typical behavior of the material in uniaxial compression test (the strain rate was 0,01 min^{-1}) is shown in Fig. 1.

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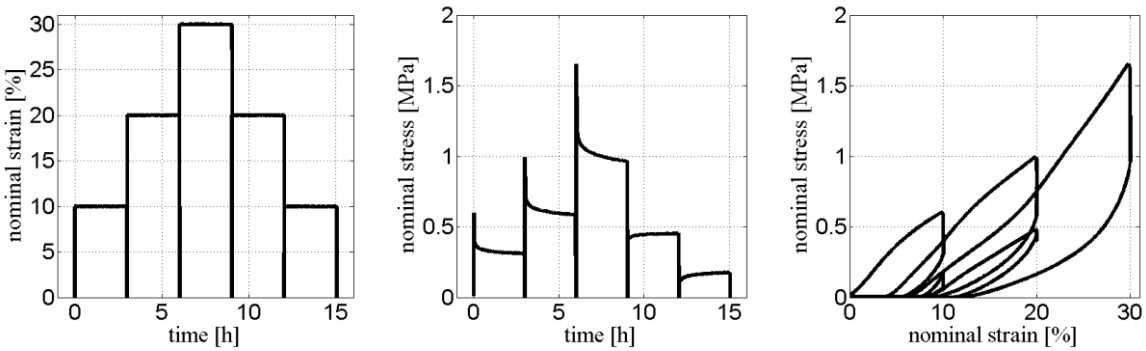

(b) (c)

Fig. 1. Compression test: (a) prescribed nominal strain in time, (b, c) obtained nominal stress.

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CHARACTERIZATION OF HETEROGENEOUS ARC WELDS THROUGH MINIATURE TENSILE TESTING AND VICKERS HARDNESS MAPPING

Stijn Hertelé[1], Nenad Gubeljak[2], Primož Štefane[2], Patricia Verleysen[3], Wim De Waele[1]
[1]Ghent University, Soete Laboratory, Technologiepark Zwijnaarde 903, 9052 Zwijnaarde, Belgium
[2]University of Maribor, Laboratory for Machine Parts and Structures, Smetanova 17, 2000 Maribor, Slovenia
[3]Ghent University, Department of Materials Science and Engineering, Technologiepark Zwijnaarde 903, 9052 Zwijnaarde, Belgium
E-mail: Stijn.Hertele@UGent.be

Arc welds are heterogeneous as the thermal cycle during welding gives rise to local variations in microstructure. This complexity is not accounted for in standardized weld defect assessments, where stress-strain properties are 'averaged' by round bar tension testing. This simplification is known to give rise to inaccuracies. Therefore, specific procedures have been proposed to account for weld heterogeneity (e.g. the recently developed technique of 'weld homogenization'[1]). Crucial for the applicability of such procedures is the characterization of local stress-strain properties. To do so, the authors have explored two techniques on a selection of strongly heterogeneous welds: miniature tensile testing (cross section 2 x 0.5 mm²) and Vickers hardness mapping of a weld macrograph. The former technique provides full range stress-strain curves but is challenging in execution. Instead, the latter technique provides a distribution of hardness, which merely gives an indication of ultimate tensile strength, but is more straightforward to perform.

This paper provides details of the experimental program covering preparation of specimens, execution of tests and analysis of results. As regards miniature tensile testing, strain measurements have been performed by means of digital image correlation, requiring the application of small speckles having an optimal size of roughly 20 µm through a devoted speckling procedure. 3D profilometry indicated a strong sensitivity of the linear elastic response to clamping conditions. The potential presence of weld porosities was found to invalidate a fair number of test results. For non-defected specimens, reliable post-yield stress-strain responses could be obtained. As regards hardness mapping, Vickers hardness values are compared with strength values obtained from miniature tensile testing at the corresponding position. It is concluded that both techniques show specific merits and limitations, and both deserve consideration in a detailed characterization of weld strength heterogeneity.

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HEAT TREATMENT OF RAILS

Milan Hnizdil, Petr Kotrbacek, Marek Stransky, Jaroslav Horsky
Brno University of Technology, Faculty of Mechanical Engineering, Heat transfer and fluid flow laboratory,
Technicka 2896/2, 616 69, Brno, Czech Republic, EU
E-mail: hnizdil@fme.vutbr.cz

Heat treatment is increasingly used in heavy industry. The main advantage of this method is achievement of required materials and mechanical properties. It enables a manufacturing process that can improve product performance by increasing steel strength, hardness and other desirable characteristics.
Microstructure, grain size, chemical composition has effect on the overall mechanical behavior. Heat treatment is efficient way to manipulate with the properties of steel product by controlling the cooling rate. It can be expressed by heat transfer coefficient (HTC). Controllability of cooling process is very important. Mist and water nozzles could provide a good controllability of HTC.
An experimental stands were designed and build by Heat transfer and fluid flow laboratory. The stand is compound of movable trolley with a test sample which moves under the spray at a given velocity. Sensors indicate the temperature history of the tested material. This experimental stand enables simulation of a variety of cooling regimes and evaluates the final structure of tested samples. The same experimental stand is also a tool for use in the design of cooling sections in order to find the required heat treatment procedure and final structure.
This paper describes a design procedure of cooling sections for obtaining the demanded structure and mechanical properties of rails.

ADVANCED ELECTROCHEMICAL CHARACTERIZATION OF NANOPARTICLES AS ELECTROCATALYSTS FOR FUEL CELL

Nejc Hodnik[1,2], Primož Jovanovič[2], Andraž Pavlišič[2], Milena Zorko[2], Barbara Jozinović[2], Marjan Bele[2], Miran Gaberšček[2], Karl Mayrhofer[1]
[1]Max-Planck-Institut für Eisenforschung GmbH, Max-Planck Str. 1, 40237 Düsseldorf Germany
[2]National Institute of Chemistry, Hajdrihova 19, 1000 Ljubljana, Slovenia
E-mail: hodnik@mpie.det, nejc.hodnik@ki.si

Due to increasing public demand of sustainable energy sources as alternatives to conventional fossil fuels, technologies like proton exchange membrane (PEM) fuel cells are receiving substantial attention. The high amount of noble material (costs), the overpotential required for electrochemical reactions (activity) together with the degradation (stability) are the main issues that are slowing down the much anticipated commercialization. In order to advance the technology an improved understanding of electrocatalysis as the central phenomenon is required which, however, is often impeded by a lack of appropriate characterization.

In this presentation novel, advanced electrochemical characterization methods will be presented, and their advantages for the determination of electrocatalyst performance will be shown on the example of Pt alloys:

1. Thin film rotating disc electrode:
   - Basic principle of the activity [1] and stability of electrocatalysts [2].
2. Identical location electron microscopy (SEM [2, 3] and TEM [4]):
   - Visualization of nano-scale degradation mechanisms.
3. Electrochemical flow cell coupled to Inductively Coupled Plasma Mass Spectrometry:
   - Highly sensitive potential-resolved electrochemical Pt dissolution [5].
4. In-situ electrochemical TEM:
   - Basic principle and some initial results.

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METAMATERIAL EMBEDDED WIDE-BAND ANTENNA FOR MICROWAVE C-BAND RADAR APPLICATION

M. I. Hossain, M. R. I. Faruque, M. T. Islam
Universiti Kebangsaan Malaysia, 43600 UKM, bangi, Selangor, Malaysia
E-mail: ipk_eee@yahoo.com

Nowadays, metamaterials[1] are being used in antenna engineering to enhance antenna's performances and reduce antenna's sizes. In this paper, a metamaterial embedded compact microstrip-fed patch antenna is introduced for microwave C-band applications. The proposed antenna composed of a rectangular shape metamaterial embedded patch, microstrip-fed line and a partial ground plane.

The finite integration technique (FIT) based on Computer Simulation Technology (CST) Microwave Studio is utilized in this study. The effective parameters (effective permittivity, effective permeability, and effective refractive index) of proposed metamaterial unit-cell are analyzed. The antenna performances parameters (as indicated in Figure 1) comprising return loss, radiation efficiency, gain, and radiation pattern are studied to validate antenna performances.

The results show that the proposed metamaterial embedded antenna exhibits wide impedance bandwidth over C band (from 3.7 GHz to 6.5 GHz). The results also indicate good radiation efficiency and antenna gain with nearly Omni-directional radiation pattern at the frequencies of interest.

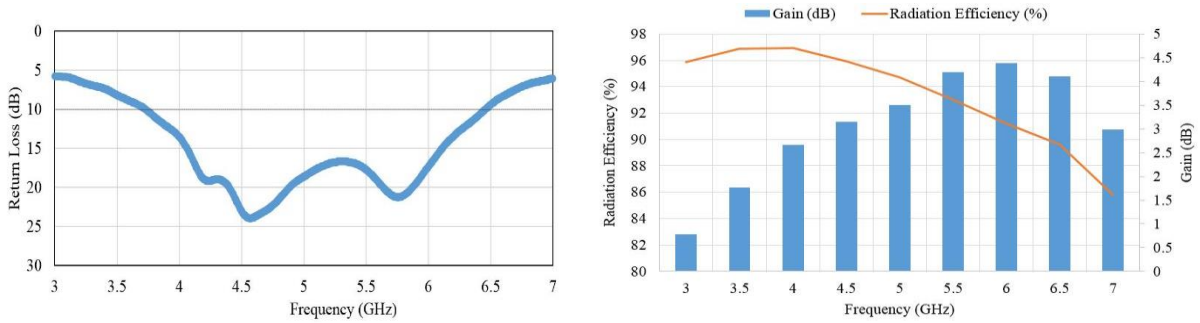

Fig. 1. Antenna performances: (a) return loss, (b) radiation efficiency and gain.

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HIGH TEMPERATURE TENSILE DEFORMATION OF Fe-28Al-0.5Zr-0.5Mo-0.5Nb-0.5B ALLOY

Yuanding Huang, Norbert Hort
Institute of Materials research, Helmholtz-Zentrum Geesthacht, Max-Planck-Str. 1, 21502 Geesthacht, Germany
E-mail: yuanding.huang@hzg.de

The Fe_3Al-based alloys have a potential application in some tribological circumstances in replace of some stainless steels, especially where oxidation or sulfidation is also a major concern. In the present work, high temperature tensile deformations of a coarse-grained iron aluminide with the composition of Fe-28Al-0.5Zr-0.5Mo-0.5Nb-0.5B (atomic percent) have been investigated. A series of tensile tests were conducted at temperatures ranging from 750 to 900 °C with a strain rate ranging from 3.3×10^{-4} to 1.7×10^{-2} s^{-1}. When deforming at such high temperatures, the present Fe_3Al alloy exhibit an excellent plasticity with a tensile strain more than 0.5. Using the standard kinetic rate equation to relate the flow stress with temperature and strain rate, an apparent activation energy of about 300 kJ/mol has been evaluated, which was very close to that reported for high deformation of iron aluminides. The maximum strain rate sensitivity was found to be about 0.3. Microstructural observations through the optical microscopy (OM), scanning electron microscopy (SEM) and the electron back-scattered diffraction (EBSD) technique have been carried out on the deformed specimens. It has revealed the evidences for grain subdivisions by the formation of subgrains inside the previous grain. It is therefore suggested that the grain refinement caused by the subdivision of previous grain is responsible for such high plasticity for this alloy at high temperatures.

PLANAR ANTENNA ON RT/DUROID 5870 MATERIAL FOR UWB APPLICATIONS

[1]Md. Moinul Islam, [2]Mohammad Tariqul Islam, [1]Mohammad Rashed Iqbal Faruque
[1]Space Science Centre (ANGKASA), Universiti Kebangsaan Malaysia, 43600 UKM, Bangi, Selangor, Malaysia
[2]Department of Electrical, Electronic and Systems Engineering, Universiti Kebangsaan Malaysia, 43600 UKM, Bangi, Selangor, Malaysia
E-mail: mmoiislam@yahoo.com

In this paper, a planar antenna on RT/duroid 5870 material that attains a compact ultra-wideband (UWB) profile physically belonging to nearly omni-directional radiation characteristics, gain and sharp current distribution is proposed. In [1], a miniaturized antenna with crescent patch was mentioned for UWB application. The antenna dimension was 45 × 50 mm, which was a relatively large size and did not cover the UWB completely. A planar UWB elliptical ring antenna using a coplanar waveguide was investigated in [2]. Commercially available high frequency electromagnetic solver HFSS based on the finite element method (FEM) is taken into account for calculations. This planar UWB antenna is printed on RT/duroid 5870 material of 1.575 mm thickness, 2.33 dielectric constant and 0012 dielectric constant. The antenna formation is smooth with simple design and comfortable fabrication. The measured results point out that the reported antenna belongs to a wide bandwidth comprehending from 3.1 GHz to more than 11 GHz with VSWR < 2. It has a peak gain of 5.52 dBi where 3.98 dBi is the average gain. Nearly omnidirectional radiation patterns are observed within the operating frequency bands. A good term is existed between computational and experimental results, which lead the reported antenna to be an appropriate candidate for UWB applications.

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ANTIMICROBIAL MODIFICATION OF POLYOLEFINS WITH SILVER NANOPARTICLES IMMOBILIZED BY ON ZINC STEARATE

Gabriela Jandíková, Petr Stloukal, Vladimír Sedlařík
Centre of Polymer Systems, University Institute, Tomas Bata University in Zlin, Tř. Tomaše Bati 5678, 76001 Zlín, Czech Republic,
E-mail: jandikova@ft.utb.cz

Microwave synthesis of Ag nanoparticles in presence of the zinc stearate (ZnSt) was performed to immobilize nanoparticles on its surface. The hybrid ZnSt/Ag particles were subsequently used for preparation of polymer composites based on polypropylene and ethylene-vinyl acetate copolymer. Concentration of the ZnSt/Ag filler was from 0.5 to 10 wt %. The amount of the immobilized Ag nanoparticles on the surface was determined by atomic absorption spectroscopy. Mechanical properties of the prepared composites were investigated by tensile testing. Thermal properties were characterized by differential scanning calorimetry and the structure of samples was observed by scanning electron microscopy (SEM). Water contact angle was measured to characterize the surface properties of the films. Furthermore, antimicrobial activity of the prepared samples was also tested. The results showed that Ag concentration in ZnSt/Ag systems was up to 2.5 wt %. Only slight changes in tensile and thermal properties were observed due to low concentration of the filler in the composites. On the other hand, antimicrobial activity of the composites against both Gram positive and Gram negative bacterial strains was achieved.

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IN-SITU SYNTHESIS OF TITANIUM CARBIDE PARTICLES IN IRON MATRIX DURING DIODE LASER SURFACE ALLOYING OF DUCTILE CAST IRON

Damian Janicki
Silesian University of Technology, Faculty of Mechanical Engineering, Welding Department, Konarskiego 18A, 44-100 Gliwice, Poland
E-mail: damian.janicki@polsl.pl

Ductile cast iron (DCI) is extensively used for manufacturing of machine parts in many industries such as automotive, power generation, mining, military and agricultural. However, in some applications, there is a need to increase durability of machine parts by improving their resistance to erosion. The enhancement of erosion resistance of DCI can be achieved by reinforcing its surface layer by ceramic particles (reinforcing phase), in particular by in situ synthesis of titanium carbide (TiC). During in-situ fabrication of composite surface layers (CSLs), the reinforcing phase (RP) are formed throughout the matrix (from the melt) by a chemical reaction. As a result, the RP are free of contaminants and have high coherency and strong interface with the metal matrix. The difficulty with in-situ fabrication of CSLs are that the distribution homogeneity and the average particle size of the RP depend on solidification conditions and are difficult to control.

The present study investigates the in-situ formation of TiC particles during laser surface alloying of DCI with direct injection of titanium powder into the molten pool, using a high power direct diode laser (HPDDL) with a rectangular laser beam spot and the uniform distribution (top-hat) of laser power. This study has been specifically concerned with establishing the effect of processing parameters and shielding gas atmosphere on the precipitation morphology of TiC particles and its distribution throughout the matrix. The microstructure of the CSLs has been assessed by optical microscopy, scanning electron microscopy and X-ray diffraction (XRD). Comparative erosion tests between the CSLs and as-received DCI have been performed following the ASTM G 76 standard test method.

The study showed that the HPDD laser surface alloying of DCI enables to produce in-situ TiC reinforced CSLs with uniform distribution of RP throughout the matrix and high erosion resistance, especially at steep angles. It was found that the precipitate morphology of TiC particle depends directly on a titanium powder feed rate, the cooling rate of the molten pool and also the shielding atmosphere.

GROWTH AND NANOSCALE INDENTATION OF ZnO NANOWIRES

A. Jasmin[1,2,3], M. Lorusso[2], M. Fontana[1], S. Porro[2]
[1]Istituto Italiano di Tecnologia, Center for Space Human Robotics, C.so Trento 21, 10129, Torino, Italy
[2]Dipartimento di Scienza Applicata e Tecnologia, Politecnico di Torino, C.so Duca degli Abruzzi 24, 10129, Torino, Italy
[3]University of the Philippines Baguio, Gov. Pack Road, Baguio City 2600, Philippines
E-mail: alladin.jasmin@polito.it

Recent breakthroughs in nanoscale research pave the way for the development of prototype nanoscale devices while taking advantage of size-effect characteristics of 1D ZnO nanostructures for possible electrical, photonic and electromechanical applications. Nanowire-based electromechanical devices, designed to have high-endurance during operation, have to be mechanically stable and highly-sensitive at variable load inputs. For this reason, a systematic assessment of structural and mechanical properties is of much importance, from the design perspective, in order to use ZnO nanowires for optimum device integration and applications. Thus study, this aims to synthesize ZnO nanowires with structural and mechanical properties suitable for piezoelectric applications.
Vertically aligned and high-aspect ratio ZnO nanowires with high c-axis crystal growth orientation are deposited on ZnO-seeded Si substrate via low-pressure chemical vapor deposition technique. Vapor-liquid-solid self-catalytic process was observed based on the growth of tapered nanowires with spherical tips. Homogeneous nanowire growth is desired for unifom sensitivity of piezoelectric sensors. Morphology and structural characterization are done using SEM and XRD. Nanomechanical characterization is performed with a nanoindentation facility (with a Berkovich tip) that has the capability to measure buckling behavior of several nanowires with micro-Newton force. Load-displacement curves are analyzed using Euler model to determine the critical buckling force and buckling energies for each applied force. Statistical data of nanowire density, length and diameter from SEM measurements are used to estimate the applied load, Young's modulus and critical stress. Radial component of the applied load due to nanowire misalignment from the indentation axis contributes to the deviation of Young's modulus estimates. Large h_c/h_{max} ratio confirms the dominant plastic deformation of the nanowires predicted by Oliver-Pharr model.

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TRANSMISSION ELECTRON MICROSCOPY COMPARATIVE STUDY OF $(K_{0.50}Na_{0.50})NbO_3$ SYNTHESIZED FROM NANO AND MICRON-SIZED Nb_2O_5

Mahdi Feizpour[1], Darja Jenko[2], Touradj Ebadzadeh[1], Matjaž Godec[2], Barbara Malič[3]
[1]Ceramics Department, Materials and Energy Research Center, Karaj, Iran
[2]Laboratory of Applied Surface Science, Institute of Metals and Technology, Ljubljana, Slovenia
[3]Electronic Ceramics Department, Jožef Stefan Institute, Ljubljana, Slovenia
E-mail: darja.jenko@imt.si

In this study, two Nb_2O_5 powders with different particle sizes were used to synthesize potassium sodium niobate $(K_{0.50}Na_{0.50})NbO_3$ [KNN] by the solid state reaction method with sodium and potassium carbonates: as received micron-sized Nb_2O_5 (BET: 3.21 m^2/g) and nano-sized Nb_2O_5, obtained by milling the as-received powder in a colloidal mill for 4 h (BET: 23.85 m^2/g). All the synthesis process parameters were considered the same for both powders. Both stoichiometric mixtures of precursors were calcined twice for 4 h at 625 ˚C with intermidiate milling in a planetary mill. X-ray diffraction analyses of both synthesized powders showed pure perovskite structure, without any un-reacted or intermediate phases. Transmission Electron Microscopy (TEM) investigation of the micron and nano-sized Nb_2O_5 precursors showed a big difference in the morphology (shape and size) of the particles. TEM and High Resolution TEM (HR-TEM) images of the synthesized KNN powders from nano-sized Nb_2O_5 showed that the morphology of the particles was cube-shaped and similar to the KNN powders synthesized from the as received Nb_2O_5. Energy Dispersive X-ray Spectroscopy (EDS) analysis of synthesized KNN powders from both Nb_2O_5 precursors confirmed the existence of silicon which could have its origin from Nb_2O_5 source. Further, the presence of silicon could lead to the formation of $K_6Nb_6Si_4O_{26}$ secondary phase in the sintered samples from both Nb_2O_5 precursors.

SURFACE MODIFICATION OF NITI SHAPE MEMORY ALLOY

Monika Jenko[1], Tadej Kokalj[1,2], Miran Mozetič[3]
[1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
[2]KUL, Division of Mechatronics, Biostatistics and Sensors, Willem de Croylaan 42, 3001 Leuven
[3]Jozef Stefan Institute, Jamova 39, 1000 Ljubljana
E-mail: monika.jenko@imt.si

Nitinol, a group of nearly equiatomic Ni-Ti alloys, have unique mechanical properties, shape memory effect (SME), superelasticity, and its biocompatibility as well as mechanical compatibility. A number of useful items have already been produced, such as orthodontic implants and stents [1]. Medical applications are still hindered by the concern for the release of Ni into surrounding human tissues. Concerns have been raised about the composition of Nitinol, specifically with the presence of nickel, a known allergenic carcinogen that exhibits one of the highest sensitivities in metallic allergen tests [2]. The patterns of Ni release from Nitinol modify depending on the type of material; NiTi alloys with low or no processing versus commercial sheets [3]. A thick TiO_2 layer is often considered as a reliable barrier against Ni release, but it was shown that Nitinol with the thickest oxide TiO_2 showed the highest Ni release [4].

Results of our previous research [5,6] showed that the surface of a melt spun NiTi shape memory alloy was covered with a thin oxide film. The thickness of the native oxide film was about 10 nm. After experiments on biocompatibility the oxide film thickness increased to about 20 nm. The oxide film before and after the biocompatibility tests consisted of titanium oxide and near the surface inhomoheniously distributed metallic Ni nano grains.

In order to improve the biocompability and to prevent Ni release, the material has been cleaned by hydrogen plasma and exposed to oxygen plasma. The oxides were characterized by field emission Auger electron spectroscopy (AES) depth profiling and X-ray photoelectron spectroscopy depth profiling (XPS). The AES depth profiling showed that the oxide thickness increased with increasing oxygen plasma treatment time. After treatment from 6 s, to 10 s, the oxide film was estimated from 30 nm to 500 nm. In all cases the oxide film contained TiO_2 and TiO_x, near the surface and no Ni. We have also studied the mechanical properties of oxides.

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SOL-GEL-DERIVED TiO_2 NANOLAYERS – A WAY FOR POTENTIATION OF VAPOUR PHASE HYDROGEN PEROXIDE DECONTAMINATION

Petr Kacer[1], Jiri Kovarik[1], Eva Cermakova[1], Jakub Pekarek[1], Marek Kuzma[2]
[1]Institute of Chemical Technology Prague, Technicka 5, 166 28 Prague 6, Czech Republic
[2]Institute of Microbiology, Videnska 1083, 142 20, Prague 4, Czech Republic
E-mail: Petr. Kacer@vscht.cz

The main task of this work was to develop a new material compatible with Vapour Phase Hydrogen Peroxide (VPHP) decontamination having photocatalytic activity, which increases the amount of hydroxyl radicals, and thus the decontamination potential of the method. One of the successful approaches was deposition of TiO_2 nanolayers, which after being activated by UV, generated a markedly higher amount of hydroxyl radicals in the course of VPHP decontamination process. The principle of the VPHP process is formation of hydroxyl radicals that degrade microbial as well as VPHP susceptible organic contaminants. VPHP is virtually an "ideal decontamination agent" for its high efficiency, easy and safe manipulation, and financial availability, ability to decontaminate large and hardly accessible areas, monitoring capability, and finally, its environmental friendliness. The environmentally friendly nature of VPHP is due to the spontaneous decomposition of hydrogen peroxide to oxygen and water. The strategy of connecting the photocatalyst and VPHP represents a novel highly promising method. The photocatalytic potentiation of VPHP was verified on model contaminants, which were maintained on the surface of TiO_2 layers during the VPHP process. The degradation of model contaminants in the presence and absence of these nanolayers was compared. Within the frame of this work, a detailed characterization of the prepared photoactive TiO_2 nanolayers or silver doped TiO_2 nanolayers was carried out. TiO_2 nanolayers prepared by the sol-gel method using titanium isopropoxide as a precursor were experimentally evaluated in vapour phase hydrogen peroxide (VPHP) decontamination process. For the practical use, VPHP would be advantageous if compatible with the materials present in the applied areas. Therefore, wide range of materials has been tested, starting from commercially and readily available to contemporarily developed materials. Their compatibility has been tested under a short-term and long-term exposure to VPHP as well as with liquid phase hydrogen peroxide (LPHP). The degree of the surface damage was observed by microscopic analysis. The tested materials were categorized by means of evaluating the surface structural irregularities.

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CREEP AND WEAR RATE OF WELD HAZ FOR TWO GRADES OF 9–12 % Cr STEELS

Fevzi Kafexhiu[1], Franc Vodopivec[1], Jelena Vojvodič Tuma[1], Bojan Podgornik[1], Igor Velkavrh[2]
[1]Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia
[2]V-Research GmbH, Stadtstraße 33, 6850 Dornbirn, Austria
E-mail: fevzi.kafexhiu@imt.si

Effect of growth, redistribution, and change in mutual spacing of carbide particles on creep rate of parent metal (α) and two microstructures of simulated weld heat affected zone (HAZ), namely inter-critical (α+γ) and coarse-grained (γ) microstructure of two creep-resistant steels, X20CrMoV121 and X10CrMoVNb91 was investigated. Aiming to simulate microstructural changes at real conditions in fossil-fuel power plants (FPP), all three microstructures were tempered for 2, 24, 168, 720, 4320, and 8760 hours (up to 1 year) at 650 °C and 750 °C, and additionally for 13140 and 17520 hours (up to 2 years) at 650 °C. On such samples, accelerated creep tests at 580 °C and 170 MPa, lasting up to 100 hours were performed. From the same samples, metallographic specimens were prepared and Scanning Electron Microscopy (SEM) imaging at 3k and 10k magnifications was carried out, aiming to analyse the microstructural changes that appear during tempering. Results from SE image analyses and experimental results from creep tests were correlated, where the theoretical creep rate was expressed as a function of inter-particles spacing, which on the other hand depends on tempering time and temperature. In addition, room temperature wear tests were performed on parent metal (α) and two simulated HAZ microstructures (α+γ and γ), in order to determine wear resistance of these materials at different operating and contact conditions.

Microstructural changes regarding the size, distribution, and average spacing of carbide precipitates in all three microstructures (α, and simulated α+γ and γ) of both X20 and P91 steels are much greater when tempered at 750 °C as compared to tempering at 650 °C.

Tempering causes the stationary creep rate of both steels to increase with time. However, faster increase was observed after tempering at 750 °C corresponding to faster changes in the microstructure. In addition, the increase of the stationary creep rate after tempering at 650 °C was more pronounced in the steel X20 than in P91. In both steels and both tempering temperatures, the most troublesome region with respect to the creep behaviour was observed to be the simulated inter-critical (α+γ) HAZ microstructure.

The wear volume and wear rate were found to increase with tempering time and temperature. In general, lower values of wear volume and wear rate were observed for the steel X20, whereas for both steels lower values were present in the specimens prior to additional tempering.

THE PHENOMENON OF REDUCED PLASTICITY OF LOW-ALLOYED COPPER ALLOYS

Wojciech Ozgowicz[1], Elżbieta Kalinowska-Ozgowicz[2], Barbara Grzegorczyk[1], Klaudiusz Lenik[2], Aneta Duda[2]
[1]Silesian University of Technology, Mechanical Engineering Faculty, Institute of Engineering Materials and Biomaterials 18A Konarskiego Str., 44-100 Gliwice, Poland,
[2]Lublin University of Technology, Fundamentals of Technology Faculty, 38 Nadbystrzycka Str., 20-618 Lublin, Poland
E-mail: kalinowska-ozgowicz@tlen.

The paper presents the results of investigations to determine the influence of the temperature of plastic deformation on mechanical properties of low-alloy copper alloys with cobalt CuCo2 and with cobalt and boron CuCo2B. The investigations were focused on determination of the range of ductility minimum temperature (DMT) at which reduced plasticity of the alloys evaluated by elongation and contraction occurs.
The plastic strain of the tested alloys was carried out in a static tensile test on a universal testing machine Instron 4505 in the temperature range from 20 °C to 800 °C using a furnace with Ar-He protective atmosphere. The structural effects and topography of the fractures of plastically deformed CuCo2 and CuCo2B alloys in the tested range of temperatures were observed with a light microscope and scanning electron microscope. The analysis of the results of investigations has allowed finding out that the minimum plasticity of CuCo2 alloy occurs at 500–700 °C and of CuCo2B alloy at 450–650 °C. In the range of DMT, the structure of homogeneous grains of α solution with numerous cracks revealed at the grain boundaries occurs. The fractures of alloys after decohesion at the ductility minimum temperature are intercrystalline brittle in nature.

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THE MICROSTRUCTURE OF METASTABLE AUSTENITE IN X5CrNi18-10 STEEL AFTER ITS STRAIN-INDUCED MARTENSITIC TRANSFORMATION

Agnieszka Kurc-Lisiecka[1],Wojciech Ozgowicz[2], Elżbieta Kalinowska-Ozgowicz[3], Wojciech Maziarz[4]
[1]Rail Transport Department, University of Dąbrowa Górnicza,1C Cieplaka Str.,
41-300Dąbrowa Górnicza, Poland E-mail: alisiecka@wsb.edu.pl
[2]Institute of Engineering Materials and Biomaterials, Silesian University of Technology, 18a Konarskiego Str.,
44-100 Gliwice, Poland, E-mail: wojciech.ozgowicz@polsl.pl
[3]Fundamentals of Technology Faculty, Lublin University of Technology, 38 Nadbystrzycka Str., 20-618 Lublin,
Poland, E-mail: kalinowska-ozgowicz@tlen.pl
[4]Institute of Metallurgy and Materials Science, Polish Academy of Sciences, 25 Reymonta Str., 30-059 Krakow,
Poland
E-mail: w.maziarz@imim.pl

The performed investigations concerned the influence of degree and temperature of deformation on the microstructure of metastable austenite in stainless steel X5CrNi18-10 after its strain-induced martensitic transformation. Samples of steel strip were cold-rolled within the degree of deformation from 20 to 70 % and stretched at a low temperature of –196 °C. The microstructure was observed by means of a scanning electron microscopy (SEM) and transmission electron microscopy (TEM, HREM). It has been found that after cold-rolling with a small degree of deformation (20 %) in the tested steel generally a single-phase microstructure of the matrix γ is found with a high density of dislocation and numerous deformation bands morphologically characteristic for stainless steel with a low stacking fault energy. After rolling with a 50 % thickness reduction, however, the microstructure displayed deformation twins as well as refined morphologic formations of the phase α', mostly localized in the vicinity of the grain boundaries of the metastable matrix γ, and also trace amounts of precipitations of carbides. In samples stretched at a temperature of –196 °C microstructure of the matrix displayed a considerable density of dislocations with lath areas of the martensite α' and precipitations of carbides $M_{23}C_6$. Moreover, the tested steel revealed a crystallographic dependence of the planes and directions on the identified phases γ and α', corresponding to the dependences of the Kurdjumov-Sachs type, independently of the method and temperature of plastic deformation. Tests carried out in TEM proved that typical sites of nucleation induced by the plastic deformation of martensite are the shear bands, particularly their intersection. The preferred mechanism of transformation, observed in the conditions of cold-rolling is, however, a direct transformation of the type γ (fcc) → α' (bcc).

USING OF ULTRASONIC SEWING ON POLYESTER BASED MULTIAXIEL FABRICS AND INVESTIGATION OF ITS EFFECTS ON THE MECHANICAL PROPERTIES OF THE COMPOSITES

Mahmut Kayar, S. Ilker Mistik, E. Dilara Koçak, Sabih Ovali
Marmara University Faculty of Technology Department of Textile Engineering, Istanbul, Turkey
E-mail: mkayar@marmara.edu.tr

Ultrasonic sewing is an alternative method to the conventional sewing methods. Ultrasonic sewing is only applied to thermoplastics and their blends and is not required any sewing yarn. Nowadays, chain and lock stitches are used for the production of the multiaxial structures. In this study, multiaxial fabrics were produced by using ultrasonic sewing for the first time. Polyester was used for the multiaxial fabric production. Polyester multiaxial fabrics were sewn by using ultrasonic, chain and lock stitches then produced multiaxial structures were used as reinforcement for the production of the composites. Mechanical properties of the produced composite structures were investigated.

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POSSIBILITY OF ATTRITION IRON CONTENT MEASUREMENT VIA OBJECTIVE COLOUR DETERMINATION

P. Kejík, T. Svěrák, O. Krištof, P. Bulejko, K. Sikorová
VUT v Brně, Fakulta strojního inženýrství, Laboratoř sdílení tepla a proudění, Technická 2896/2, 616 69 Brno
E-mail: kejik@lptap.fme.vutbr.cz;

This paper deals with a possibility of application of an objective colour determination in the materials grinding industry. The work presents flame atomic absorption spectrometry (F-AAS) data as a reference method, and CIELAB objective colour measurement from which the whiteness factor was used for an experiment on determination of iron content in limestone and corundum ground stock. In order to have substantial colour change in the samples comparing to feedstock, attritor-type mill grinding process with steel grinding bodies and duration up to 21 h was used for samples preparation. Limestone and corundum were chosen as materials for the experiment for their hardness and abrasiveness diversity in the milling process. It is concluded that, when properly calibrated, the method could be used in grinding plants for very fast tentative inspections of the comminuted material.

Zn AND Zn-ALLOY BONDED Nd-Fe-B MAGNETS

Paul McGuiness, Spomenka Kobe, Luka Kelhar
Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia
E-mail: luka.kelhar@ijs.is

Commercial Nd-Fe-B bonded magnets based on melt-spun ribbons and a polymer binder are popular components for mild conditions where a complex-shape magnet is required. However, with a shift towards the use of these magnets in automotive applications that are subject to temperatures exceeding 100 °C, and in some cases higher, with the additional problem of a corrosive atmosphere, idea of metal-bonded RE-based magnets becomes an attractive alternative.

In this work, we introduce novel type of Nd-Fe-B bonded magnets, made of magnetic powder and metallic binder. The binder or so called “Low melting point (LMP)” phase consists of a metal or an alloy, and should be low-cost, eco-sustainable, corrosion resistant and preferably have the potential to be recycled. For the fabrication of composites, we used crushed MQP-B ribbons supplied by Molycorp, produced by melt-spinning and crushing. For binder we used Zn metal and Zn alloy in powder form. The material mixture was homogenized by introducing interactions of rotation, translation and inversion, according to Shatz geometric theory. Mixture of MQP-B ribbons and binder was consolidated by PECS (Pulsed electric current sintering). This enabled us very fast heating rates and short sintering cycles. The characterization included measuring the density, magnetic properties, and microstructure assessment. By combining approximately 30 wt % of metallic binder and 70 wt % of MQP-B magnetic powder we managed to achieve sufficient density and therewith mechanical strength. Measurements indicate that magnetic properties can be preserved to some extent, given the amount of binder.

Our study shows that metal-bonded Nd-Fe-B magnets present a viable alternative to polymer-bonded magnets. Such type of magnets could find applications in high temperature automotive applications, benefiting from higher melting point of the metallic binder.

EXPERIMENTAL STUDY ON THE CYCLIC & STATIC BEHAVIOR OF NEW ODS ALLOYS

Bohuslav Masek[1], Omid Khalaj[1], Hana Jirkova[1], Jiri Svoboda[2]
[1]The Research Centre of Forming Technology, University of West Bohemia, Univerzitní 22, 306 14, Pilsen, Czech Republic, khalaj@vctt.zcu.cz
[2]Institute of Physics of Materials, Academy of Sciences Czech Republic, Zizkova 22, 616 62, Brno, Czech Republic
E-mail: svobj@ipm.cz

Application of innovative processing techniques to conventional raw materials can lead to new structural materials with specific mechanical and physical properties, which open new possibilities of use in some areas of industry. The processing is enabled by powder metallurgy, which utilizes powders consisting of a metal matrix with dispersed stable particles achieved by mechanical alloying and their hot consolidation by rolling. A new Oxide Dispersion Strengthened (ODS) Fe-Al based alloys are tested under different cyclic and static thermomechanical treatment at different temperatures. The results show that new ODS alloys are significantly affected by the thermo-mechanical treatment leading to the microstructural changes. Their analysis is performed using different analytical methods such as optical microscopy, scanning electron microscopy and X-ray diffraction analysis.

STRUCTURE AND PROPERTIES OF BULK METALLIC GLASSES BASED ON MAGNESIUM

Anna Kiljan, Rafał Babilas, Ryszard Nowosielski
Silesian University of Technology, Faculty of Mechanical Engineering, Institute of Engineering Materials and Biomaterials, Konarskiego 18A Street, 44-100 Gliwice, Poland
E-mail: anna.kiljan@polsl.pl

Nowadays, Mg-based amorphous alloys are very attractive group used in industries such as the automotive, aviation and medicine sector. This group of bulk metallic glasses has specific properties like corrosion resistance, strength and stiffness higher than those of the crystalline ones. Also, Mg-based amorphous alloys are characterized with high glass forming ability, low density, good ductility, light weight, good thermal and electrical conductivity and low cost. The paper describes the preparation methods, structure characterization and mechanical properties of Mg-based bulk metallic glasses in cast state and after crystallization process. The aim of the study was to produce amorphous plates of Mg-Zn-Ca and to study the mechanical properties, especially compressive strength, extension and microhardness. To obtain amorphous alloy High Pressure Casting method of molten alloy into the copper mold was used.
The investigations of the samples were carried out using X-ray diffractometer (XRD) and scanning electron microscope (SEM). The study of mechanical properties of metallic glasses based on magnesium carried out on the basis of the designation the compressive strength, extension and the measurement of microhardness.

FABRICATION AND CHARACTERIZATION OF AL_2CA-CONTAINED Al-2.5Mg, 4.5Mg SHEET MATERIALS

Bong-H. Kim, Young-O. Yoon, Shae-K. Kim
Korea Institute of Industrial Technology, 156 Gaetbeol-ro, Yeonsu-gu, Incheon 406-840 Korea
E-mail: bonghk75@kitech.re.kr

The wrought aluminum-magnesium alloys have been widely used in transportation industries of automotive, ship and building, beverage can in the form of sheet metals, because they show good formability, weldability, corrosion resistance together with medium strength. Magnesium in aluminum forms solid solutions over a wide range of Mg content and Al-Mg alloys containing from about 1 wt % to slightly more than 5 wt % Mg are commercially used.

The magnesium in aluminum melt has a strong tendency to oxidize during casting processes. The oxidation of Mg deteriorates the quality and properties of products as well as processing capabilities, which obstacles the widening of the application of Al-Mg alloys. Industrially, the trace amount of beryllium has been utilized to inhibit the Mg oxidation, even though it is extremely toxic and harmful to human body and not so effective due to its low content. Meanwhile, a specially fabricated Mg alloy containing Al_2Ca phase has been developed and patented recently.

In the present study, the influence of the Mg alloy containing Al_2Ca was investigated in rolling process of Al-Mg alloys. For this purpose, Al_2Ca-contained Al-2.5, 4.5Mg alloys were fabricated by using mass production facilities of casting and rolling. The surface roughness of the slab, edge cracking and oil stain during production will be addressed. Mechanical properties and strain hardening behavior of the rolled sheets will be discussed in a variety of temper conditions. Finally, the result of sheet forming an automotive part will be shown.

COMPARATIVE STUDY OF TENSILE PROPERTIES OF AS-EXTRUDED AND AS-ROLLED Al-7.5Mg ALLOYS CONTAINING Al_2Ca

Bong-H. Kim, Young-O. Yoon, Shae-K. Kim
Korea Institute of Industrial Technology, 156 Gaetbeol-ro, Yeonsu-gu, Incheon 406-840 Korea
E-mail: bonghk75@hotmail.com

Non heat-treatable, wrought Al-Mg alloys have been increasingly introduced to automotive applications for light-weight solutions to improve their fuel economy and reduce gas emissions. The Al-Mg alloys show various combination of a wide range of strength, good forming and welding characteristics, and high corrosion resistance. The strength of Al-Mg alloy can be mainly controlled by solid-solute hardening and it increases with magnesium content up to about 5.5 wt % Mg of commercial limit, without decrease of ductility.

The Al-Mg alloys with higher magnesium content over the limit can theoretically show higher mechanical properties, because the maximum solubility of Mg in Al is 14.9 wt % at eutectic temperature. However the strong oxidation tendency of Mg in Al melt prohibits from widening the application of high-Mg contained Al-Mg alloys. Industrially, the oxidation of Mg can be decreased by adding trace amount of beryllium, even though it is very toxic and not so effective due to the small amount. Meanwhile, a specially fabricated Mg alloy containing Al_2Ca phase has been patented to inhibiting Mg oxidation in various aluminum alloys.

The purpose of the present work is to investigate tensile properties and microstructure of Al-7.5Mg alloy in a variety of as-extruded and as-rolled tempers. The alloy was continuously cast into a billet with 7 in of diameter. The billet was extruded into a sheet form followed by cold-rolling. The tensile properties and microstructure of the alloy in a variety of temper will be discussed.

EFFECT OF Al_2C ON HOT COMPRESSION BEHAVIOR OF Al-5Mg ALLOYS

Bong-H. Kim, Young-O. Yoon, Shae-K. Kim
Korea Institute of Industrial Technology, 156 Gaetbeol-ro, Yeonsu-gu, Incheon 406-840 Korea
E-mail: bonghk75@gmail.com

The Al-Mg series alloy have been industrially applied in various sheet/plate forms, because they give various combinations of formability, weldability with medium strength controlled by the mechanism of solid solution hardening. The high-strength Al-Mg alloys have been attracted, because automotive applications of Al alloys for light-weight and emission reduction purpose have recently grown fast. Reports with the goal of increasing the strength of Al-Mg alloys have continued. The effect of higher Mg amount for increasing strength of Al-Mg alloys can be compensated by its oxidation behavior resulting to poor quality and properties if processes are not strictly controlled.

The oxidation of Mg in Al melt has been well studied and reported to be prevented by addition of small amount of third element such as beryllium or calcium. But, beryllium is extremely harmful so that its application is strictly prohibited. The beneficial effect of Ca on oxidation of Mg has been well reported, however together with disadvantage of embrittlement behavior in the condition of high temperature tensile load. Meanwhile, recently a specially fabricated Mg mother alloy containing Al2Ca phase has been invented and patented for suppression of Mg oxidation in Al melt. So, it is worth to understand the effect of Al_2Ca on high temperature compression behavior.

In the present research, Al-5Mg containing different level of Al_2Ca were cast into Y-block (20 mm of thickness). The casting block was machined into a cylindrical sample with 10 mm of diameter and 12 mm of height for high temperature compression test. The cylindrical samples were homogenized to remove micro-segregation and compression-tested. The microstructure of the deformed sample were analyzed and discussed in order to understand the effect of Al_2Ca addition on the compression behavior.

EFFECT OF MECHANICAL ACTIVATION ON FORMATION AND CHARACTERIZATION OF MAGNESIUM ALUMINATE SPINEL

Derya Kırsever, Nilgün Kaya Karabulut, Nuray Canikoğlu and H.Özkan Toplan
Sakarya University, Metallurgy and Materials Engineering, 54187 Sakarya, Turkey
E-mail: dkirsever@sakarya.edu.tr

Magnesium aluminate spinel ($MgAl_2O_4$, MA) is widely used refractory material due to its high temperature properties, mechanical resistance, thermal shock resistance and high corrosion resistance to acidic and basic slags. Also, MA spinel refractories are very attractive due to their environmental friendliness, contrary to magnesium chromite refractories. But, synthesis of spinel and fabrication of spinel refractories were not possible for any commercial methods due to the difficulty in sintering [1,2]. High purity spinel were synthesized mostly by hydrothermal techniques, sol-gel, spray plasma, cool drying, controlled hydrolysis, co-precipitation, mechanical activation and aerosol method [1].
Al_2O_3 and MgO powders were mixed corresponding to stoichiometric according to chemical formula of magnesium aluminate spinel ($MgAl_2O_4$) by mechanical activation. Cyclindrical samples were consolidated by uniaxial dry pressing and sintered at different temperatures (up to 1750 °C). The phase and microstructural evolution, water absorption, bulk density, mechanical properties of sintered samples were investigated.

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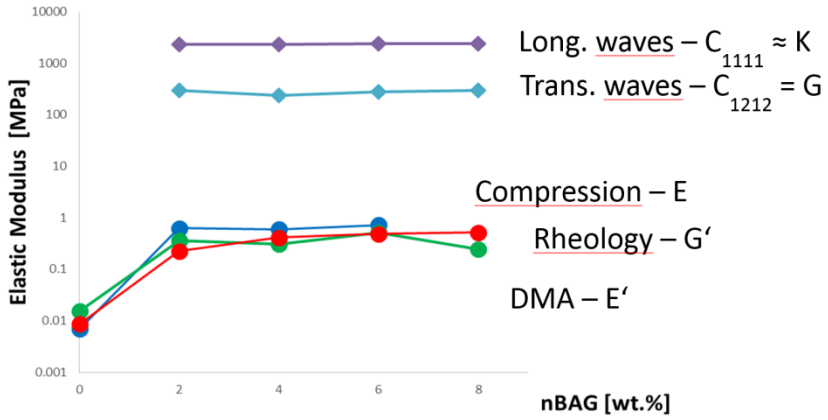
MEASURING VISCOELASTICITY OF HYDROGEL-BAG COMPOSITES

Rok Kocen[1,2], Ana Gantar[1,2], Christian Hellmich[3], Michael Gasik[4], Saša Novak[1,2]
[1]Jožef Stefan Institute, Department for Nanostructured Materials, Jamova c. 39, 1000 Ljubljana, Slovenia
[2]Jožef Stefan International Postgraduate School, Jamova c. 39, 1000 Ljubljana, Slovenia
[3]Institute for Mechanics of Materials and Structures, Vienna University of Technology, Austria
[4]School of Chemical Technology, Aalto University, Finland
E-mail: rok.kocen@ijs.si

Tissue engineering is in search of a material that could fulfill requirements for cell scaffolds, like biocompatibility, biodegradability, bioactivity and suitable mechanical properties. Mechanical properties are often neglected, although they are crucial in load bearing aplications (cartilage, bone…). BAG (bioactive glass) is a very promising material, but is very brittle on its own. One of the common solutions is to embed BAG particles into a polymer matrix, to eliminate brittleness.
We have studied gellan gum hydrogel with dispersed nanoparticulate BAG[1]. Because such materials exhibit particular viscoelastic properties, different measuring techniques might give different results. Therefore, we compared some of the most common measuring techniques: quasi-static compression, DMA (Dynamic Mechanical Analysis), SAOS (Small Amplitude Oscillatory Rheology), and acoustic measurements (speed of longitudinal and transversal wave propagation).
Results have shown that compression, DMA and SAOS give similar results, whereas results of acoustic measurements differ significantly. The difference of the latter one can be explained by the linear elasticity theory.



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BIODEGRADABLE Fe-BASED ALLOYS

Aleksandra Kocijan, Irena Paulin, Črtomir Donik, Matej Hočevar, Klemen Zelič, Matjaž Godec
Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia
E-mail: aleksandra.kocijan@imt.si

Traditionally, the most commonly used metallic materials for biomedical applications are AISI 316L stainless steel, Ti-based alloys or Co–Cr alloys. They have the appropriate mechanical properties, such as a high ultimate tensile strength and a good corrosion resistance. Such implants are associated with permanent applications. However, in some cases, the implants must be removed after a certain period of exposure, which causes additional stress for the patient. This brings forward a new concept of biodegradable materials, with the ability to degrade *in vivo* via hydrolytic mechanisms, resorption or electrochemical reactions.

In the present study we focused on the development of Fe-Mn and Fe-Mn-Si alloys synthesis by commonly used producing steps, such as die casting and hot rolling for achieving better mechanical properties. The chemical composition of alloys was measured by using X-ray fluorescence spectrometer XRF. A scanning electron microscope coupled with energy dispersive spectrometer was used to analyze the chemical composition of phases. The corrosion behavior of developed materials in terms of their suitability for biomedical applications in artificial physiological solution was performed. The study was conducted using the electrochemical techniques of potentiodynamic measurements and electrochemical impedance spectroscopy (EIS).

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NEW CONCEPT FOR MANUFACTURING CLOSED DIE FORGINGS OF HIGH STRENGTH STEELS

Bublíková Dagmar, Mašek Bohuslav, Ibrahim Khodr
University of West Bohemia, Research Centre of Forming Technology, Univerzitní 8, 306 14 Plzeň
E-mail: ibrahim@rti.zcu.cz

In automotive industry, there is an ever growing demand for components of steels with enhanced mechanical properties. Typically, this involves steels with high strength combined with adequate ductility. Thanks to improved properties, structural components of these steels can be less bulky, requiring less material, energy and lower costs. Processing a material to obtain high strength and high ductility at the same time used to be rather difficult. Today, it can be accomplished by incorporating retained austenite in a martensitic matrix. A new heat treatment method for closed-die forgings, termed Q&P process (Quenching and Partitioning), leads to a combination of martensite and retained austenite with strengths above 2000 MPa and an elongation of 10–15 %.

METHODOLOGY FOR NON-DESTRUCTIVE EVALUATION OF CONCENTRATION AND ORIENTATION OF STEEL FIBERS IN STEEL-FIBER-REINFORCED CONCRETE

Tereza Komárková, Martin Friedl
Brno University of Technology, Faculty of civil Engineering, Veveří 331/95, 602 00 Brno,
Brno University of Technology, Faculty of Electrical Engineering and Communication Brno University of Technology, Technická 3058/10, 616 00 Brno
E-mail: komarkova.t.fce.vutbr.cz

Steel-fiber-reinforced concrete is a composite material that excels in the parameters especially for its tensile properties and resistance emergence and spread of shrinkage cracks. For these properties excels especially assuming uniform distribution of the steel fibers in the resulting hardened composite. Steel-fiber-reinforced concrete must be considered as a specific construction material, especially with respect to its production and testing.
So far is possible to evaluate concentration and distribution of steel fibers with the desired accuracy measurement on the basis of the obtaining cored specimens from the structure. The disadvantage of these tests is mainly their destructive effect. The paper deals with methodology based on the non-destructive testing principle of evaluation of the concentration and distribution of steel fibers in the steel-fiber-reinforced concrete. Using experimental measurements carried out in laboratory on specimens there were derived and established the basic principles of method and methodology of non-destructive testing for evaluation of distribution, density and orientation of ferromagnetic electrically conductive fibers in the composite material.

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CHARACTERISATION OF THE PORE-FORMING PROCESS IN GEOPOLYMER-BASED FOAMS BY MEANS OF X-RAY MICRO-TOMOGRAPHY (MICRO-CT)

Lidija Korat, Vilma Ducman
Slovenian National Building and Civil Engineering Institute, Dimičeva 12, Ljubljana, Slovenia
E-mail: lidija.korat@zag.si

Geopolymers are inorganic systems which consist of (i) a reactive solid component which contains SiO_2 and Al_2O_3 in sufficient amounts, and in reactive form (e.g. different types of ash, and active clays), and (ii) an alkaline activation solution which mainly contains (apart from water) alkali hydroxides and silicates (Provis, 2014). Recent innovations have led to the development of different geopolymeric products, including highly porous geopolymer-based foams, which are formed by the addition of foaming agents, which decompose, or react with the liquid matrix or oxygen, resulting in the release of gases which form pores prior to the hardening of the gel. Such foams have good mechanical and thermal properties, so that they can be used for applications in acoustic panels and lightweight pre-fabricated components for thermal insulation (Henon, 2013).
This study presents the first results which were obtained in an analysis of the pore-forming process in geopolymers foams, when two different foaming agents were added to a fly ash based geopolymer-based matrix; aluminium powder, and H_2O_2. The physical, mechanical, and microstructural properties of the geopolymer-based foams, and the effects of the foaming agent's characteristics and its added amount, are presented and discussed. In order to better understand the effect of porosity on the properties of geopolymers, an analysis of porosity, pore size distribution, thickness of walls, pore shape, and pore interconnectedness was performed by means of three-dimensional X-ray micro-tomography (micro-CT), which was supported by a suitable image analysis programme. This technique has already been successfully applied in the case of the analysis of ceramic foams (Maire et al., 2007), and in the present study, too, it has proved to be an excellent tool for the studying of the microstructure of foams, since it does not interfere with or destructively affect the sample.

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DEVELOPMENT OF ALUMINIUM ALLOYS FOR AEROSOL CANS

[1]Jože Turk, [2]Jožef Medved, [2]Maja Vončina, [1]Stanislav Kores
[1]TALUM d.d., Tovarniška cesta 10, 2325 Kidričevo, Slovenia
E-mail: stanislav.kores@talum.si
[2]University of Ljubljana, Faculty of Natural Science and Engineering, Department for Materials and Metallurgy, Aškerčeva 12, 1000 Ljubljana, Slovenia
E-mail: jozef.medved@omm.ntf.uni-lj.si

New aluminium alloys ware developed for aluminium narrow strip, casted with »rotary strip caster« system, to produce slugs for aerosol cans. Innovative alloys provide constant mechanical properties of material during the manufacturing process of aerosol cans, good transformation and enable to achieve high deformable and burst pressures of aerosol cans.

The problem that occurs at the manufacturing process of aerosol cans is the decrease of mechanical properties of the material up to 15 %. This is reflected in lower deformable and burst pressure of aerosol cans.

On the existing casting-rolling line an aluminium alloy was developed to produce the aluminium narrow strip for production of slugs, which enables:

- casting of aluminium narrow strip with high casting speeds by using the »rotary strip caster« system with excellent surface and a minimum number of defects,
- constant mechanical properties of the material during the hole manufacturing process of aerosol cans, which is reflected in higher burst and deformable pressure of aerosol cans,
- good transformation and surface of aerosol cans from slugs extruded from innovated aluminium alloys.

Figure 1 present the mechanical properties of the innovative alloys (T1-T4) compared with the existing standard alloys for the production of slugs for aerosol cans.

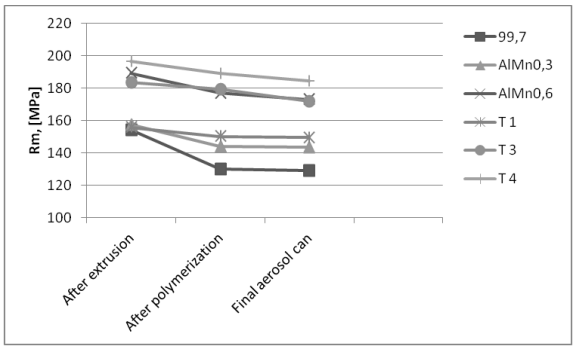

Figure 1: Mechanical properties of the aerosol can material

With increasing the mechanical properties of aerosol cans materials, it is possible to produce aerosol cans with thinner walls, which is having a significant impact on the weight of the final aerosol cans.

BRASS AS A SOURCE OF LEAD IN DRINKING WATER

Mirjam Bajt Leban, Tadeja Kosec
Slovenian National Building and Civil Engineering Institute
E-mail: tadeja.kosec@zag.si

Since 70's in last century when the use of lead pipes was stopped, the sources of lead in drinking water were accessories made from brass and zinc coating of galvanized steel pipes.
Brass is one of widely used metallic material for drinking water installations components such as fittings, valves and water meters. Lead is added into brass in different concentrations in order to increase its workability, which is of great importance for drinking water applications. Due to dezincification processes taking place on the brass in the contact with drinking water, lead is released into water. On the other hand, zinc layer of galvanized pipes in contact with drinking water is stable on the pipe only in the case when it is protected by carbonate layer formed in hard water. When conditions for carbonate layer are not fulfilled, the dissolution of zinc layer, which before 2004 consisted also of 1mass% of lead, occurs.
At the end of 2013 Drinking water directive decreased the maximum allowed concentration of lead in water from 25 to 10 µg/L. Parallel to this decrease, the most known schemes in EU, so called "Acceptance schemes for materials in contact with drinking water" published allowed types of brasses based on clearly defined chemical composition with the highest concentration of lead and also other elements, which are dangerous for human health.
After the acceptance of Drinking water directive criterion in Slovenia, the exceeded concentrations of lead in drinking water were detected. Most of exceedance of lead concentration was observed in a few years old multi apartment buildings. Drinking water installation system of these buildings was commonly built up by mixing galvanized and plastic pipes, connected by galvanized or brass fittings. At the entrance of each drinking water part of the system, water meter made from brass was mounted. Detailed investigation has shown that the main source of lead in these building presented brass components and not galvanized pipes.
After field investigation we stared laboratory study where two brass alloys with different lead concentration and concentrations of some other elements, one accepted by "Acceptance schemes" and one not, were compared. Surprisingly, the results have shown that from the accepted alloy more lead is released into water, whereas the corrosion behaviour determined by electrochemical tests does not exhibit such variation. Laboratory results successfully explained the results from the field investigation where increased lead was observed regardless to the type of brass.

SINGLE-CORE AND MULTI-CORE FePt NANOPARTICLES AS MRI CONTRAST AGENTS

Nina Kostevšek[1,2], Sašo Šturm[1], Igor Serša[3], Ana Sepe[3], Spomenka Kobe[1], Kristina Žužek Rožman[1]
[1]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia
[2]Jožef Stefan International Postgraduate School, Jamova 39, Ljubljana, Slovenia
[3]Department for Condensed Matter Physics, Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia
E-mail: nina.kostevsek@ijs.si

Different processing routes were established to synthesize FePt nanoparticles (NPs) of different sizes and, consequently, different values of saturation magnetization, since it is known that the magnetic properties of such NPs are not only composition dependent, but change drastically with the NPs' size. We propose a synthesis route for obtaining single-core FePt NPs of different sizes (3–10 nm). Furthermore, we propose the synthesis of multi-core FePt NPs that are shown to possess much higher values of magnetization. The ratio between the two surfactants (oleylamine and oleic acid) was found to strongly influence the shape of the FePt NPs, while the surfactant's concentration dictates the size of the NPs. Small, single-core FePt NPs typically possess a low magnetization saturation (M_s < 8 emu/g), which is undesirable due to the small magnetic force that is being generated. To increase the M_s, first, a larger volume of the added surfactants was found to increase the size of the NPs (from 3 to 8 nm), together with the M_s. Second, a seed-mediated growth was needed to increase the the NPs' size even more (< 10 nm), with the latter exhibiting double the magnetization values (M_s = 14.5 emu/g) compared to the NPs formed via a conventional route. Third, multicore NPs (> 20 nm) were formed by changing the ratio of oleic acid to oleylamine and exhibited the largest M_s = 18 emu/g, while maintaining their superparamagnetic nature. Stable water suspensions were prepared using two different approaches: a) functionalization with a biocompatible zwitterionic catechol ligand, which was used on the FePt nanoparticles for the first time, and b) coating with a SiO_2 shell of various thicknesses. To check the magnetic imaging potential of these newly synthesized FePt-based nanostructures, the cathechol- and the silica-coated single-core and multi-core FePt NPs were investigated in terms of the relaxation rates. It was found that the multi-core FePt NPs with a higher magnetization are superior for applications such as magnetic separation, but as a magnetic contrast agent the single-core FePt nanoparticles are a better choice.

THE SIZE EFFECT OF HEAT TRANSFER SURFACES ON BOILING TO A SPRINKLED TUBE BUNDLE

Petr Kracík, Jiří Pospíšil
Institute of Power Engineering, Brno University of Technology, Faculty of Mechanical Engineering,
Technická 2896/2, 616 69 Brno, The Czech Republic
E-mail: kracik@fme.vutbr.cz

A sprinkled tube bundle is frequently used in technology processes where increase or decrease of a liquid temperature in a very low-pressure environment is required. Phase transitions of liquid very often occur at low temperatures at pressure ranging in thousands of Pascals, which enhances heat transfer. This paper focuses on the issue of heat transfer coefficient that is experimentally examined at the surface of a tube bundle. The tube is located in a low-pressure chamber where vacuum is generated using an exhauster via ejector. The tube consists of smooth copper tubes of 12 mm diameter placed horizontally one above another. Heating water flows in the bundle from the bottom towards the top at an average input temperature approx. 40 °C and an average flow rate approx. 7.2 litres per minute. Falling film liquid at an initial temperature approx. 15 °C at an initial tested pressure approx. 97 kPa (atmospheric pressure) is sprinkled onto the tubes' surface. Afterwards pressure in the chamber is gradually decreased. When reaching the minimum pressure approx. 3 kPa(abs) water partially evaporates at the lower part of the bundle. Consequently the influence of falling film liquid temperature increase is tested. This gradually leads to boiling of water at a significant part of the bundle and the residual cooling liquid that drops back to the bottom of the vessel is almost not heated anymore. In this paper are presented influences the size of the heat transfer surfaces.

MICROSCOPIC CHARACTERIZATION OF NANOPARTICLES IN STEEL

Ana Kračun[1,2], Matjaž Torkar[1], Jaka Burja[1], Bojan Podgornik[1]
[1]Institute of Metals and Technology, Ljubljana
[2]International postgraduate school Jožef Stefan, Ljubljana
E-mail: ana.kracun@imt.si

It is well established that the steel matrix composites commonly have a good combination of hard ceramic reinforcement particles (e.g. TiC, TiB_2, WC and Al_2O_3) and ductile metallic matrix, which make them a promising candidate in wear resistance applications. Generally, there are several methods for fabricating the particulate reinforced steel matrix composites, such as powder metallurgy, conventional melting and casting, reactive sintering and self-propagating high-temperature synthesis. The casting process is more economical than the other available routes for integration of nanoparticles into microstructure of steel. However, it is extremely difficult to obtain uniform dispersion of ceramic nanoparticles in liquid metals due to the poor wettability and the specific gravity difference between the ceramic particles and metal matrix. Furthermore, low concentrations and only few nanometers size limit the possibility of identifying presence, distribution and effect of ceramic nanoparticles in the steel matrix.

The aim of the present work was to identify the distribution of nanoparticles in the steel matrix introduced through conventional melting and casting method, but above all to determine methodology and analyzing techniques suitable for analyzing and identifying nanoparticles incorporated in the steel matrix. In the frame of this work the steels dispersed with Al_2O_3 and TiO_2 nanoparticles were produced by conventional casting method and their microstructure investigated by optical, SEM and TEM techniques. Microstructural analysis shows that distribution of Al_2O_3 and TiO_2 nanoparticles, which show high degree of agglomeration, is very non-uniform. Furthermore, for detailed analysis of nanoparticles specific preparation and characterization by advanced microscopic techniques is required.

EXPERIMENTAL DETERMINATION OF THE INFLUENCE OF WATER/CEMENT RATIO VALUE ON THE RESISTANCE OF CONCRETE TO THE ACTION OF WATER AND CHEMICAL THAWING AGENTS

Dalibor Kocáb, Tereza Komárková, Monika Králíková, Petr Misák, Bronislava Moravcová
Brno University of Technology, Faculty of Civil Engineering, Department of Building Testing, Veveří 95, 602 00 Brno, Czech Republic
E-mail: kralikova.m@fce.vutbr.cz

The GAČR 13-18870S project deals with research in concrete durability which is determined mainly by the quality of its surface layer. The assessment of the surface layer is rather complicated and therefore the project involves the use of the available standardised and non-standardised test methods, using which the concrete surface layer or its internal structure can be characterised. Determination of resistance of cement concrete surface to water and defrosting chemicals is one of such methods and is commonly used.

The paper presents the results of experiments performed with concretes differing only in water/cement ratio and amount of plasticiser. The research used two more methods based on the action of a thawing solution upon the surface of the specimen during freezing and thawing. These methods only differ in the direction in which the thawing agent acts on the test surface. The assumption prior to performing the experiments was that there is a strong dependence between the outcomes of the methods and the water/cement ratio value.

The analyses performed have confirmed the pre-experiment assumptions to be correct.

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INVESTIGATION OF MATERIAL PARAMETERS OF EPOXY RESIN USING UNIAXIAL STATIC TENSILE CYCLIC TESTS

Tomáš Kroupa, Hana Srbová, Jan Klesa
University of West Bohemia in Pilsen, Univerzitní 22, 306 14 Plzeň, Czech Republic
E-mail: kroupa@kme.zcu.cz

Material parameters for elastic, plastic and damage behavior of low molecular weight epoxy resin CHS-EPOXY 520 hardened with CHS-P 11 are identified in the paper. Uniaxial cyclic static tests are performed on specimens respecting ASTM standard D638-10 using ZWICK ROELL/Z050 test machine with clip-on biaxial extensometer BTC-EXACLBI.001. Poisson's ratio and tensile strength are calculated directly from the test results. Other parameters are identified using combination of uniaxial material model written in Python and optiSLang optimization software. The proposed material model assumes infinitesimal strain theory and it respects elastic, plastic, and damage behavior. The optimization process uses simple design improvement and gradient based algorithms with the goal to minimize the difference between force–displacement curves recorded during tests and those calculated using the proposed model. It is possible to convert the problems of plastic flow and damage flow to a single transcendental equation in each case within the numerical algorithm and so the solution is found using golden section method in each load step.

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MECHANICAL AND STRUCTURAL PROPERTIES OF MULTILAYERS COMPOSITE STEEL PREPARED BY HOT ROLLING

Tomáš Kubina, Jan Nacházel
COMTES FHT a.s., Dobrany, Czech Republic
E-mail: tomas.kubina@comtesfht.cz

Multilayered metal composites consisting of alternating metals or alloys have been well developed to obtain the superior mechanical properties different from those in any of the constituent materials.In the present work, hot rolling bonded multi-layered composites consisting of austenitic stainless steel and martensitic tool steel with high nitrogen content are focused. The effects of hot rolling on microstructure of composites with different variety of layers are discussed. Influence of the tempered microstructure on the tensile behaviour of a 3-layer to 64-layer laminated composite steels will be also described and discussed. Also will be investigated possible the enhanced plasticity of the brittle layer in the composite.

THE EFFECT OF DIFFERENT CURRENT TYPES ON THE MICROSTRUCTURE AND CORROSION PROPERTIES OF Ni/NANOAl_2O_3 COMPOSITE COATINGS

Beata Kucharska, Agnieszka Krawczynska, Krzysztof Rozniatowski, Karol Poplawski, Jerzy Robert Sobiecki
Warsaw University of Technology, Woloska 141, 01-407 Warszawa,Poland
E-mail: bhucharska@gmail.com

Nickel matrix composite coatings with ceramic disperse phase have been widely investigated due to their enhanced properties, such as higher hardness and wear resistance in comparison to the pure nickel. The paper describes an investigation of the nickel and nickel-alumina coatings. The coatings were obtained from Watts bath with presence of nickel grain growth inhibitors by direct (DC), pulse (PC) and pulsed reverse (PRC) current plating. The study included the composite coatings of microcrystalline and nanocrystalline Ni matrix and nanometric Al_2O_3 particles. In order to ensure uniform co-embedding of disperse phase particles with nickel matrix and producing a stable suspension, the mechanical agitation was also used. It was proved in our previous investigations that the mechanical agitation is the best way of embedding of nano-alumina particles in nickel matrix. The Ni/Al_2O_3 nanocomposite coatings were characterized by SEM, TEM and imaging of surface profiles techniques. In order to evaluate corrosion resistance of produced coatings, the corrosion studies have been carried out by the electrochemical impedance spectroscopy and potentiodynamic method in a 0.5M NaCl solution. Nyquist and Bode diagrams obtained by the impedance spectroscopy method are established. The equivalent electric circuit and its parameters were determined to interpret impedance spectra. The corrosion current, corrosion potential and corrosion rate were determined. Investigations of the corrosion damages of the produced surface layers were performed by scanning microscope techniques.
The completed studies have shown that the type of current significantly affects the structure of nickel and composite coatings, as well as its corrosion properties.

TIME DEPENDENCE OF OCCURRENCE OF TYPICAL DAMAGES ON BEARING SURFACE OF NITRIDED DIES FOR Al HOT EXTRUSION AS INDICATOR FOR INCREASING OF SERVICE TIMES

I. Peruš[1], M. Terčelj[1], P. Cvahte[2], G. Kugler[1]
[1]Faculty of Natural Sciences and Engineering, University of Ljubljana, Aškerčeva cesta 12, 1000 Ljubljana, Slovenia
[2]Impol, Partizanska ulica 38, 2310 Slovenska Bistrica, Slovenia
E-mail: goran.kugler@omm.ntf.uni-lj.si

On selected nitrided dies for Al hot extrusion main reasons for their decreased service times were revealed and explained. Main influential parameters in this study refer to contact pressures on die bearing surface, die design, length of bearing surface and quality of nitrided layer. Additionally laboratory wear tests using "block on cylinder" test configuration were carried out at various contact pressures and quality of nitrided samples; thus laboratory obtained results on wear characteristics of nitrided samples were combined with results of wear analysis on selected industrial dies. Time occurrence of typical damages on bearing surface of dies indicates on possibility of increasing die service time. Especially, the time occurrence of in sliding direction oriented removal of the nitrided layer, can be the main indicator at assessment of possibilities for prolongation of die service time. Achieving the lower contact pressure on die bearing surface by improved design of dies can lead to increasing of their service times. This phenomenon was verified also in laboratory wear testing. Lower quality of nitrided layer in combination with short bearing surface and occurrence of enough high contact pressure close to exit edge of bearing surface can considerably decrease die service time.

COMPOSITE FILLINGS – MONITORING THE POLYMERISATION REACTION

Danica Kunaver[1], Matevž Kunaver[2]
[1]Public helth center – Vič-Rudnik
[2]Faculty for electrotechnics, University of Ljubljana
E-mail: danica.kunaver@gmail.com

In this contribution, we shall present the basic components of composite fillings and monitor the crosslinking of the composite with a differential dynamic calorimetry (DSC), coupled with a source of UV light. Composite fillings are chemically very challenging mixture of a variety of binders and fillers, enabling the manufacture of durable and aesthetically suitable dental fillings. Crosslinking takes place with UV light, so it is important that both the duration and intensity are sufficient. With the DSC measurements we proved how crosslinking takes place and how much energy is released during the exothermic reaction of crosslinking. Because the UV irradiation was governed in short intervals, it was necessary to repeat it several times to achieve a perfect crosslinking of composite filling material.

A noticeable difference is between the first two irradiations, when the reaction is the most prominent and strongly exothermic and the others where the intensity decreases to a constant value, which represents the heat change due to light energy of UV irradiation and not due to the heat released by reactions. We repeated the experiment several times and found out that it is necessary to irradiate seven times in duration of three seconds, to achieve a perfect crosslinking. By adding up the released energy of reaction we get a value of –20.3 J/g. When the sample was thermaly crosslinked by heating to 300 ^{o}C, the enthalpy of reaction was –16.3 J/g, which is comparable, even though we used two different ways of crosslinking.

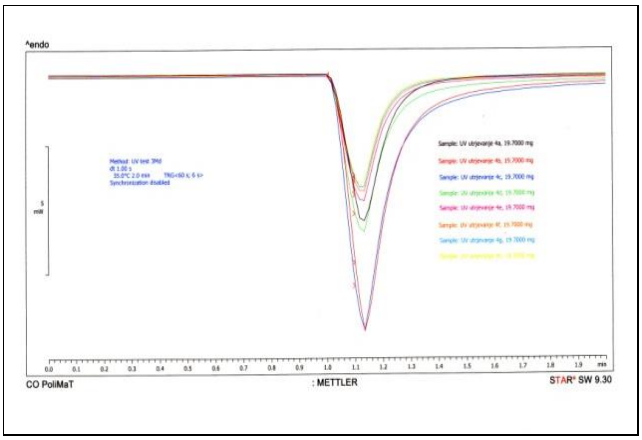

Figure 1: Enthalpy changes during the UV irradiation.

FTIR analysis of the crosslinked and initial sample showed a difference in chemical composition and, above all, which functional groups react during UV polymerisation. After the polymerisation the intensity of the waveband at 1320 cm^{-1} is reduced, which is typical for the vibration of the C-O-C group in methylmetacrylate. At the same time the characteristic hydroxyl groups waveband at 3384 cm^{-1} disappears entirely. The changes are the result of the crosslinked polymer structure, where the movement of specific functional groups is limited or fully disabled. These changes in FTIR spectrum prove the complete polymer crosslinking and are consistent with the DSC measurements.

LASER WELDING OF NEW GRADE OF ADVANCED HIGH STRENGTH STEEL DOMEX 960

Agnieszka Kurc-Lisiecka[1], Aleksander Lisiecki[2]
[1]University of Dąbrowa Górnicza, Rail Transport Department, Cieplaka 1c, 41-300 Dąbrowa Górnicza, Poland
E-mail: alisiecka@wsb.edu.pl
[2]Silesian University of Technology, Faculty of Mechanical Engineering, Welding Department, Konarskiego 18A, 44-100 Gliwice, Poland
E-mail: aleksander.lisiecki@polsl.pl

The article describes the results of the autogenous laser welding of the new generation advanced high strength steels (AHSS) Domex 960, recently introduced to the industry. The new Domex 960 grade steel is classified to a group of thermomechanically rolled steels, by the manufacturer. However, details of the manufacturing process of the new grade steel are undisclosed. The manufacturer provides just a little information on the arc welding of this steel grade, but there is no information about laser welding. Therefore, novelty of this article is based on the study of the effect of laser welding parameters on the quality and properties of butt joints of the new Domex 960 grade steel. The modern Yb:YAG disk laser TruDisk 3302 emitted at 1.03 μm was used for butt joints welding of 5.0 mm thick steel sheets. First the bead-on-plate welds were produced in a wide range of laser welding parameters. The influence of the laser welding parameters on the penetration depth, fusion zone shape, and weld quality was investigated. Next the test butt joints were one-side laser welded. Results of joints microstructure analysis, mechanical tests such as tensile, bending and impact test, as well as the microhardness measurements, have shown that the low heat input during laser welding of the new Domex 960 grade steel is advantageous. Low heat input and thus high cooling rate of the weld metal and heat affected zone (HAZ) leads to the formation of a favorable fine-grained microstructure and also provides high mechanical properties of butt joints, comparable to the properties of the base metal. Despite the high cooling rates, there was no significant increase in microhardness measured across the butt joints. Moreover, slight decrease of the microhardness was observed in the HAZ.

IMPACT TOUGHNESS OF WMD AFTER MAG WELDING WITH MICRO-JET COOLING

Tomasz Węgrzyn[1], Jan Piwnik[2], Aleksander Borek[3], Agnieszka Kurc-Lisiecka[4]
[1]Silesian University of Technology, Transport Faculty, Krasińkiego 8, 40-019 Katowice, Poland
E-mail: tomasz.wegrzyn@polsl.pl
[2]Bialystok University of Technology, Mechanical Faculty, Wiejska 45c, 16-351 Białystok, Poland
E-mail: j.piwnik@pb.edu.pl
[3]Plasma System, Towarowa 14, 41-103 Siemianowice Śląskie, Poland
E-mail: borek@plasmasystem.pl
[4]University of Dąbrowa Górnicza, Rail Transport Department, Cieplaka 1c, 41-300 Dąbrowa Górnicza, Poland
E-mail: alisiecka@wsb.edu.pl

MAG is an important industrial and widely used welding process. Developments in arc welding processes are strongly related with the need to increase productivity without losing quality of the weld. Properties of steel welded structures depend on many factors such as welding technology, filler materials, state of stress. The main role of that conditions is also connected with materials, chemical composition of steel and metal weld deposit. Chemical composition of metal weld deposit could be regarded as a very important factor influencing properties of weld metal deposit (WMD). Especially nickel and molybdenum, are regarded as the main elements positively effecting on mechanical properties and metallographic structure of low alloy welds. Welding parameters, metallographic structure and chemical composition of metal weld deposit are regarded as the important factors influencing the impact toughness properties of deposits. In typical low alloy steel weld structure the best mechanical properties correspond with maximal amount of acicular ferrite (AF) in weld metal deposit (WMD) and minimal amount of MAC phases (self-tempered martensite, retained austenite, carbide). The article focuses on mild steel welding and covers the new possibilities of that method. Since 2011 innovate welding technology based on micro-jet cooling just after welding is being checked. Weld metal deposit (WMD) was carried out for standard MIG welding and for new welding method with micro-jet cooling. A very high percentage of acicular ferrite (AF) in WMD was gettable (55–73 %) for low alloy welding with micro-jet cooling injector. This beneficial structure (very high amount of AF) is unusual to observe in WMD in other welding methods. This method is very promising mainly due to the significant improvement of weld quality and reduces costs. Furthermore impact toughness and strengths of WMD were carried out. The present paper aims at outlining same of the recent innovations in MIG welding which represent steps ahead to achieve the objectives outlined above.

GALLIUM-BASED ANTIBACTERIAL PROTECTION OF HYDROXYAPATITE

Mario Kurtjak, Marija Vukomanović, Danilo Suvorov
Jožef Stefan Institute, Advanced Materials Department – K9, Jamova cesta 39, 1000 Ljubljana
E-mail: mario.kurtjak@ijs.si

Hydroxyapatite is a bioactive material, widely used for bone, tooth implantation and a highly promising material for tissue engineering.[1] In order to prevent infection during implantation and enable wound healing and tissue repair, antibacterial protection with low cytotoxicity is needed. The increasing problem of antibiotic resistance calls for other ways of such protection, like incorporation of antibacterial ions[2] or attachment of nanoparticles[3]. Gallium is still unexplored in that field despite its favourable properties, such as promotion of bone growth and antibacterial activity[4]. Ga^{3+} ions substitute Fe^{3+} ions, but cannot be involved in one-electron reduction, so many important redox processes inside the bacterial cell are blocked.[4] They are very effective against iron-dependent bacteria, like Pseudomonas Aeruginosa, which can cause acute prosthetic joint infections and create biofilms on biomaterials.[5] Gallium has provided good antibacterial protection to phosphate-based glass[6], but it has not been explored yet for protection of hydroxyapatite. We present two different strategies for gallium-based protection of hydroxyapatite: incorporation of gallium ions and attachment of gallium nanoparticles on hydroxyapatite surface. The two materials are compared regarding their mechanism of action, effectiveness against P. Aeruginosa and cytotoxicity.

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COMPARISON OF ALUMINIUM-MATRIX COMPOSITE SURFACES PRODUCED USING LASER FEEDING OF CERAMIC POWDERS

Krzysztof Labisz, Tomasz Tański, Mariusz Krupiński, Wojciech Pakieła
Institute of Engineering Materials and Biomaterials, Silesian University of Technology, ul. Konarskiego 18a, 44-100 Gliwice, Poland
E-mail: Krzysztof.labisz@polsl.pl

Surface layer engineering, especially surface laser treatment, consists of introduction of small amount of alloying additions into the surface layer in form of ceramic particle powders with different properties. This is a method which may offer new appliance possibilities, due to its complex microstructure as well as hardness and wear resistance enhancement. This paper presents the investigation results concerning the reinforcement of the surface layer of cast aluminium-silicon-copper alloy after heat treatment alloyed with ZrO_2 and Al_2O_3 ceramic powder using High Power Diode Laser (HPDL). In this work was determine the proper laser treatment conditions for laser surface treatment, for investigation of the obtained structure there was used light and scanning electron microscopy with EDS microanalysis as well as mechanical properties using Rockwell hardness tester were measured. After the laser surface treatment carried out on the heat treated aluminium cast alloys, there are visible structural changes concerning the microstructure as well as distribution and morphology of the phase occurred in the alloy, influencing the hardness of the achieved layer. In the structure there were discovered three zones, with different structure and properties. Concerning the laser treatment conditions for laser surface hardening also the laser power and ceramic powder feed rate was analysed. The structure of the surface laser tray changes in a way, that there are zones detected like the remelting zone the heat influence zone. The main goal of this work is to determine the possibility of HPDL application for remelting and alloying on the cast Al-Si-Cu cast aluminium alloy and make it appropriate for application in real working conditions mainly for light metal constructions in different industry branches.

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RECYCLING OF AZ61 AND AZ80 MAGNESIUM ALLOYS MACHINING CHIPS THROUGH LOW-TEMPERATURE CONSOLIDATION

Paweł Ostachowski[1], Andrzej Korbel[1], Włodzimierz Bochniak[1], Marek Łagoda[1], Romana Śliwa[2]
[1]AGH-University of Science and Technology, Faculty of Non-Ferrous Metals, A. Mickiewicza 30Av, 30-059 Cracow, Poland
[2]Rzeszow University of Technology, Powstańców Warszawy 12Av. 35-959 Rzeszów, Poland
E-mail: mlagodakrk@gmail.com

The recycling of flaked fractions, particularly metal chips which are a side product of machining, remains one of the main challenges of material engineering. The existing metallurgical technique of melting chips proves to be ineffective and therefore not up to today's standards. Developing new recycling methods is not only necessary for technological or economic reasons, but also if not mainly in order to fulfil environmental requirements, such as the need to preserve natural resources.
The KOBO method, initially developed to upgrade the processing of solid metals and wrought, extruded, drawn, rolled or turned alloys, gives an opportunity to consolidate the chips of metals and light alloys on an industrial scale at a room temperature (without the need to pre-heat the charge or tools). The application of the KOBO method intensifies the deformation, does not require extra energy and allows for the process to take place at a low (room) temperature.
Cyclic twisting, which is an accompanying process to the KOBO extrusion, results in an intense localization of deformation in shear bands and the „exposure" of new, unoxidized elements in the surface of the adjoining chips. The high compressive stress between these elements ensures their good adhesion and subsequently enables their permanent, atom bonding.

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STUDY, CALCULATION AND ANALYSIS OF CHANGES IN CHEMICAL REACTION PROPAGATION VELOCITY IN MULTILAYERED THERMITE STRUCTURES

E. A. Lebedev[1], M. I. Vorobiev[1], Y. P. Shaman[2], D. G. Gromov[1], A. S. Shuliatyev[1], Yu. I. Shilyaeva[1]
[1]National Research University of Electronic Technology, Shokin sq., bld. 1, Zelenograd, Moscow, Russia
[2]Scientific Manufacturing Complex "Technological Centre", 5 pas. 4806, Zelenograd, Moscow, Russia
E-mail: dr.beefheart@gmail.com

In recent years the multilayered thermite materials are of particular interest to the researches throughout the world due to their ability to be used as an effective local heaters. Multilayer structures replaced the traditional powder thermite mixtures and opened up new possibilities of nano- and micro-scale surfaces, materials and devices joining integration. For such structures fabrication traditional and well-known vacuum deposition techniques (magnetron, electron beam) are used, what allows to achieve excellent purity of materials and to control the structure parameters with high accuracy. Such control is very important when the thicknesses of individual layers are subjected to dimentionality reduction and are only a few dozen or even few nanometers thick. In this case even a slight deviation can lead to a significant change not only in the reaction propagation velocity but in total heat release.

The authors have produced the study of main thermal effects using differential scanning calorimetry and thermos gravimetric analysis, and reaction propagation velocities were analyzed in Al-Ni based multilayered thermite structures. It was shown that the start temperature of the reaction can be "moved" in a wide range (from room temperatures) by changing the component layer thicknesses. Changing the atomic proportions of thermite structure components allows to change intensity and character of heat release. Thus the multilayered thermite materials can be tailored to specific applications and tasks.

Also a mathematical model of the multilayer structure was developed and modeling of reaction propagation possibility and its velocity for different structural parameters were produced.

The propagation velocity of chemical reactions were also evaluated in experimental works using highspeed camera. Obtained results allowed us to correct developed mathematical model.

USING THE FEM IN THE PROCESSES OF CHANGES AND DESTRUCTION OF THE SURFACE LAYER SUBJECTED TO ELASTIC AND PLASTIC STRAIN

Aneta Duda, Sylwester Korga, Klaudiusz Lenik
Lublin University of Technology, Fundamentals of Technology, 38 Nadbystrzycka Str, 20-618 Lublin, Poland
E-mail: a.duda@pollub.pl, wpt.kpt@pollub.pl, s.korga@pollub.pl

This paper presents the numerical analysis of the adopted kinetic model of a friction pair. The process of a change in the state of stress and strain depending on the adopted initial conditions was assessed. They were compared to the results obtained at the test stand and during the metallographic investigations. The states of stress and strain in the material resulting in its specific changes, degradations and destruction were discussed.The important aspect of modelling is the possibility of using the finite element method. The performance of the numerical analysis allows the tested phenomenon to be examined in detail. This also concerns a change in condition of the surface layer and its degradation under drawing conditions. The performed investigations concerned the use of the reverse test method in the analysis of deformation of the material and its changes including the degradation processes followed by destruction.The investigations of the adopted universal sliding friction pair using modelling and the finite element method allowed the assessment of the impact of frictional resistances on changes, including degradation and destruction, in the material subjected to strain. As a result, it allows the boundary conditions for conducting the drawing process to be determined.

ARCHAEOMETALLURGICAL METALLOGRAPHY

Nataša Lipovšek[1], Matjaž Knap[2], Jakob Lamut[2]
[1]Institute of Metals and Technology, Lepi pot 11, Si-1000 Ljubljana Slovenia
[2]OMM NTF, University of Ljubljana, Aškerčeva 12, SI-1000 Ljubljana, Slovenia
E-mail: natasa.lipovsek@imt.si

Man started to produce metals and alloys trough pyrometallurgical processes thousands of years ago. Different metal objects that have been made in the distant past can be observed in museums. The collections in museums and written archives testify to the rich cultural and technical heritage.
The production of different metals and alloys, the manufacture of tools, different objects and machines has been present in the Slovenian territory for ages. At some places the production site has been preserved until nowadays. The field of production technologies has also been subject to innovation: the production of ferromanganese in the blast furnace (Jesenice), the use of brown coal in the production of puddle steel (Prevalje) and the utilisation of iron rich slag from the puddle furnace (secondary resource) and scale in the Štore and Mislinja ironworks.
The earth is a special and priceless »archive« that contains and preserves products that were made during past production. We can speculate on the technological rout of the production of different metal products on the basis of such »archive« data. The preparation of metallic and non-metallic archaeological samples must be very careful.
Structure of slags that occur during the production of wrought iron during the reduction of iron ore and heating of the iron on a forge are presented, where typically the wrought microstructures and the advanced corrosion in iron and steel products were observed.

EROSION WEAR RESISTANCE OF TITANIUM MATRIX COMPOSITE Ti/TiN PRODUCED BY DIODE LASER GAS NITRIDING

Aleksander Lisiecki[1], Agnieszka Kurc-Lisiecka[2]
[1]Silesian University of Technology, Faculty of Mechanical Engineering, Welding Department, Konarskiego 18A, 44-100 Gliwice, Poland
E-mail: aleksander.lisiecki@polsl.pl
[2]University of Dąbrowa Górnicza, Rail Transport Department, Cieplaka 1c, 41-300 Dąbrowa Górnicza, Poland
E-mail: alisiecka@wsb.edu.pl

Titanium alloys have excellent properties as structural materials, high corrosion resistance, however, their resistance to surface wear by friction and erosion, is not satisfactory. Therefore different methods of surface modification of titanium and titanium alloys are developed. One of the most promising and widely investigated methods of surface modification of titanium alloys is laser gas nitriding (LGN). Moreover, the continuous development of laser devices, increasing capacity and parameters of the laser generators, as well as increasing the flexibility of the laser beam allow for further development of laser surface modification of titanium alloys. Novelty of this article is based on application of a prototype experimental stand equipped with a high power direct diode laser (HPDDL), characterized by unique properties of the laser beam, for producing the titanium matrix composite (TMC) surface layer during laser gas nitriding in liquid state. In contrast to the nitriding in solid state, the laser nitriding of titanium alloys in liquid state is not well studied and described. Results of the study indicate that the processing parameters such as laser output power, scanning speed, gas atmosphere, etc. strongly affect the morphology and properties of the composite surface layers produced on the substrate of titanium alloy Ti6Al4V. It was found that the composite surface layers are composed mainly of δ-TiN and also ε-Ti_2N precipitations in the metallic titanium matrix. Microhardness of the surface layers, which reaches almost 2400 HV0.2 is related to the phase composition and density of the nitrides precipitations in the metallic matrix. Erosion wear resistance of the composite surface layers is significantly higher compared to the substrate of titanium alloy Ti6Al4V. The erosion wear resistance depends on the angle of incidence. Reducing the angle of incidence decreases the weight loss of the composite surface layers, and simultaneously increases the weight loss of the Ti6Al4V. It was found that the weight loss of the composite layer with the highest resistance is over six times lower compared to to the Ti6Al4V, at an incidence angle of 15 °.

PREDICTION OF FRACTURE FORMATION IN OPEN DIE FORGING OF HEAVY COMPONENTS MADE OF ULTRA HIGH STRENGTH STEEL

Łukasz Lisiecki, Piotr Skubisz
AGH University of Science and Technology, Mickiewicza Av. 30 30-059 Kraków, Poland
E-mail: lisiecki@agh.edu.pl

An increase in the capacity of nuclear power, metallurgical and mining industries in the world requires the development and use of new energy-saving processes of fabrication of forging ingots for the parts of responsible destination, the weight of which exceeds 40 T. Such forgings are unique, they meet high requirements in quality of final products.

One of the solutions concerning forging of large ingots is the possibility of realization the forging sequence with the use the hollow preform to be drawn out in cogging process with flat dies on a mandrel. However, novel method of manufacturing large components bring about unfavourable state of stress, which in connection with relatively brittle, and accelerated dissipation of heat due to thinner walls and increased contact area tool/metal is a cause of high vulnerability to fracture occurrence at any of passes required to obtain required dimensions.

Definition of fracture models and criteria dedicated for open-die forging of non-worked and roughly worked ingot material gives the ability of cost-effective prediction and recognition of fracture-related defects during forging. This in turn, allows determination and verification of forging variable conditions at the stage of design of technology.

In this work fracture criteria conforming to state of stress and conditions prevailing in the forging operations were selected. Estimation of integral limiting parameters by compression tests and numerical calculation, following selection of specimen geometry in a sensitivity analysis was conducted for ultra high strength steel AISI 4140, used in high-duty parts for power-train applications. Fracture model parameters were implemented into FEM code. Estimation of limiting integral parameters based on laboratory specimens, followed by determining limiting integral value in the moment of cracking by means of finite element method allowed implementation of the model into simulation of the industrial forging process for prediction of cracks locations. The results of analysis with a use of the proposed model were verified in industrial practice indicating credibility and consistency with observed damage locations.

MICROSTRUCTURE OF A Nb-BEARING Ni-Cr-Mo DENTAL ALLOY

Franc Zupanič[1], Carlos A. Nunes[2], Gilberto C. Coelho[2], Paula L. Cury[2], Gorazd Lojen[1], Christian Gspan[3], Tonica Bončina[1]
[1]University of Maribor, Faculty of Mechanical Engineering, Smetanova ul. 17, SI-2000 Maribor, Slovenia
[2]University of Sao Paulo, Department of Materials Engineering – School of Engineering, Estrada Municipal do Campinho, s/n, Caixa Postal 116, 12602-810, Lorena, São Paulo, Brazil
[3]Institut für Elektronenmikroskopie und Nanoanalytik 8010 Graz, Steyrergasse 17/III, Austria
E-mail: gorazd.lojen@um.si

The use of Ni-Cr-Mo alloys has become increasingly popular in producing of dental prosthesis, due to their low cost, good corrosion resistance, good aesthetic and functional aspects enabling manufacturing of thinner, lighter and cheaper prostheses [1]. In order to produce an alloy with an improved performance, an alloy Ni-Cr-Mo was alloyed with Nb, which is produced in Brazil. The samples for microstructural investigations were produced using three different methods: investment casting, continuous casting and centrifugal casting. They were characterized using metallography and mechanical testing. The main characterization methods were light microscopy, scanning and transmission electron microscopy, energy dispersive X-ray spectroscopy, X-ray diffraction and compression testing. The microstructure of the alloy mainly consisted of three different phases: Ni-based solid solution (γ-matrix), the γ'-Ni_3(Al,Ti) precipitates and a ternary intermetallic compound – $Nb_6Ni_{16}Si_7$. The mechanical compression test revealed high strength of this alloy, which was close to 1897 MPa, and appropriate ductility of 0.30. The microstructure of continuously cast samples were much finer than that of the investment and centrifugal cast samples, providing better mechanical properties. The investigation also provided data for explaining the processes taking place during solification of the alloy in dependence of the cooling rate.

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OPTIMIZING THE REACTIVITY OF THE RAW MATERIAL MIXTURE FOR PORTLAND CLINKER FIRING

Marcela Fridrichová, Dominik Gazdič, Karel Dvořák, Radek Magrla
Brno University of Technology, Faculty of civil engineering, Veveří 331/95, 602 00 Brno, Czech Republic
E-mail: magrla.r@fce.vutbr.cz

On the basis of long-term chemical, mineralogical and granulometric analysis concluded that concrete recycled materials are usable for production of Portland cement clinkers. However, it should combine them with high-calcium limestone, because even the finest undersize fraction contains a relatively low proportion of CaO, usually not exceeding 10 %. Furthermore, it was concluded that dosing recycled with high-calcium limestone in a ratio of about 1: 3 can be obtained Portland cement clinker of the same quality as a common commercial clinker. The problem of the preparation of the cement clinker is in the very low reactivity of the raw material mixture containing high-calcium limestone and an increased proportion of silica in the concrete component. [1–4]

In order to improve the reactivity of the raw material mixture was proposed modifications with intensifiers for clinker production. As possible additives of this type was selected gypsum, $CaSO_4 \cdot 2H_2O$, fluorite, CaF_2, and sodium fluorosilicate, Na_2SiF_6. The prepared samples of raw material mixtures were assayed for reactivity during the cement clinker firing process using kinetic method. After evaluation of the achieved results, a sample modified with the most effective grinding aid was burned in an operation rotary kiln. The effectiveness of the modifications was evaluated based on the phase composition of the burned cement clinker and by determining the technological properties. Fraction recycled concrete 0-8 mm and high-calcium limestone were used to prepare the raw material mixtures.

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EFFECT OF DEFLOCCULANTS ADDITION ON RHEOLOGICAL PROPERTIES OF CERAMIC SLURRIES FOR SHELL MOULDS FABRICATION

P. Wisniewski, M. Malek, J. Mizera, K.J. Kurzydlowski
Faculty of Materials Science and Engineering, Warsaw University of Technology
E-mail: p.wisniewski@inmat.pw.edu.pl

In Poland from few years undertaken research work to determine the possibility of the exploitation of new materials for ceramic shell moulds preparation. Most of methods of fabrication ceramic slurries for investment casting are based on alcohol binders. This is a one of first research for determine how to prepare ceramic slurries using a new ecological method of production based on water soluble binders. Work present rheological properties of ceramic slurries based on silicon carbide and new binders additions (polyvinyl alcohol and two polyacrylic binders). To modification rheological properties of investigated slurries deflocculants in amount 15 wt % as a solution were added. Solid phase content in ceramic slurries were 62.5 wt %. Standard industrial parameters like: pH, density, Zhan 4# Cup viscosity and dynamic viscosity on rheometer were studied. To characterization silicon carbide material grain size, SEM and Zeta potential were studied. Ceramic slurries were made in mechanical mixer. Time of mixed was 96 h. Obtained results shown that ceramic slurries were stable vs. time and meet standard industrial requirements. Ceramic slurries had very promising properties and there are very perspective for future shell moulds fabrication.

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MODELING OF SHOT PEENING EFFECTS ON THE SURFACE PROPERTIES OF (TiB + TiC) / Ti–6Al–4V COMPOSITE EMPLOYING ARTIFICIAL NEURAL NETWORKS

Erfan Maleki, Abolghasem Zabihollah
Mechanical Engineering Department, Sharif University of Technology-International Campus, Kish Island, Iran
E-mail: maleki_erfan@kish.sharif.edu

Titanium matrix composites (TMCs) have wide application prospects in the field of aerospace, automobile and other industries because of their good properties such as high specific strength, good ductility, and excellent fatigue properties. However, in order to improve their fatigue strength and life, crack initiation and growth at surface layers must be suppressed using surface treatments. Shot peening (SP) is an effective surface mechanical treatment method widely used in industry which can improve mechanical properties of surface. Well as, artificial neural network (ANN) has been used as an efficient approach instead of various and costly tests to predict and optimize the engineering problems. In present study effects of the SP on TMC were modeled by means of ANN. Back propagation (BP) error algorithm is developed to networks training. Data of experimental tests on (TiB + TiC)/Ti–6Al–4V composite are employed in order to train the networks. Volume fractions of reinforcements (TiB + TiC) were 5 % and 8 %. ANN's testing is accomplished using different experimental data which were not used during networks training. Distance from the surface (depth) and SP intensity are regarded as input parameters and residual stress and hardness of Ti–6Al–4V before and after the SP process and adding reinforcements are gathered as output parameters of the network. A comparison was made between experimental and predicted data. The predicted results were in good agreement with experimental ones, which indicates that developed neural network can be used for modeling the SP process on TMCs.

SEM, AES AND XPS INVESTIGATIONS OF NON-TREATED AND LASER-TREATED AlZnMgSi THIN FILMS

Djordje Mandrino[1], David Nolan[2], Matjaž Godec[1]
[1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
[2]BlueScope Steel Limited, Old Port Road, PORT KEMBLA, NSW2505, Australia
E-mail: djordje.mandrino@imt.si

AES depth profiling and XPS were performed to compare non-treated and laser treated surfaces of the AlZnMgSi corrosion-protection coating. AES profiling data were also used to distinguish between oxidized and non-oxidized metal along the profile. This was achieved by plotting $\Delta KE = (E_{kin})_{elemental} - (E_{kin})_{measured}$ vs. depth. XPS measured BE provided data about elements constituting sample surface and their oxide states.

AES depth profiles of non-treated and treated sample showed expected initial drop of C with maximum O shortly after and Al increase coinciding with O decrease. Results from non-treated and laser treated surface are very similar.

ΔKE vs. depth plots showed that in non-treated sample Al turns from oxidized into non-oxidized between 20 and 40 nm, as it does in laser treated sample where oxidized Zn is also found in first 15 nm. This oxidized Zn becomes non-oxidized at approximately same depth as Al (15–40 nm).

XPS results from non-treated and laser treated surface were also similar with exception of Al where at least for Al 2 s BE difference between 2 types of surfaces is larger than 1 eV. For most of the selected elements BE differences between at least some of their oxidation states are below 1 eV, while corresponding Auger KE shifts may be up to several eV which makes AES rather handy for evaluating oxidation states of this particular selection of elements. XPS also confirmed Si on the surface and evaluated its oxidation state.

TRIPLEX COATINGS BEHAVIOR IN EXTREME THERMAL CONDITIONS

Sorin Dimitriu[1], Victor Manoliu[2], Gheorghe Ionescu[2], Adriana Stefan[2], Mihai Botan[3], Alina Dragomirescu[2]
[1]„Politehnica" University of Bucharest-ROMANIA
[2]National Institute for Aerospace Research „Elie Carafoli" – INCAS-220 Iuliu Maniu Bd., Bucharest 6, ROMANIA
[3]Dunarea de Jos University Galati – ROMANIA
E-mail: sorindimitriu@yahoo.com,ionescu.gheorghe@incas.ro, stefan.adriana@incas.ro,
botanmihai@yahoo.com, dragomirescu.alina@incas.ro, manoliu.victor@incas.ro

Plasma spray thermal barrier coatings (TBC) is widely accepted solution for increasing the functional performances and life of some vital parts of power generators systems, in aerospatiale, metallurgy and machine building industries

From the frame of the wear factors acting simultaneously at high values-corrosion, erosion, wear, temperature on the aimed parts provided with protection, generic named thermal barrier coatings, the thermal shock acts the most perturbing.

To illustrate the behavior of some multilayer ceramic structures in extreme thermal conditions, the authors conceived and achieved an installation and the associated procedure for testing at quick thermal shock, versatile functioning in semiautomatic mode and monitoring the functional parameters. The fundamental functional parameter which particularize the installation is heating-cooling speed up to 70 °C/s, performance superior of the known installation in the field.

High heating-cooling gradients generate within the triplex ceramic structures, morphological, structural and compositional modifications, individual in each layer – bond coat (BC), intermediate layer (IL), top coat (TC) – and interfacial support/bond coat, bond coat/intermediate layer and intermediate layer-top coat which are evidenced by optical and electronic microscopy investigations. Complex modification, thermal induced in the triplex elaborated structures evidenced by microscopic investigations and tribological tests, produce effects which determine the exfoliations of the protective coatings. Tribological behavior – friction coefficient, wear, etc. some morphological data in the wear trace of the couples of the studied materials associated, especially top coat (TC) from the multilayers structures will be synthetically presented.

FEM ANALYSIS OF DEFECTS IN THE WELDING OF THIN MATERIALS USED IN THE AVIATION INDUSTRY BASED ON THERMOGRAPHIC MEASUREMENTS

K. Maś, M. Marchewka, D. Płoch, M. Woźny, E. M. Sheregii
Faculty of Mathematics and Natural Sciences, Centre for Microelectronics and Nanotechnology, University of Rzeszow, Pigonia 1, 35-959 Rzeszow, Poland
E-mail: marmi@ur.edu.pl

Thermography measurements allow to detect the defects that may appear on a joint at welding of components [1]. Energy pulse generated by a xenon lamp with adequate power in a short period of time is sufficient for thermal excitation and enables to register the temperature distribution using the thermography high resolution camera FLIR SC7000 [2]. The impulse with 6 kJ energy and 6 ms time generate sufficient power to measure the temperature distribution on the surface of the weld tested.

Based on the results of the experiment the numerical experiment were deigned. The FEM method implemented in COMSOL environment where used [2]. The numerical method takes into account the values of the energy generated by the xenon lamp as well as the time dependence of the cooling the tested elements as a function of time. The data from the thermography camera after developing FEM provide information on the size of defects, their distribution, and the impact on the strength of welded components: if the properties of material (k, ρ, c_p) are changed, the effusivity e (which is a thermal property that measures the material ability to exchange heat with its surroundings) is changed too, what causes the local change of temperature ΔT. This allows to register the defects in welds "on-line" at the production process. Material used for analysis detection of defects in the welded joints is Inconel 718, stainless steel 410 and stainless steel 321 [3]. The peak energy which flow throw the samples with defects in the welded joints its completely or partially blocked. It cause different temperature distribution on the surface in the places where the connection discontinuity take place. That was confirmed by numerical analyses also.

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ETCHING METHODS OF DUPLEX STEELS

Petr Martínek, Pavel Podaný
COMTES FHT a.s., Průmyslová 995 334 41 Dobřany
E-mail: petr.martinek@comtesfht.cz

In the present paper, an optimum method of etching a duplex ferritic-austenitic steel is sought for measuring the proportions of major phases by image analysis and for determining the amount, distribution and types of intermetallic phases, where relevant. The microstructures were revealed using seven different reagents. The proportions of phases were measured using image analysis and, in some cases, using the quantitative grid method. The experimental material was the X2CrNiMoN 22-5-3 steel in two conditions: open-die-forged and subsequently solutioned and annealed with a long holding time. In the latter case, the material contained a vast amount of intermetallic precipitates.
The quantities of major and intermetallic phases in the specimens were determined by EBSD as well. Both quantitative and qualitative results of the EBSD analysis were compared with the data from optical microscopy measurements.

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ACOUSTIC AND ELECTROMAGNETIC EMISSION OF LIGHTWEIGHT CONCRETE WITH POLYPROPYLENE FIBERS

Richard Štoudek, Tomáš Trčka, Michal Matysík, Tomáš Vymazal, Iveta Plšková, Barbara Kucharczyková
Brno University of Technology, Faculty of Civil Engineering, Veveri 331/95, 602 00 Brno,
Czech Republic
E-mail: matysik.m@fce.vutbr.cz

This paper is focused on the failure monitoring in lightweight concrete (special high performance concrete which contains porous aggregate with low bulk density) with high-strength polypropylene fibers under mechanical loading. The aim was to determine how the cracks generation intensity in tested concrete samples depends on the fibers length and quantity. Our diagnostic method is based on the measurement of acoustic and electromagnetic emission signals, which occur when the solid dielectric materials are mechanically stressed. Several groups of lightweight concrete samples with various types and concentrations of high-strength polypropylene fibers have been prepared for our experiment. We have made two-channel measurements of the concrete samples from each group for defined loading conditions. First channel was electromagnetic emission (EME), second was acoustic emission (AE). Electromagnetic emission and acoustic emission methods are promising methods to study the generation and behavior of cracks. The main advantage of EME and AE is their ability to be detected already in stressed stage, which prevents the macroscopic deterioration in solids. From the obtained results can be concluded that the generated cracks intensity is significantly affected by the presence of polypropylene fibers and by theirs length and dosage.

TRACEABLE MAGNETIC MEASUREMENTS

Paul McGuiness
Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
E-mail: paul.mcguiness@imt.si

Being able to make accurate measurements of a physical property is vital in the world of materials science, and this is particularly so in the area of magnetic materials. Unlike the situation for mass, there are no SI artifact standards for magnetic materials, and there are no base SI units for magnetic quantities. Therefore, it is necessary to generate a magnetic field, and then with this field we can calibrate a field-measuring device. However, the traceable nature of this magnetic field must be assured. In theory a magnetic fild is traceable through measurements of mass, length and electrical current; however, in practise we use nuclear magnetic resonance in order to calibrate fields and field-measuring devices. For the magnetic samples, traceable measurements of length and mass are required, and the uncertainties in all these measurements must be combined to provide us with an overall uncertaintly for the magnetic properties of a magneti material. In this presentation we will look at the practical proplems of traceability and assess how accuate measurements of magnetic properties can be in a practical situation.

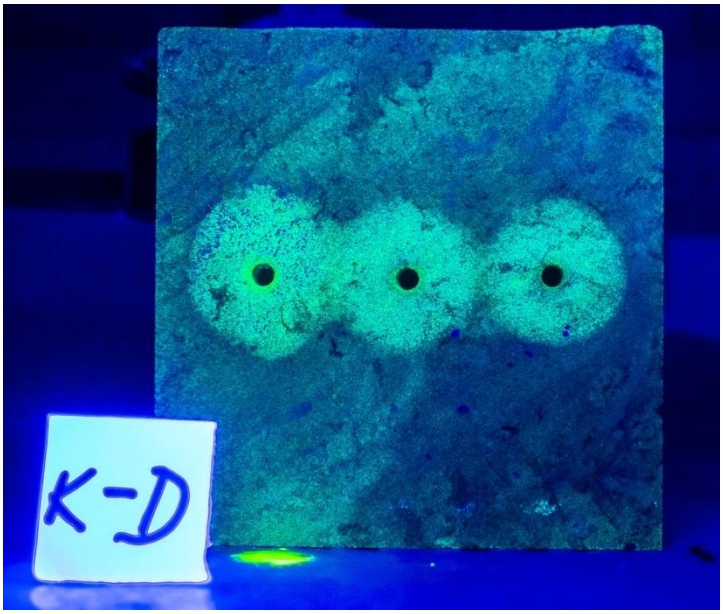
EXAMINATION METHODS OF WATERPROOFING INJECTION SCREENS IN VARIOUS BUILDING MATERIALS

Rostislav Drochytka, Pavel Dohnálek, Jindřich Melichar
Brno University of Technology, Faculty of civil engineering, Veveří 331/95, 602 00 Brno, Czech Republic
E-mail: melichar.j@fce.vutbr.cz

Redevelopment method of wet masonry by additional creating waterproofing injection screens in building structures is nowadays one of the most widespread methods of treating rising capillary wetness. Main advantages of this method are relatively quick and easy application and excellent final efficiency.

Many building constructions, especially those which are considerably old and fragile would not withstand any other mechanical procedures which have usually big impact on structures statics. In most of the times it is these types of buildings that are struck by rising wetness in lower levels and cellars. In that case usage of injection gels is the ideal solution.[1]

Factors like wetness, temperature or type of building material have influence on injections screens functionality. Main focus of this paper is testing of various injection gels penetration abilities and their final efficiency in dependence on these factors.



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BEHAVIOUR OF POLYMER-SILICATE MATRIX BASED COMPOSITE MATERIALS UNDER EXTREME TEMPERATURES

Tomáš Melichar, Jiří Bydžovský
Brno University of Technology, Faculty of Civil Engineering, Institute of Technology of Building Materials and Components, Veveří 331/95, 602 00 Brno, Czech Republic
E-mail: melichar.t@fce.vutbr.cz

Composite material systems are used in the building industry numerously. One of advantageous option is use of these materials in environment with extreme conditions, where conventional materials fail. Of course, to ensure sufficient resistance it is necessary to select and validate the appropriate composition of the mixture. Now this issue is discussed in the article, which presents some results of research into composites subjected to thermal stress. The current trend of environmental situation tends to diminish consumption of primary raw materials. Therefore, during design formulas, attention was focused on secondary raw materials and by-products of various industrial processes. The existing knowledge relevant to the query theme was also taken into account, i.e. special studies and publications. Blast-furnace slag and fly ash were used for modification of the binder. Primary binder was substituted in an amount of 35 wt % by the alternative raw materials. Furthermore dispersed reinforcement based on cellulose was applied. Emphasis was also placed on the different types of filler component. The filler component was formed by a combination of dense (primary – amphibolite) and porous (secondary – sintered fly ash) aggregate. Designed materials were exposed in environments up to 1000 °C with following controlled cooling to assess the behavior under extreme conditions. Effect of three different modes – slow and shock (air and water) cooling was analyzed. After stabilizing the temperature conditions first basic material properties including visual assessment were tested. For further clarification of behavior under the conditions used, also physico-chemical and structural analysis were performed. Through these analyzes, it was possible to identify potential defects at the interface of the matrix and filler, as well as the distribution of dispersed reinforcement, cracking of the matrix or filler etc. It was found that using a high fly ash can be achieved almost comparable parameters as in case of recipe containing blast furnace slag. Different behaviour of the compressive and flexural strength is quite interesting when the tensile strength in bending is significantly more sensitive to the shock water cooling. Shock and gradual cooling by the air has similar effect on monitored characteristics.

CHANGES OF COMPOSITES STRUCTURE AND PARAMETERS AFTER EXPOSITION TO SYNERGIC ACTION OF VARIOUS EXTREME CONDITIONS

Tomáš Melichar, Jiří Bydžovský, Ámos Dufka
Brno University of Technology, Faculty of Civil Engineering, Institute of Technology of Building Materials and Components, Veveří 331/95, 602 00 Brno, Czech Republic
E-mail: melichar.t@fce.vutbr.cz

Durability of building materials is one of the key aspects of the smooth function in the structure. Among these factors that could realistically effect on building constructions are numerous. Continuity is perceptible as the exterior climatic conditions, the presence of aggressive media, as e.g. accidental exposure to high temperatures. Realistically then may occur situation when the structure is loaded with cyclic exposure to water and low (freezing) temperatures with subsequent origin of a fire.

During design of building materials that could be exposed in these conditions, it is necessary to verify their proper composition – the interaction of individual components. The research presented in this paper is aimed at studying the properties of composites designed for reinforced concrete structures, which can be expected to have an increased risk of fire, i.e. shock to extreme temperatures. Two recipes were developed compositions based on polymer-cement matrix and porous filler. These materials were subjected to cyclic freezing and thawing in combination with the water. From the viewpoint of term, durability characteristics were observed both after 50 and 100 cycles. At this stage, the research has not considered the impact of increased humidity. After testing the frost resistance thus specimen were dried. Then thermal shock stress followed at temperatures of 400, 600 and 1000 °C. Cooling of specimen was carried out with controlled gradual temperature decrease. The reason of assessing the impact of just the two exposure conditions on the properties of designed materials was mainly use of porous filler. This filler has a favorable effect on the temperature resistance. On the other hand, may cause a negative influence on the resistance to frost in combination with water.

Studying the influence of the above two exposures were made using basic physico-mechanical and also physico-chemical methods. Also analytical methods were utilized for assessment of the microstructure. The structure was also assessed using an innovative imaging technique allowing three-dimensional visual assessment, which aimed primarily to identification of structure failures.

MULTIPLE – SHELL MAGNETIC CORE NANOPARTICLES

Daniela Istrati[1], Dan Eduard Mihaiescu[1], Buteică Sandra Alice[3], Adrian Fudulu[1], Maria Colie[2], Vanessa Traistaru[2] Adrian Surdu[2], Bogdan Vasile[2], Anton Ficai[2], Adelina Ianculescu[2], Ecaterina Andronescu[2]
[1]Department of Organic Chemistry "Costin Nenitescu" Faculty of Applied Chemistry and Materials Science, Politehnica University of Bucharest, Polizu Str. No. 1-7, 011061 Bucharest, Romania
[2]Department of Science and Engineering of Oxide Materials and Nanomaterials, Faculty of Applied Chemistry and Materials Science, Politehnica University of Bucharest, Polizu Str. No. 1-7, Bucharest, Romania
[3]Faculty of Pharmacy, University of Medicine and Pharmacy of Craiova, 2 Petru Rares Str., Craiova, Romania
E-mail: danedmih@gmail.com

The core-shell nanoparticles area is one of most dynamic research direction of the last years nanomaterial synthesis. The variety of core materials, related to different shell compounds categories and synthetic pathways, advise core-shell materials as versatile nanocarriers or nanocatalysts for a wide range of applications, like new nano-concentration methods by Fe_3O_4/cyclodextrin[1], new biodiesel production catalysts by Fe_3O_4/silica[2], pesticide degradation catalysts by Fe_3O_4/Au[3], but also novel inversed Fe_3O_4 on Ag nanoparticles[4] – using magnetite as shell. Our research is focused on new nanomaterials synthesis, using core-shell nanoparticles as support, yielding onion-like multiple-shell structures, using different organic and inorganic materials as secondary shell precursors. The magnetic core-shell Fe_3O_4/PABA support, obtained by a modified[5] method using PABA (p-aminobenzoic acid) shell precursor compound, were used as support for the secondary Ag, Pd and Au shell. The water dispersibility were provided by a final polar organic shell. All nanomaterials were characterized by DLS, FT-IR, TEM, XRD and AFM. The target of this study was to reduce the Ag, Pd, Au consumption in potential biomedical applications and thin layers deposition.

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S420 AND IF STEEL SHEETS IN STATIC AND DYNAMIC CONDITIONS

Mária Mihaliková, Miroslav Német, Anna Lišková
Department of Materials Science, Faculty of Metallurgy, Technical University of Košice, Letná 9, 042 00 KOŠICE, Slovakia
E-mail: maria.mihalikova@tuke.sk

The study deals with two different kind of automotive steels HSLA steels. The first kind is Interstitial Free Steel (IF) from type of HSLA (Hight Strength Low Alloy) and the second is S420 steel (Micro-Alloyed Steel). Changes of properties of these materials were carried out by static 10^{-3} $s^{-1}$and dynamic 10^{3} s^{-1} rate stress experiments as a study topic Fig. 1 and Fig. 2. Following measurements were made to assess its plastic properties: HV1 hardness was measured on samples after static and dynamic tests and steel substructures observation were implemented in order to determine the distribution of dislocation for various types of stress. According measured values as well as according the analysis of literary knowledge we can show the hardness of all tested materials had a higher level in dynamic loading conditions by slow rate of deformation. The higher strain hardening of materials was recorded too that was confirmed by distribution of dislocations.

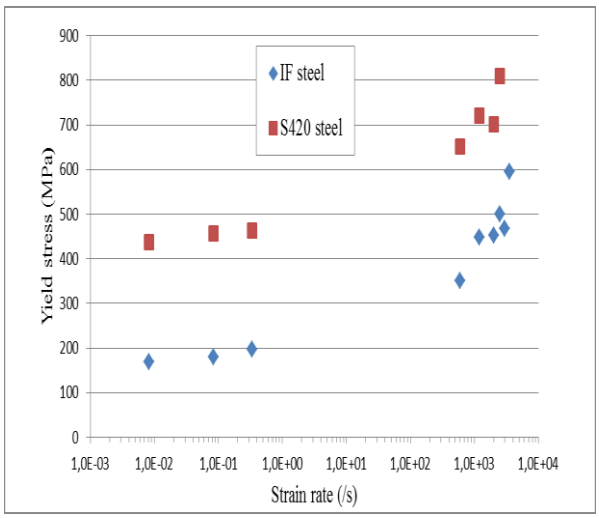

Fig. 1 Dependence strain rate of IF and S420 steel sheets at yield stress

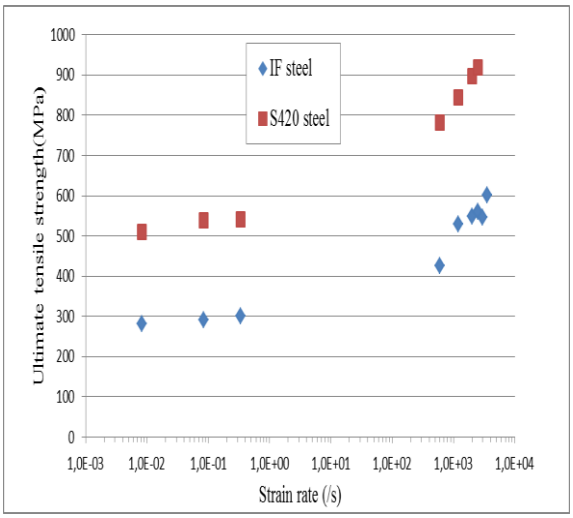

Fig. 2 Dependence strain rate of IF and steel sheets at UTS

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INVESTIGATION OF SOUND AND HEAT ABSORBANCE PROPERTIES OF BASALT FIBER-PUMICE REINFORCED THERMOPLASTIC COMPOSITES

S. Ilker Mistik, Sabih Ovali
Marmara University Faculty of Technology Department of Textile Engineering, 34722, Kadikoy, Istanbul, Turkey
E-mail: imistik@marmara.edu.tr

Basalt fibre is a material made from extremely fine fibers of basalt. It is similar to carbon and glass fibers, having better mechanical properties than glass fiber, but is significantly cheaper than carbon fiber and little more expensive than glass fiber. Its chemical structure is nearly related to glass fiber. The most important components of basalt are SiO_2, Al_2O_3, CaO, MgO, Fe_2O_3 and FeO. The manufacture of basalt fiber requires the melting of the quarried basalt rock to about 1400 °C. The molten rock is then extruded through small nozzles to produce continuous filaments of basalt fiber. Basalt fibers can be used over a wide range of temperature, from 200 °C to 600 °C. Basalt fiber has great potential application to composite manufacturing. Basalt fibers have good insulation properties.

In this study, filament basalt fibers were formed into multiaxial fabric. Produced basalt multiaxial fabrics were used as reinforcement. Pumice stones, which have different sizes, were also used as filler for the production of the composites. Polypropylene polymer was used as matris. Finally basalt multiaxial fabric-pumice stone reinforced polypropylene composites were produced by using hot press compression machine. Then sound and heat absorbance properties of the composites were investigated. Better sound and heat absorbance properties were obtained by adding pumice stone as filler to the basalt fiber reinforced thermoplastic composites.

LIFE+ RUSALCA – AN INNOVATIVE PROTOTYPE SYSTEM FOR THE REMEDIATION OF MUNICIPAL WASTE WATER

Ana Mladenovič[1], Primož Oprčkal[1], Peter Nadrah[1], Adrijana Sever Škapin[1], Janez Ščančar[2], Radmila Milačič[2], Janja Vidmar[2], Alenka Mauko Pranjič[1]
[1]Slovenian National Building and Civil Engineering Institute, Dimičeva ulica 12, 1000 Ljubljana
[2]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana
E-mail: primoz.oprckal@zag.si

The aim of the project is to reduce the consumption of drinking water by the treatment of waste water in order to make the latter suitable for reuse. The way in which this could be done has been demonstrated by means of an innovative multi-stage plant for waste water recycling which has been built in the municipality of Šentrupert (in the Dolenjska region of Slovenia). Conventional cleaning is performed in a small aerobic biological wastewater treatment plant, whose outflow is directed into a first reaction tank, where the innovative remediation with zero-valent iron nanoparticles takes place. This is followed by a second chemical treatment by means of oxidizing agents. In this last stage the partly purified water is treated in an ion exchange column and filtered through activated carbon. Using this procedure the purified water achieves the quality of drinking water. However, it is not intended that this water should be used for drinking purposes, but for secondary purposes in households and as a supply to meet certain common public needs (e.g. irrigation, fire-extinguishing, and plant watering) instead of drinking water from natural sources. The aim of the project is therefore to reduce the consumption of drinking water from natural sources by 30 %.

The zero-valent iron nanoparticles (which have diameters of approx. 50 nm) have a body-centered cubic crystalline elemental iron core (representing 80 wt % of the particle), which is enveloped by a shell consisting of iron hydroxides. The nanoremediation processes are based on elemental iron corrosion reactions. This way various halogenated organic compounds can, by means of elemental iron, be effectively degraded by means of hydrogenation and reductive dihaloelimination. In contact with the dissolved oxygen this elemental iron produces reactive oxidative species, which can inactivate bacteria and degrade organic matter. The inorganic contaminants (e.g. trace elements) are reduced to less mobile and bioavailable species, or adsorbed onto surface sorption sites. After the nanoremediation process has taken place, the nanoparticles are transformed into non-reactive agglomerated iron hydroxides and can be separated from the water by sedimentation.

THE INFLUENCE OF BIOACTIVE ADDITIVES ON POLYLACTIDE ACCELERATED DEGRADATION

Anna Morawska-Chochół[1], Paulina Uszko[1], Barbara Szaraniec[1], Karol Gryń[1], Jan Chłopek[1], Maciej Ambroziak[2]
[1]AGH University of Science and Technology, Faculty of Materials Science and Ceramics, Department of Biomaterials, Al. Mickiewicza 30, 30-059 Krakow, Poland
[2]Medical University of Warsaw, Chair and Clinic of Orthopaedics and Traumatology, ul. Lindleya 4, Warsaw, Poland
E-mail: morawska@agh.edu.pl

Bioactive ceramic additives are becoming to play a role in modifying biological properties of resorbable polymers (including polylactide) used in biomedical applications. They facilitate the growth of bone tissue that is supposed to replace the resorbable implant gradually. Yet the additives may affect the process of polymer degradation. Due to the long duration of polylactide degradation, it is difficult to observe the whole process in laboratory conditions. That is why, the accelerated degradation (taking place in harsh environmental conditions) is studied, especially for the sake of preliminary assessment of clinical utility.

The aim of the research was to describe degradation mechanisms of composite resorbable implants based on PLA matrix and modified with bioactive additives, such as tricalcium phosphate (TCP) and hydroxyapatite (HAP). The influence of the applied modifiers on the degradation process was also established. The tests were conducted for: the two-component composite PLA/TCP, the three-component one PLA/TCP/HAP, and the PLA alone taken as reference. The amount of modifiers was respectively: 7 wt % TCP and 0.3 wt % HAP. The degradation process was assessed on the basis of microstructural, structural and mechanical alterations.

The measure of PLA degradation progress was gradual decrease in its molecular weight and mechanical strenghth. As the degradation proceeded, the plastic properties of materials decreased. In the case of composites such changes took place faster, which implies the accelarating influence of modifiers on the degradation process. This phenomenon is connected with the presence of interphase boundaries in composites, which eases diffusion of liquids inwards the material and promotes degradation. Moreover, modifiers act as crystallisation seeds, accelarating and stimulating the matrix organization and apperance of crystalline areas, which is confirmed by structural analysis of the tested samples. What is important, even the slight HAP share significantly eliminated the changes caused by TCP presence. The properties of the two composites differ, which means that HAP hinders the TCP influence on degradation process. The tests made it possible to create a model of accelerated hydrolytic degradation of poly-l-lactide.

SPARK PLASMA SINTERING OF SILICON CARBIDE SHS-POWDER

D.O. Moskovskikh[1], A.S. Rogachev[1,3], A.S. Mukasyan[1,2]
[1]National University of Science and Technology «MISIS», Moscow, Leninskiy prospekt 4, 119049, Russia
[2]Department of Chemical & Biomolecular Eng., University of Notre Dame, Notre Dame, IN, 46556, USA
[3]Institute of Structural Macrokinetics and Materials Science, Russian Academy of Sciences, Chernogolovka, Moscow Region, Acad. Osipyan street 8, 142432, Russia
E-mail: mos@misis.ru

Silicon carbide (SiC) is an important ceramic material that is widely used in many engineering and industrial projects. The set of unique properties such as high hardness and strength at elevated temperatures, excellent thermal conductivity and stability, good wear and corrosion resistance make SiC a highly attractive material for a variety of applications including abrasives and structural ceramics, heating and corrosion protective elements, in the microelectronics and atomic industries.
A systematic study was conducted to verify the influence of various spark plasma sintering (SPS) parameters (heating rate, temperature, duration and applied load), on the densification and grain-growth kinetics of a silicon carbide nanopowder produced by self-propagating high temperature synthesis (SHS) [1-2]. The direct in situ SHS+SPS method for fabrication of SiC ceramics was also investigated. It was shown that SiC powders could be fully densified by SPS at lower temperature and within shorter time, as compared to the conventional sintering. It is suggested that the densification is enhanced in the initial part of the sintering cycle by a local spark-discharge process in vicinity of the contacts between the particles, and that both grain-boundary diffusion and grain-boundary migration are enhanced by the electrical field originating from the pulsed direct current used for heating the sample. Both the diffusion and the migration that promote the grain growth were found to be strongly dependent on temperature, implying that it is possible to retain the original particle nano-structure in fully densified materials. Thus sintered pore-free SiC nanostructured ceramics has a micro-hardness around 25 GPa and fracture toughness of 5 $MPa \cdot m^{1/2}$.

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MATERIAL PARAMETERS OF PLASTIC DEFORMATION MEASURED ON SPECIMENS WITH VARIOUS TYPE OF HEATING

Petr Motyčka, Hugo Folgar
COMTES FHT a.s., Průmyslová 995,334 41 Dobřany, Czech Republic
E-mail: petr.motycka@comtesfht.cz

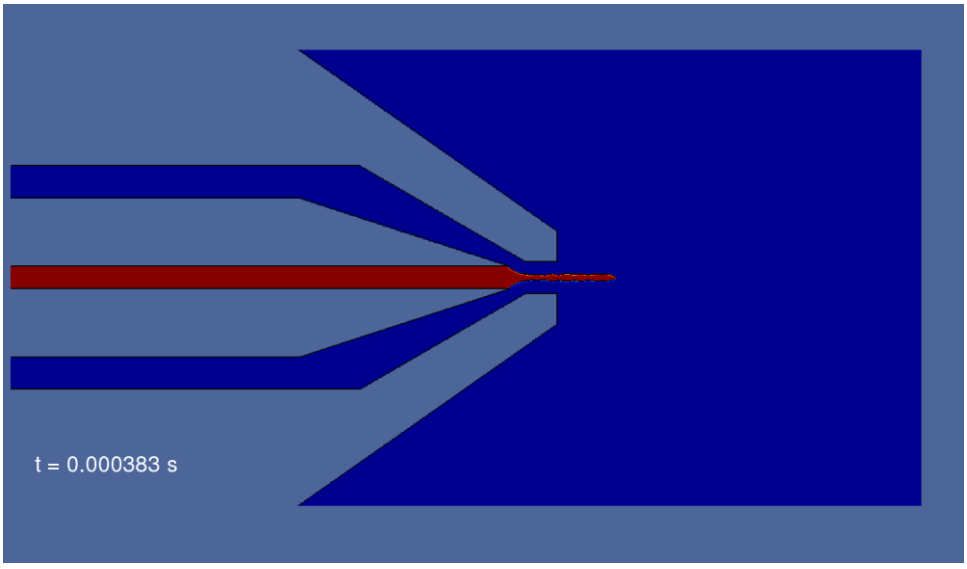
Stress-strain curves at various temperatures and strain rates are important material parameters of computational models simulating forming processes. The contribution focuses on getting data for computer model of forming using numerical simulation of the tensile tests, especially from tensile tests measured on specimens with resistive heating. Despite an inhomogeneous temperature distribution and thermal localization of deformation, resistive heating is useful as it allows to prepare and subsequently test unstable state of material (e.g. supercooled austenite or mixtures of austenite and products of its transformation). Benefits from using this data and its limitations compared to data originating from tensile tests with heating in furnace and with inductive heating are discussed. Experience with various methods of temperature and deformation measurements is shared.

NUMERICAL MODELING OF GAS-FOCUSED MICRO-JETS

Katarina Mramor[1], Rizwan Zahoor[2], Božidar Šarler[1,2]
1 University of Nova Gorica, Vipavska 13, 5000 Nova Gorica, Slovenia
E-mail: katarina.mramor@ung.si
2 Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
E-mail: bozidar.sarler@imt.si

Many technologies, such as inkjet printing and micro-dosing of liquid samples[1] require a controlled delivery of steady continuous jet or of monodisperse stream of liquid droplets on micro-scale. This can be achieved by focusing a liquid with a gas flow[2], which controls the shape and the flow of the liquid. The stability of the jet thus produced, is a function of geometry of the nozzle, material properties of the liquids and operating conditions. The application of computational fluid dynamics in modelling of gas-focused micro-jets enables further improvement of the nozzle geometry and helps determine the jetting to dripping transition.

In this contribution, two regimes of flow – jetting and dripping – are considered. An adaptive mesh projection method incorporated in a tree based solver[3] is used for the solution of time-dependent incompressible Euler fluid flow equations. The jetting and the dripping examples are calculated for the same geometry. The transition from jetting to dripping is in this case achieved by changing either material properties or operating conditions.



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ABRASIVE WEAR PROPERTIES OF LOW TEMPERATURE AUSFERRITIC DUCTILE IRONS

Dawid Myszka[1], Emilia Skołek[1], Andrzej N. Wieczorek[2]
[1]Warsaw University Of Technology, Faculty of Production Engineering, Warsaw, Poland
[2]Silesian University of Technology, Faculty of Mining and Geology, Gliwice, Poland
E-mail: myszkadawid@wp.pl

The purpose of this study was to determine experimentally the wear properties of 2 groups of ausferritic ductile iron austempered in 310 °C and 250 °C. The wear tests were carried out on a disc-on-disc test rig. The test samples were examined under conditions of sliding mating, while the leading destructive process was microcutting of the surface with loose corundum grain. The loss of mass of the examined samples was measured as a parameter characterizing the wear. Base on it, other wear coefficients were determined, for example the volume loss, the intensity of wear and the wear rate. The volume loss values determined were presented as a function of the initial hardness. Based on the results obtained, it was found that very long time of heat treatment (> 6 h) causes a significant increase in resistance to abrasive wear.

INFLUENCE OF Cu, Mg AND Si ON FORMATION OF METASTABLE QUASICRYSTALS IN Al-Mn BASED ALLOYS

Iztok Naglič[1], Zoran Samardžija[2], Spomenka Kobe[2], Blaž Leskovar[1], Kemal Delijić[3], Boštjan Markoli[1]
[1]University of Ljubljana, Faculty of Natural Sciences and Engineering, Department of Materials and Metallurgy, Aškerčeva cesta 12, 1000 Ljubljana, Slovenia
[2]Jožef Stefan Institute, Department for Nanostructured Materials, Jamova cesta 39, 1000 Ljubljana, Slovenia
[3]University of Montenegro, Faculty of Metallurgy and Technology, Cetinjski put, 81000 Podgorica, Montenegro
E-mail: iztok.naglic@omm.ntf.uni-lj.si

The discovery of quasicrystals (QCs) in rapidly solidified Al-Mn alloys by Shechtman[1] created a revolution in crystallography[2]. In this work aluminium alloys with primary metastable QCs were prepared and characterized. Al-Mn based alloys with different additions of copper, magnesium and silicone were cast into a copper mold to form castings with 5 mm in diameter which ensures cooling rates of approximately 500 K/s. Characterization of the as-cast alloys microstructure involved light microscopy, scanning electron microscopy (SEM), energy dispersive x-ray spectroscopy (EDS) and electron backscatter diffraction (EBSD). Primary phases based on aluminium, manganese and other alloying elements, which form in these alloys, were decagonal quasicrystals (dQCs) and/or icosahedral quasicrystals (iQCs). Their presence was confirmed by their morphology and EBSD. Compositions of dQCs and iQCs phases in different alloy systems were also determined by EDS. Average metallic radius and electron per atom concentration in QCs phases with different composition were also calculated on the basis of composition determined by EDS.

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REACTIVE NANOSTRUCTURED FOILS BY MEANS OF HIGH-ENERGY BALL MILLING AND SUBSEQUENT COLD ROLLING

A.A. Nepapushev[1], A.S. Rogachev[1,2], A.S. Mukasyan[1,3]
[1]National University of Science and Technology «MISIS», Moscow, Leninskiy prospekt 4, 119049, Russia
[2]Institute of Structural Macrokinetics and Materials Science, Russian Academy of Sciences, Chernogolovka, Moscow Region, Acad. Osipyan street 8, 142432, Russia
[3]Department of Chemical & Biomolecular Eng., University of Notre Dame, Notre Dame, IN, 46556, USA
E-mail: anepapushev@gmail.com

Magnetron sputtered multilayer nanofoils, which consist of regularly alternating nanolayers of solid reactants, is a new class of functionally graded materials. Since such materials possess a set of unique properties, including low temperature of reaction initiation, high velocity of a combustion wave propagation and high rate of heat release, they found a variety of applications including joining of different materials [1]. However, due to the technological complexities, which are related to the sputtering of some elements, the range of compositions for such reactive nano-foils is not broad. To overcome these shortcomings and expand composition ranges a novel method for fabrication of reactive nanostructured foils (ribbons) by means of the high-energy ball milling (HEBM) followed by cold rolling is suggested [2].

The powder mixture of titanium and silicon (Ti + 0.6 Si) were subjected to HEBM in a planetary ball mill Activator 2S (Activator, Russia). It is shown, that such mechanical treatment leads to the formation of composite particles in which the silicon and titanium are presented in the form of nanoscale layers. In addition, it was demonstrated that for the composite Ti +0,6 Si particles fabricated under optimal conditions the ignition temperature could be as low as 820 K. Thus obtained nanostructured reactive powder was subjected to the cold rolling. The process allows us to produce the ribbons with length up to 10 mm, width ~2 cm and a thickness of ~250 μm.

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MODEL OF CARBONITRIDE PRECIPITATION KINETICS IN MICROALLOYED STEELS

Marek Opiela
Institute of Engineering Materials and Biomaterials, Silesian University of Technology, Konarskiego 18a, 44-100 Gliwice, Poland
E-mail: marek.opiela@polsl.pl

A model of the kinetics of carbonitride M(C,N) precipitation in the HSLA steel containing microalloying elements of Ti and V is presented. The model is based on the classical theory of nucleation (general model of Kampmann and Wagner) [1]. It makes it possible to analyse the precipitation kinetics of simple carbonitrides under conditions of isothermal precipitation in austenite. Moreover, the model enables to distinguish specific stages of the precipitation process: nucleation, growth and coagulation. Despite the simplifications, the model makes it possible to predict changes occuring in the precipitation kinetics caused by changes in chemical composition.
The calculated results contain data concerning: distribution of particle's radius, nucleation rate as a function of time, particle's number within the volume unit as a function of time, chemical composition of the matrix as a function of time and the percent volume of the particles as a function of time.
An example of the application of computer program CarbNit_kinet for the carbonitride precipitation in steel containing 0.31 % C, 0.033 % Ti and 0.008 % V is reported.

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AN INNOVATIVE METHOD FOR THE REMEDIATION OF CONTAMINATED SOIL BY UTILIZING RECYCLED MATERIALS

Primož Oprčkal[1], Ana Mladenovič[1], Janez Ščančar[2], Radmila Milačič[2]
[1]Slovenian National Building and Civil Engineering Institute, Dimičeva ulica 12, 1000 Ljubljana
[2]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana
E-mail: primoz.oprckal@zag.si

In many cases past industrial activities have left behind degraded areas, where different contaminants are present in high concentrations in the soil. For this reason such soils, containing hazardous substances and various species of trace elements in both mobile and bioavailable form, are often classified as hazardous waste. Such degraded areas represent "old burdens" which need to be rehabilitated in the most practical, economical, and environmentally acceptable way. One such old burden in Slovenia involves the area of the Old Zinc-Works near the town centre of Celje. There an area of 17 ha is covered by more than 1.5 M m^3 of contaminated soil, which has been classified as hazardous waste according to the Slovenian legislation since it contains large quantities of water soluble species of different trace elements (As, Zn, Pb, Cd, Cu, Mo), as well as SO_4^{2-}. An innovative remediation and rehabilitation method has been developed for the treatment of this heavily contaminated soil material in situ, and has been validated in the real case treatment of the most contaminated soil from the above-mentioned old zinc-works area. An immobilization approach is used, where the bioavailable and mobile species of the trace elements are chemically and physically incorporated into a newly formed composite, which is a mixture of crushed and homogenised contaminated soil to which ash from paper sludge incineration, as well as electric arc furnace slag from secondary metallurgical processes, is added. After establishing the optimum moisture content, the composite is placed as compacted layers, i.e. as part of engineering fill. Due to the high degree of compaction and pozzolanic or hydraulic activity of the additives, a cement matrix is formed. In this process the contaminants are either physically microencapsulated, or chemically adsorbed onto the surface and/or incorporated into the crystalline lattice of the calcium silicate hydrate phases. The hydration products are similar to those of Portland cement. The alkaline pH values of the pore solution favour the formation of low soluble hydrolysis products of most of the trace elements. Hydraulic conductivity, too, is very low, which means that very little water is percolated, and that the rate of transport of chemical species of trace elements is thus very slow.

THE INFLUENCE OF THE DEGREE OF THE POLYNOMIAL IN THE RELATIVE ERROR OF INTERPOLATION AND CLASSIFICATION OF TRANSFER FORCE STANDARD

Branka Muminović, Mirsada Oruč, Sulejman Muhamedagić
University of Zenica, Institute of Metallurgy "Kemal Kapetanović" ZENICA, Travnička cesta 7, 72 000 Zenica, Bosnia and Herzegovina
University of Zenica, Faculty of Metallurgy and Materials Science, Travnička cesta 1, 72 000 Zenica, Bosnia and Herzegovina
E-mail: branka.muminovic@miz.unze.ba

Force standards are used for calibration of machines for force measurement. These standardas are calibrated according to standard ISO 376. ISO 376 defines classification criteria of force standards on which their class is determined. One of the significant classification criteria is the relative error of interpolation, which is determined by polynomial with characteristic degree. This polynomial determines the dependence of the output force data obtained from the measurement results. This paper presents the interpolation curves described by polynomials of different degrees determined on the case of the mean values of readings of force recorded during calibration of transfer force standard MGCplus-Z4/500 kN. Based on obtained coefficients of polynomials are calculated relative errors of interpolation, carried out classifications of force standards for polynomials of various degrees and analyzed the influences of the degree of the polynomial on the classification of force standard.

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EFFECT OF METAL NITRATE SALT ON THE PHASE FORMATION AND COMPOSITION OF NiO-BCZY COMPOSITE PREPARED BY EDSS METHOD

Nafisah Osman[1], Abdullah Abdul Samat[2], Hamidi Abd Hamid[1], Mahendra Rao Somalu[2], Andanastuti Muchtar[2,3]
[1]Faculty of Applied Sciences, Universiti Teknologi MARA, 02600 Arau, Perlis, Malaysia
[2]Fuel Cell Institute, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia
[3]Department of Mechanical and Materials Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia
E-mail: fisha@perlis.uitm.edu.my

NiO-$BaCe_{0.54}Zr_{0.36}Y_{0.1}O_{2.95}$ (NiO-BCZY) composite powders with different weight ratios of NiO to BCZY (NiO:BCZY) were prepared by evaporation and decomposition of solution and suspension (EDSS) method using nitrate-based nickel salt. The prepared powder was respectively denoted as S1 (50:50), S2 (60:40) and S3 (70:30). The characteristics of the samples were analyzed using Thermogravimertic analyzer (TGA), X-ray diffractometer (XRD) and scanning electron microscope/energy dispersive X-ray (SEM/EDS). TGA results showed that the thermal decomposition of intermediate compounds for the dried powder (T = 150 °C) was completed at ~700 °C. XRD measurement confirmed that the calcined powder (T = 1100 °C) of S3 consists of two main composite phases (BCZY and NiO) and other impurity phases of $BaZrO_3$, $BaCO_3$, $(Ce,Zr)O_2$ and Ni-metal. However, XRD spectrum for S1 and S2 did not show any crystalline peaks related to BCZY compound as the peaks associated to $BaCeO_3$ and $BaZrO_3$ were appeared in the XRD pattern. We found that even after calcined at 1400 °C, the impurity phases of $BaCeO_3$ and $BaZrO_3$ along with NiO still remained in the S1 sample. As calcination temperature increased, the particles size of S1 also increased and its elemental composition deviates from the nominal stoichiometric of the NiO-BCZY as proven by SEM/EDS analysis. The results indicate that the formation of homogenize NiO-BCZY composite was not favored by using nitrate-based nickel salt as precursor material.

MULTIPLEX SURFACE TREATMENT OF Ti6Al4V ALLOY TO IMPROVE WEAR RESISTANCE AND TRIBOLOGICAL PROPERTIES UNDER DRY SLIDING WEAR CONDITIONS

Maciej Ossowski[1], Maciej Spychalski[1], Maciej Dubek[1], Rafal Przybyla[2], Jerzy Grygorczuk[2], Tadeusz Wierzchon[1]
[1]Faculty of Materials and Science Engineering, Warsaw University of Technology, Woloska 141, 02-507, Poland
[2]Space Research Centre Polish Academy of Science, Poland, Bartycka 18A, 00-716 Warsaw, Poland
E-mail: ossomac@wp.pl

Technologies related to space exploration are one of the most rapidly developing areas in which the newest technological achievements are used. Special attention in this study is paid to mechanical systems and to improving their tribological properties to ensure trouble-free operation and increase their energy efficiency. As it is impossible to use conventional lubricants in vacuum environments, or specialized synthetic vacuum greases due to the prevailing temperature range of 160–200 °C, there has been a development of solutions incorporating surface engineering technologies, which increase wear resistance and reduce the friction coefficients of the associated components.
Titanium and titanium alloys, due to their high relative strength as well as corrosion resistance and paramagnetic properties, are often used in devices operated in space conditions. However, due to their low wear resistance, their use in mechanisms operated in space is significantly reduced in favour of high-chromium steels.
The aim of the study which results will be presented in paper was to examine the influence of surface texturing on the tribological properties of Ti6Al4V substrate subjected to multistage treatment combining: plasma nitriding with producing of solid state lubricant coating of pure Pb and Ag.

Fig.1. Multiplex surface treatment applied for Ti6Al4V

Tribological properties were carried out by "ball on disc" test, which was used to determine the friction coefficient and wear resistance. There were also carried out the scanning electron microscope and optical profilometry observations for quantitative description of surface after texturting and wear volume after „ball on disc” tests.

LOW TEMPERATURE CONSOLIDATION OF AZ91 METAL SHAVINGS

Paweł Ostachowski[1], Andrzej Korbel[1], Włodzimierz Bochniak[1], Marek Łagoda[1], Romana Śliwa[2]
[1]AGH-University of Science and Technology, Faculty of Non-Ferrous Metals, A. Mickiewicza 30Av, 30-059 Cracow, Poland
[2] Rzeszow University of Technology, Powstańców Warszawy 12Av. 35-959 Rzeszów, Poland
E-mail: pawel.ostachowski@agh.edu.pl

The results of pilot studies provide the basis for developing effective management technology of magnesium alloy chips from machining of processes serving the manufacturing of products, including aerospace, without involving metallurgical processes.
This is particularly important in the search for innovative technological solutions, cost-effective, enabling favorable "recycling" and allow to obtain a product with the required high performance, enabling their possible use in the aerospace and related industries looking for a lightweight and durable goods. The results justify the need for the further study of this issue.
As a result of the low-temperature extrusion of industrial AZ91 magnesium alloy chips with the KOBO method it is possible to obtain solid products with a disired geometry. Despite the chips being polluted with a cooling media (during machining) the final products have similar density and mechanical properties as materials obtained as a result of metallurgic processes and, what is more, they can be further deformed with the use of conventional plastic deformation methods.

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THERMAL ANALYSIS AND THERMAL STABILITY OF SELECTED LATENT HEAT STORAGE MEDIA

Milan Ostrý[1], Pavel Charvát[2], Radek Přikryl[3] and Lubomír Klimeš[2]
[1]Brno University of Technology, Faculty of Civil Engineering, Institute of Building Structures, Veveří 95, 602 00 Brno, Czech Republic
[2]Brno University of Technology, Faculty of Mechanical Engineering, Technická 2896/2, 616 69, Brno, Czech Republic
[3]Brno University of Technology, Faculty of Chemistry, Purkyňova 464, 612 00, Brno, Czech Republic
E-mail: ostry.m@fce.vutbr.cz

The legislation of the European Union supports construction of sustainable buildings; therefore, utilization of renewable energy sources plays a significant role in decision making of investors. The use of thermal energy from the renewables in buildings is constrained by the possibility of installation of thermal energy storage systems or components. Sensible heat storage capacity of building structures is limited by the weight and specific heat capacity of building materials. That is where latent heat thermal storage in phase change materials (PCMs) becomes an option. The phase change materials can be encapsulated and integrated in building structures and air-conditioning systems to improve energy performance of buildings [1]. There are several parameters that influence suitability of PCMs for such use; the heat of fusion, thermal capacity in solid and liquid phase, thermal conductivity, phase change temperature range, and the stability of properties in thermal cycling.

A suitable melting range of PCMs for the direct integration in building structures is between 20 and 26 °C. Based on this requirement 7 commercially available PCMs were selected for thermal analysis and thermal cycling. The thermal cycling was performed in a small environmental chamber. The differential scanning calorimeter was used for the determination of latent and heat, onset temperatures and melting range. The results from the laboratory measurements served as inputs for mathematical modelling and evaluation of the suitability of PCMs for application in buildings.

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FORMATION OF CORROSION-RESISTANT ALUMINA COATING ON 6061 ALUMINUM ALLOY BY THE COMBINATION OF MICRO ARC OXIDATION AND SEALING TREATMENTS

Merve Koca, Ozge Gokce, Sanaz Mohammadzadeh, Ahmet Hilmi Paksoy, Faiz Muhaffel, Huseyin Cimenoglu
Istanbul Technical University, Metallurgical and Materials Engineering Department, 34469, Istanbul, TURKEY
E-mail: cimenogluh@itu.edu.tr

Micro arc oxidation (MAO) technique is an attractive coating solution for protection aluminum alloys used in wide-spread industrial applications such as automotive, structural and aerospace. However, improvements in corrosion resistance of aluminum-based materials are required for longer service life of the components against harsh environments. In the aim of the mentioned approach, an alumina coating was formed on 6061 quality aluminum alloy and oxidized samples were subsequently immersed in stearic acid solution in order to reduce wettability and seal the pores and cracks for improving corrosion resistance of the protective alumina coating. The surface and cross-sectional morphologies and the phase composition of the coatings were characterized by scanning electron microscopy (SEM) and X-ray diffraction (XRD). The wettability and surface roughness of the samples before and after stearic acid treatment were measured by goniometer and profilometer, respectively. The corrosion resistance was assessed by long-term immersion in 3.5 % NaCl solution. On the basis of the results, enhanced hydrophobicity and sealing of the surface by stearic acid treatment significantly improved the corrosion resistance of 6061 quality aluminum alloy as compared to untreated state and unsealed oxidized sample.

BIODEGRADABLE POLYESTER URETHANE BASED MATRICES FOR NANOFIBRES FABRICATIONS

Alena Pavelková, Pavel Kucharczyk, Vladimir Sedlařík
Centre of Polymer Systems, University Institute, Tomas Bata University in Zlin, Tř. Tomaše Bati 5678, 76001 Zlín, Czech Republic,
E-mail: apavelkova@ft.utb.cz

Electrospinning received much attention for biomedical applications mainly due to the growing interest in nano-technologies and the unique material properties. Nanofabrics such as nanoparticles or nanofibres, are suitable materials to mimic biological environment because they have shown improved interactions with cells.[1] Especially nanofibres based on biodegradable polymers have been promising materials for innovative tissue engineering applications.[2]

The presented work deals with synthesis and characterization of novel biodegradable polyester urethanes (PEU) based on polylactic acid/polyethylene glycol chain linked copolymers for nanofibres fabrication by an electrospinning process. An effect of isocyanate/hydroxyl moieties ratio on molecular mass, physic-chemical, mechanical and thermal properties of the resulting PEUs was studied. Moreover, degradation behavior under both abiotic and biotic conditions was observed.

Subsequent processing step involved electrospinning techniques for nanofibres fabrications. Effect of polymer solution conductivity on characteristics of nanofibres was also described.

The prepared PEU matrices exhibited molecular mass up to 64 kg/mol and mechanical properties comparable to conventional polylactide. On the other hand, degradation experiment revealed relatively fast decomposition of PEU when all samples were fully hydrolyzed within 25 days of experiment carried out at 37 °C. Electrospinning processing showed an interesting dependence between chemical compositions of PEUs and morphology of prepared electrospun nanofibres.

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EVALUATION OF ACOUSTIC EMISSION EVENTS GENERATED AT THREE POINT BENDING OF DIFFERENT CONCRETE SPECIMENS BY SPECTRAL ANALYSIS

Luboš Pazdera, Libor Topolář, Tomáš Vymazal, Jaroslav Smutný, Petr Daněk, Petr Misák
Brno University of Technology, Faculty of Civil Engineering, Veveri 331/95, Brno, Czech Republic
E-mail: pazdera.l@fyz.fce.vutbr.cz

The article is aimed at the determination of the mechanical properties of the concrete specimens at three point bending test by application of the Acoustic Emission Method. There are chosen recorded acoustic emission events generated during the three-point loading. Some frequency and jointed time-frequency methods are applied on these records. Time series as acoustic emission events is may be analysed in the time domain, frequency domain, or time-frequency domain. Wang et all [1] combine acoustic emission technology with wavelet packet analysis for evaluate the mass fractions of composites. Online monitoring of cracking in concrete structures applied on a three-points bending test with application acoustic emission method have been used by Dumoulin et all [2], Ohno et all [3], Iliopoulos et all [4] and other authors. Jiang [5] evaluated the acoustic emission signal at three-point bending loading test by frequency and non-linear independent component analysis.
The selection is based on the type of the signal in question, on the type of analysis to be used or result achieved. In many applications, direct evaluation of the time-amplitude representation is neither easy nor advantageous. The individual mixtures were different in cement dosage and water-cement ratio based on how much the amount of cement was increased while maintaining consistency S2 according to EN 206-1.
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DIELECTRIC PROPERTIES OF THE SOLUTION-DERIVED $Ba_{0.5}Sr_{0.5}TiO_3$ THIN FILMS

Tanja Pečnik[1,2], Sebastjan Glinšek[1,3], Brigita Kmet[1], Barbara Malič[1]
[1]Electronic Ceramics Department, Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia
[2]Jozef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia
[3]CEA Grenoble, Leti, Minatec Campus, 17 Rue des Martyrs, F-38054 Grenoble, France
E-mail: tanja.pecnik@ijs.si

Strongly electric-field-dependent dielectric permittivity and relatively low microwave dielectric losses of ferroelectric materials in the paraelectric state make them attractive for electrically tunable components such as frequency agile microwave antennas. Compared to the competing wireless technologies, ferroelectrics-based varactors are characterized by a high tuning speed, small leakage currents, high breakdown fields and radiation hardness [1-3]. In this contribution we studied broadband dielectric properties of the $Ba_{0.5}Sr_{0.5}TiO_3$ (BST) thin films with thicknesses in the range from 90 to 400 nm.

The BST thin films were prepared from the solutions based on alkaline-earth acetates and Ti-alkoxide in organic solvents. The films were deposited on polycrystalline alumina substrates by spin-coating and heated in a rapid thermal annealing furnace after each deposition at 900 °C. The deposition-annealing steps were repeated several times to achieve the final thickness of the films. For investigation of the dielectric properties in the kHz range, the planar capacitors were patterned by lift-off photolithography and sputtering of Cr/Au, while for measurements in the GHz range the split-post dielectric resonators were used.

The films crystallized in a randomly oriented perovskite phase with uniform and dense microstructures consisting predominantly of columnar grains. The dielectric properties show a non-linear thickness dependence, which may be divided into three regions. For the thinnest films the 100-kHz-permittivity increases from 650 to 1250. In the intermediate thickness range, between 170 and 240 nm, the permittivity only slightly increases to 1350 for the 240-nm-thick film, and it decreases to 970 as the thickness increases further to 400 nm. A similar trend is also observed in the GHz range.

In this contribution we discuss how the film thickness, the grain size and the residual stress, which develops in the films as the consequence of the film – substrate thermal expansion mismatch, influence the dielectric properties of the BST films.

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LIQUID PHASE EXPLOSIVE FABRICATION OF SUPERCONDUCTING MgB_2 COMPOSITES

A. Peikrishvili[1,3], G. Mamniashvili[2], B. Godibadze[3], T. Gegechkori[2], E. Chagelishvili[3]
[1]F. Tavadze Institute of Metallurgy and Materials Science, 15 kazbegi Av. 0130, Tbilisi, Georgia
[2]Andronikashvili Institute of Physics Ivane Javakhishvili Tbilisi State University, 6 Tamarashvili St., 0177, Tbilisi, Georgia
[3]G.Tsulukidze Mining Institute, 7, Mindeli St., 0186, Tbilisi, Georgia
E-mail: akaki.peikrishvili@stcu.int

An original two-stage liquid phase hot explosive compaction (HEC) procedure of Mg-B precursors above 900 ^{o} C provides the formation of superconductivity MgB_2 phase in the whole volume of billets with maximal T_c = 38.5 K without any further sintering.
The liquid-phase HEC strongly solid-state reaction rate due to the high penetrating capability of shock-waves in a whole volume of cylindrical billets and to consolidate superconductive MgB_2 composites near to theoretical density. There were established that the structure and the superconductive characteristics of fabricated MgB_2 billets strongly depends on consolidation temperature and intensity of loading.
The above mentioned and other features of structure/property relationship as well as experimental conditions will be presented and considered too.

MECHANICAL PROPERTIES OF POLYAMIDE/CARBON FIBER FABRIC COMPOSITES

Cristina-Elisabeta Pelin (Ban)[1,2], George Pelin[1,2], Adriana Ştefan[1], Ecaterina Andronescu[2], I. Dincă[1], A. Ficai[2], Roxana Truşcă[3]

[1]National Institute for Aerospace Research "Elie Carafoli" Bucharest- Materials Unit, 220 Iuliu Maniu Blvd, 061126, Bucharest, Romania

[2]Polytechnic University of Bucharest, Faculty of Applied Chemistry and Materials Science, 1-7 Polizu St., 011061, Bucharest, Romania

[3]S.C. METAV Research & Development S.A., 31 C.A. Rosetti St., 020011, Bucharest, Romania

E-mail: ban.cristina@incas.ro

The use of carbon fiber reinforced polymeric composites in aeronautics and automotive applications increased tremendously in the last decade. However, studies still focus on improving their properties, as the main goal in transport industry is to obtain optimum strength to weight ratio. This fact lead to a new trend in aeronautics industry, that focuses on replacing thermoset with thermoplastic matrix in fiber composites. The paper presents the obtaining of carbon fiber fabric reinforced laminated composites based on polyamide 6 matrix by using a simple technique that involves polymer dissolution followed by fabric impregnation and high temperature pressing. The mechanical behavior of the obtained laminated composites is evaluated using tensile and 3-point bending tests and the polyamide/ solvent ratio influence is discussed. The fracture cross section is analyzed using microscopy investigation techniques, in order to evaluate the fiber matrix interface and composite fracture mechanism.

INFLUENCE OF ISOTHERMAL ANNEALING ON THE STRUCTURE AND MAGNETIC PROPERTIES OF FECOBYMO BULK AMORPHOUS ALLOY

Paweł Pietrusiewicz[1], Marcin Nabiałek[1], Jacek Olszewski[1], Sabina Lesz[2]
[1]Institute of Physics, Czestochowa University of Technology, 19 Armii Krajowej Av., 42-200 Czestochowa, Poland
[2]Institute of Engineering Materials and Biomaterials, Silesian Technical University, Konarskiego St. 18a, 44-100 Gliwice, Poland
E-mail: pietrusiewicz@wip.pcz.pl

The paper presents the results of research into bulk amorphous alloy (BMG) based on Fe. The sample of the composition $Fe_{61}Co_{10}Y_8Mo_1B_{20}$ in the form of plate was prepared by injection casting method. Then, it was subjected to isothermal annealing below the crystallization temperature of 700 K for 1 h and 770 K for 3.5 h. The structure of the samples, in the state after solidification and heat treatment, were investigated using X-ray diffraction (XRD) and Mössbauer spectroscopy. The results confirmed that both samples, after solidification and after annealing, were amorphous. Magnetic measurements were carried out using a vibrating sample magnetometer (VSM) within magnetic fields of up to 2 T. Based on these measurements, the effect of isothermal annealing on the magnetic properties such as the saturation magnetization $\mu_0 M_s$ and coercive field H_c was defined. Using Kronmüller theory [1] the initial magnetization curves were analyzed in the area of approach to ferromagnetic saturation. On the basis of this theory, the quantity and quality of structural defects, which play a critical role in the magnetization process in high magnetic fields, were defined. Following this study the sample after annealing at 770 K for 3.5 h has the lowest coercivity field and the highest magnetization saturation. Linear defects, the so-called quasidislocational dipoles, played the main role in the process of magnetization of the test samples.

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EFFECT OF SULPHIDE INCLUSIONS ON THE PITTING CORROSION BEHAVIOR OF HIGH-Mn STEELS IN CHLORIDE AND ALKALINE SOLUTIONS

Adam Grajcar, Aleksandra Płachcińska
Silesian University of Technology, Institute of Engineering Materials and Biomaterials, 44-100 Gliwice, 18a Konarskiego Street, Poland
E-mail: adam.grajcar@polsl.pl

High-Mn austenitic steels received much attention as advanced automotive steels due to their superior combination of strength, ductility and crashworthiness. Unfortunately, these alloys are characterized by poor corrosion resistance, particularly in acidic and chloride-containing solutions. It is well known that chemical composition has a significant effect on the corrosion resistance of steel. Donik et al. [1] and Pardo et al. [2] reported that the Mn additions to stainless steel have a detrimental effect on the pitting corrosion resistance in NaCl medium. Manganese favours the formation of MnS inclusions which are vulnerable for the initiation of corrosion pits. Its presence drastically increases the corrosion current density of steel and displaces the E_{corr} values toward less noble potential [2, 3]. The analysis of the influence of MnS particles on the pit initiation process carried out by Park et al. [4] confirmed that corrosion pits are formed in the metallic matrix at the interface between the inclusion and the matrix. Park et al. [3] found that the size of MnS inclusions increased with the Mn concentration in Fe–18Cr–6Mn and Fe–18Cr–12Mn steels. The shape, composition and distribution of inclusions have significant effects on the corrosion resistance too.
In this study, the corrosion properties of the 27Mn-4Si-2Al and 26Mn-3Si-3Al steels have been investigated using electrochemical polarization tests in two environments: 3.5 % NaCl (neutral) and 0.1 M NaOH (alkaline) solutions. The specimens were produced as hot rolled and cold deformed. Scanning electron microscope was used to in order to examine the microstructure and morphology of the corrosion damages produced on the steel surface. It was found that the MnS inclusions are preferential areas for pit forming and pit propagation.

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IMPROVING PROPERTIES OF SPRING STEEL THROUGH NANOPARTICLES ALLOYING

B. Podgornik[1], F. Tehovnik[1], M. Torkar[1], A. Kračun[1], D. Jenko[1], I. Paulin[1], B. Šetina-Batič[1], M.Godec[1], B. Senčič[2,3], W.R. Tuckart[4]
[1]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia
[2]ŠTORE STEEL d.o.o., Železarska cesta 3, Štore, Slovenia
[3]CO BIK, Tovarniška cesta 26, 5270 Ajdovščina, Slovenia
[4]Universidad Nacional del Sur, Bahia Blanca, Argentina
E-mail: bojan.podgornik@imt.si

In the last decades, considerable efforts are made in the development of high and even ultra-high performance steels. Part of the demand is due to needs for more compact design and cost reduction in the automotive industry and part due to environmental concerns. The environmental aspect is related to reduced CO_2 emission and improved fuel consumption. In this respect, using lighter components and reducing vehicle weight is one of the key elements. However, lighter components require high strength materials where improvement in strength should not degrade other properties such as toughness and fatigue resistance. Moreover, keeping high reliability is the first priority. Growing economic and environmental constraints are affecting the truck industry in the same manner as the automotive industry. In the case of trucks redesign and use of lighter high strength leaf springs can bring a big benefit. While increasing design flexibility and making room for additional safety components, it reduces truck weight and related fuel consumption.

In the case of spring steels, the emphasis in materials research has been focused on increasing the strength while maintaining good ductility, toughness and fatigue properties.Many attempts have been made to increase the material strength through grain refinement and precipitation of fine carbonitrides, achieved through microallyong and effective heat treatment. Nano-sized carbo-nitrides of microallyong elements can refine austenite grain size during heat treatment as well as strenghten the matrix, where the strength depends on the size, shape, stability and uniformity of the nanoparticles.

Currently, there is a growing awareness about the potential benefits of nanotechnologies in the modern engineering industry, and a number of investigations are carried out in the area of nanostructured steels. The focus is on the manipulation of microstructure at the nano-scale through innovative processing techniques and adoption of novel alloying strategies. However, the main challenge in realizing the immense potential of nano-engineered steels is to manufacture large components and quantities at low costs.

The aim of our work was to investigate the potential of nano-particles as alloying elements and their effect on the properties of spring steel. Investigation was performed on the conventional 51CrV4 spring steel, where different procedures of introducing nano-particles in the melt were analyzed. Nanoparticles included in the investigation comprised different types of carbides, oxides as well as nanotubes, added in different concentrations. Effect of nanoparticles alloying was investigated after hot rolling, soft annealing and vacuum heat treatment using typical processing parameters. Research including SEM and TEM microstructural analysis was focused on the yield and ultimate tensile strength, fracture toughness and fatigue properties under bending. Preliminary results indicate potential of nanoparticles to improve properties of spring steel, especially in terms of ultimate tensile strength.

OVERCOOLING IN OVERLAPPING AREAS DURING HYDRAULIC DESCALING

Michal Pohanka, Helena Votavová
Brno University of Technology, Faculty of Mechanical Engineering, Technická 2, 616 69 Brno, Czech Republic
E-mail: pohanka@fme.vutbr.cz

The production and processing of high quality grades of steel is connected with oxidation at high temperatures. Unwanted scales are formed on the steel surface, which is usually heated over 900 °C. These scales are often removed by hydraulic descaling during production. In most cases where long, flat products are produced, one row of descaling nozzles is used. Because these flat jet nozzles are arranged in the row, the water spray from one nozzle interferes with the spray from neighboring nozzles. This zone is called an overlapping area and oftentimes more scales remain here after the descaling process. An increased amount of scales left behind result in a lower quality of the final product. The typical configuration with an inclination and twist angle equal to 15 ° was studied. Heat transfer coefficients and surface temperatures were measured in the overlapping area and compared with values obtained from undisturbed areas. It was found that the overlapping area is grossly overcooled. Results were compared with a new configuration, where the twist angle was changed to 0 °, and it was found that the overcooling was significantly reduced. Temperature measurement showed that the increased thickness of the scales in the overlapping area can also be caused by surface overcooling because the scales become stronger at lower temperatures, and are therefore more difficult to descale. The new configuration with a twist angle of 0 ° seems to promise to improve the quality of hydraulic descaling.

STATISTICAL VIEW OF EVALUATING CONCRETE SURFACE LAYER PERMEABILITY TESTS IN CONNECTION WITH CHANGES IN CONCRETE FORMULA

Petr Misák, Tomáš Stavař, Iva Rozsypalová, Dalibor Kocáb, Petr Pőssl
Brno University of Technology, Faculty of Civil Engineering, Department of Building Testing
Veveří 95, 602 00 Brno, Czech Republic
E-mail: possl.p@fce.vutbr.cz

Concrete is one of the most common building materials and its durability has been observed with increased attention. It can be said that concrete durability is closely connected with permeability and, generally speaking, the quality of its surface layer. Evaluating the quality of the surface layer of concrete is a rather difficult issue which can be addressed in different ways. The authors of this paper focus on three internationally used methods – TPT, GWT and ISAT.

The paper sums up the results of the experiment whose goal was to investigate the influence of concrete composition on the outputs of the above-mentioned methods. For the purposes of the experiment, specimens were made using 9 mixtures which differed only in the amount of cement and plasticiser, i.e. water/cement ratio. The experiment was designed and evaluated using the statistical methodology DOE (Design of Experiment). Next, the paper discusses a new view of statistical evaluation of test results of the methods described above.

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PERFORMANCE OF AMINE AND IMIDAZOLINE BASED INHIBITORS IN A HIGH VELOCITY LABORATORY TEST RIG

A. Prethaler[1], G. Mori[1], E. Rosenberg[2], M. Rückemann[2]
[1]General and Analytical Chemistry, Montanuniversität Leoben, Franz-Josef-Str. 18, 8700 Leoben, Austria
[2]Institute for Chemical Technologies and Analytics, Technical University of Vienna, Getreidemarkt 9, 1060 Vienna, Austria
E-mail: andreas.prethaler@unileoben.ac.at

An amine based CO_2 corrosion inhibitor and an imidazoline based CO_2 corrosion inhibitor were tested in a two-phase laboratory flow loop system under conditions of a mature gas condensate well in Austria. Additionally electrochemical tests have been performed.
After a detailed description of the experimental setups, degradation rates of material API L-80 (1 % Cr) as function of flow velocity and inhibitor dosage are presented. Further one the influence of chloride addition on inhibitor performance has been investigated. All results are discussed with respect to critical inhibitor concentration to reach nearly 100 % inhibitor efficiency.
Inhibitor one exhibits as an active ingredient alkylamine dissolved in ethylene glycol and different alcohols and the effect of inhibitor two is based on imidazoline dissolved in different alcohols.
Results demonstrate that both inhibitors exhibit a good performance, independent of superficial flow velocities (tested between 3 and 35 m/s), as long as dosed above their critical concentration. The critical concentration is clearly below 100 ppm to the liquid phase. Addition of chlorides affects the performance of the alkylamine based inhibitor significantly more than in case of the imidazoline. Results of the electrochemical tests are in good accordance to the flow loop results.

HEAT TREATMENT EFFECTS ON THE PHASE AND MORPHOLOGY OF $Ba(Ce,Zr)O_3$ SOLID SOLUTION

Nurul Wahida Othman[1], Nafisah Osman[2], Azliana Ramli[2], Suhaida Dila Safian[2], Razali Idris[2]
[1]Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia
[2]Faculty of Applied Sciences, Universiti Teknologi MARA, 02600 Arau, Perlis, Malaysia
E-mail: azliana@perlis.uitm.edu.my

The properties of ceramics material are strongly depending on their preparation technique during synthesizing process and heat treatment. In this study, ceramic perovskite-type oxide based on $Ba(Ce,Zr)O_3$ was prepared by a sol-gel route and heat treated using a two-step sintering (TSS) method. The first temperature profile was set at T_1 = 1400 °C and the second temperature were varied at T_2= 1150 ^{o}C, 1200 ^{o}C, 1250 °C, 1300 °C and 1350 °C, respectively. The sintered pellets were labeled as TSS1, TSS2, TSS3, TSS4 and TSS5, accordingly. XRD results showed that all the samples exhibit single-phase of cerate-zirconate ceramics except for TSS4. The crystalline peaks for single-phase samples are matched to the standard $Ba(Ce,Zr)O_3$ with JPCDs card no. 01-089-2485. On the other hand, the presence of secondary phases of CeO_2, Ba_2ZrO_4 and $BaCO_3$ along with main phase of $Ba(Ce,Zr)O_3$ were detected in TSS4. SEM analysis revealed that the samples formed clear and compact grains with submicron sizes. As the second sintering temperature increased, the size of grain decreased from 336.4 nm to 192 nm. Therefore, the used of different sintering profile in TSS method was found to give significant effect on the phase and morphology of $Ba(Ce,Zr)O_3$ solid solution.

RESEARCH AND DEVELOPMENT OF PARTICULAR INSULATING MATERIALS BASED ON NATURAL FIBERS

Martina Reif, Jitka Hroudová, Jiří Zach
Brno University of Technology, Faculty of Civil Engineering, Admas Centre, Veveří 331/95, 602 00 Brno, Czech Republic
E-mail: reif.m@fce.vutbr.cz, hroudova.j@fce.vutbr.cz, zach.j@fce.vutbr.cz

The thermal insulation of building structures are increasingly used materials derived from natural raw materials or recycling of waste resources, industrial and agricultural production. These materials suitable for the production of insulators are asked a series of requirements. Primarily these are thermal insulating properties, which should be comparable with a classical conventional materials conventionally used for the manufacture of insulating materials also their fire resistance, moisture sensitivity and health safety.
The paper deals with the development options for insulating materials based on a mixture of recycled cellulose fibers and natural bast fibers. There are the results of research work in the field of study based thermal insulation, acoustic and mechanical properties of experimentally produced insulators on bulk density.

THE INFLUENCE OF IMPURITIES FOR QUALITY OF CERAMIC CORES USED IN THE AEROSPACE INDUSTRY

Iwona Rogalska, Ireneusz Stefaniuk
Centre for Microelectronics and Nanotechnology, University of Rzeszow, Pigonia 1, 35-959 Rzeszow, Poland
E-mail: i.rogalska@if.univ.rzeszow.pl

The problem of cracking of composite materials has been studied in detail in various works, for example in [1] describes how to produce Al_2O_3-Fe composites by casting of ceramic masses of successive, developed for the improvement of fracture toughness. In [2] ceramics based on alumina and mullite takes into account chemical reactions have been studied and highlights the problem of cracking.

We report a study of the ceramic cores using electron paramagnetic resonance (EPR). For EPR measurements we have used multifrequency and multiresonance EPR spectrometer BRUKER E-580 with temperature equipment BRUKER ER 4131VT. The measurements were performed at room temperature and in the temperature range from 100 K up to 370 K. In despite of similar chemical compositions of materials differences between of EPR spectra were detected Analysis of the temperature dependence of the EPR line width was performed based on the Orbach model to determine the relaxation time T_1.

In this work we have done measurements of X-ray diffraction for annealing ceramic cores. We have used Bruker diffractometer (XRD D8 Advanced) with Da Vinci design, also with Eva, Topas and Leptus software.

In our paper, the scanning electron examination of cross-sectional area of the core was performed. We were also studied mechanical properties of ceramic compounds by using static testing machine (Q-TEST MTS).

The aim of this work is to investigate by EPR methods the role of cores and shapes of basic Al_2O_3 materials used for industrial applications. The motivation for this study comes from the need to solve the problem of fractures of shape.

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THE METHODOLOGY OF RISK ASSESSMENT IN TECHNOLOGY OF HEAT TREATMENT PROCESSES

Marek Roszak
Silesian University of Technology, Konarskiego 18a St., 44-100 Gliwice, Poland
E-mail: marek.roszak@polsl.pl

The issue of risk assessment is a question of new technology, required in enterprises with implemented and maintained quality management system.
This requirement has emerged as recommendation of ISO 9004 and now it will present one of the requirements contained in the standard ISO 9001, what confirms the fact that this subject is current.
The article presents the proposed solution for the risk assessment of applied technology according to the analysis of heat treatment processes what is a complementary issue to the technology management.

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SURFACE PROPERTIES OF NEWLY DEVELOPED MATERIALS FOR THE PROTECTION OF CULTURAL HERITAGE OBJECTS

O. Rudic[1], A. Sever-Skapin[2], L. Skrlep[2], A. Vidakovic[1], S. Markov[1], D. Cjepa[1], J. Ranogajec[1]
[1]Faculty of Technology, University of Novi Sad, Bul. cara Lazara 1, Novi Sad, Serbia
[2]Slovenian National Building and Civil Engineering Institute, Dimiceva 12, Ljubljana, Slovenia
E-mail: ognjenrudic@yahoo.com

Newly developed protective materials, two types of consolidant formulations (for carbonate and silicate based substrates) and the protective coating (based on double layered hydroxides associated with TiO_2) were applied on porous mineral samples (handmade bricks and renders). The main aim of the investigation was the assessment of the surface properties (contact angle, roughness), antifungal effectiveness, self-cleaning activity and photoinduced hydrophilicity of the consolidated samples (treated only with the particular consolidant) and of the protected samples (treated with the consolidant and photocatalytic suspension) applied by two different application protocols. For the first application protocol, the photocatalytic suspension was applied 1, 2, 4 and 7 months after the consolidant, while in the case of the second application protocol, the photocatalytic suspension was deposited only after 1 month after the application of the consolidant. Contact angle assessment and contactless diffusion reflection, DRIFT-FTIR analysis, were used in order to investigate surface properties of the consolidated and of the protected samples, while antifungal efficiency was determined by modified ISO-DIS13125 standard. Beside the surface properties analysis, the consolidated and protected samples were subjected to two types of the adhesion tests (weathering effect of rain and modified test with semitransparent pressure-sensitive tapes) in order to investigate the durability concerning the self-cleaning efficiency and photocatalytic activity. During the entire experimental period, intensive C-H stretching signals of the samples treated with silica based consolidants were detected by DRIFT-FTIR spectroscopy. This phenomenon could be related to the slight increase of the surface hydrophobicity over time (determined by contact angle analysis). The presence of vaterite on the surface of the samples treated with lime based consolidant indicates a slow reaction rate of the amorphous calcium carbonate into calcite form. Direct correlation between the values of the contact angle and antifungal activity was not noticed either for the brick, or for the render samples. Based on the obtained results, better antifungal activity and good durability considering self-cleaning efficiency and photocatalytic activity was observed for the samples treated with both materials, consolidant and protective coating, in comparison to the samples treated only with the developed consolidants. Based on the obtained results of hydrophilicity assessment by DRIFT-FTIR analysis, it was shown that the presence of the photocatalytic coating on the porous surface increased the quantity of the adsorbed water regardless to the performed application protocol. This phenomenon is a necessary condition for the development of surface hydrophilic properties. Additionally, it was concluded that the surface characteristics (contact angle, roughness) and texture properties (capillary water absorbance, Hg porosimetry) of the porous samples coupled with the nature of the consolidates, as well as the interaction between the used consolidant and photocatalytic suspension, play important roles considering the antifungal and self-cleaning efficiency of the coated samples.

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A NEW APPROACH IN PRODUCTION OF COMPOSITE RIBS IN ONE STEP PROCESS

Rusnáková Soňa[1], Žaludek Milan[1], Fojtl Ladislav[1], Bílek Ondřej[1], Maňas Lukáš[1], Čapka Alexander[1], Rusnák Vladimír[2]
[1]Tomas Bata University in Zlín, Faculty of Technology, Department of Production Engineering, Vavrečkova 275, 762 72 Zlín, Czech Republic
[2]Faculty of Metallurgy and Materials Engineering, VŠB-Technical University of Ostrava, 17. listopadu 15, 708 33 Ostrava-Poruba, Czech Republic
E-mail: rusnakova@ft.utb.cz

In industrial practice we most frequently encountered with the applications of composite materials in which are constructionally necessary to use reinforcing planar or curved panels with ribs. The current state lies in the production of this by pultrusion technology. Pultrusion ranks among the technology, which through form, which gives the final shape of the profile stretches endless profile which may be hollow, filled with constant cross-section. In the present contribution we introduce a new approach in the production of composite profiles using vacuum infusion technology that allows the production profile in one step together with the panel, which stiffens. Benefits of this procedure include the possibility to manufacture any profile without length and dimensional constraints, eliminating the operation of bonding, shortens the production time and cheaper production cycle. In the Fig. 1 is described final I and U profile produced by vacuum infusion technology.

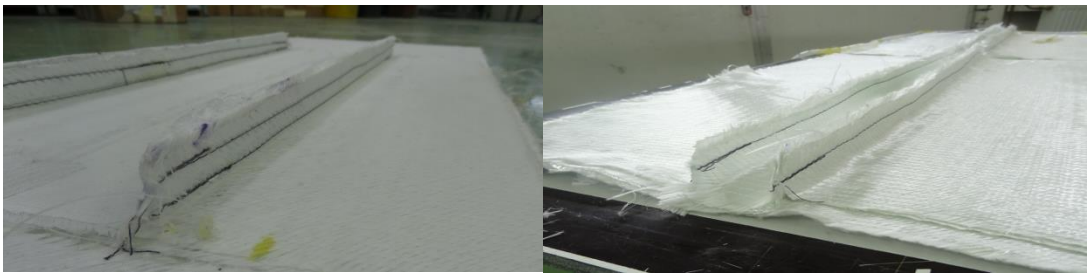

Fig.1 Composite composition before vacuum infusion technology

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REUSE OF REFRACTORY BRICK WASTES (RBW) AS A SUPPLEMENTARY CEMENTITIOUS MATERIAL IN A CONCRETE

Brahim Safi[1], Mohamed Zeghad[3], Jozef Mitterpach[2], Belaid Amrane[4], Mohammed Saidi[1]
[1]Research Unit: Materials, Processes and Environment (UR/MPE), Boumerdes University, Frantz fanon city, 35000 – Boumerdes- Algeria
[2]Department of Environmental Engineering, Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen, Slovakia Republic
[3]Faculty of Sciences, University of Tizi Ouzou, Hasnoua road, 15000- Tizi Ouzou, Algeria
[4]Faculty of Sciences, University of Bouira, Street Yahia Drissi – Bouira 10000, Algeria
E-mail: safi_b73@umbb.dz

The main purpose of this study is to evaluate the reuse of refractory brick wastes (RBW) as a supplementary cementitious materials (by a total replacement of silica fume) to produce a new concretes; for example a high performance fiber-reinforced concrete (HPFRC). This work presents an experimental study on the formulation and physico-mechanical characterization of ultra high performance fiber reinforced concretes based on three types of refractory brick wastes. These have been retrieved from the manufacturing unit of float glass MFG (Mediterranean Float Glass) after their use in the oven basin (i.e. d. they are considered waste unit). Three compositions of concrete (HPFRC) were established based on three types of refractory brick wastes (finely crushed), with the dosage of each type of bricks is kept constant, similar the dosage of silica fume used for the control concrete. While all the other components and the water/binder ratio are maintained constant with the same quantity of the superplasticizer. The performance of HPFRC, were evaluated by determining the essential characteristics of fresh and hardened concrete.

EFFECT OF THE SUPERPLASTICIZER ON THE PHYSICO-MECHANICAL AND THERMAL PROPERTIES OF FIREBRICK-BASED MORTARS

Mohammed Saidi[1], Brahim Safi[1], Abdelbaki Benmounah[1], Hanane Megdoud[2], Faiza Radi[2]
[1]Research Unit: Materials, Processes and Environment (UR/MPE), Boumerdes University, Frantz fanon city, 35000 – Boumerdes- Algeria
[1]Engineering Materials Department, Faculty of Engineering Sciences, Boumerdes University, Frantz fanon city, 35000 – Boumerdes- Algeria
E-mail: issam3009@gmail.com

This study present the effect of the waste firebricks with high content of Zirconia (HCZ) as fine aggregates by a total replacement of natural sand and / or by partial replacement of cement, on the physico-mechanical and thermal properties of mortars. An experimental study was conducted out to evaluate physico-mechanical and thermal properties of firebrick-based mortars. The natural sand is totally substituted by the firebrick waste as a fine aggregate and also the cement is partially replaced by the firebrick finely ground. The results show firstly that this waste can be upgraded not only mechanically but also thermally. In fact, the microstructural analysis (TG-DTA and XRD) show that the use of this waste contributes to the formation of multiple phases (corundum, zirconia, quartz, arnite, syn (Ca_2SiO_4)) whose melting point is considerably higher; this gives the nature of heat-resistant mortars. The introduction of superplasticizer increases in a remarkable way the mechanical strengths compared to normal mortar and waste-based mortars firebricks but is not recommended using superplasticizers at high temperatures. This study allows exploiting these mortars based refractory bricks HCZ up to 1400 °C.

INFLUENCE OF SURFACE TEXTURE SHAPE AND SEQUENCE ON TRIBOLOGICAL PROPERTIES OF CONTACT SURFACES

M. Sedlaček[1], B. Podgornik[1], A. Ramalho[2], B. Zajec[3]
[1]Institute of Metals and Technology, Lepi pot 11, Ljubljana, Slovenia
[2]CEMUC, University of Coimbra, Coimbra, Portugal
[3]Hidria Rotomatika d.o.o., Spodnja Kanomlja 23, Spodnja Idrija, Slovenia
Email: marko.sedlacek@imt.si

Surface texturing is a well know method for reducing friction, where with implementation of different patterns in form of micro dimples or channels on the surface, reduction of friction can be achieved. Varying texture parameters as their shape, depth, width, area density and orientation have influence on friction. In conditions of mixed and hydrodynamic lubrication micro-reservoirs act as micro-bearings and thereby improve the tribological properties of the contact. Since geometry of dimples can have significant effect on the building hydraulic pressure, the goal of this investigation was to see how different shapes of dimples influence on tribological properties. For this reason steel plate samples were surface textured using different shapes of imprints and laser texturing. To achieve cone like shape Rockwell C, for pyramid shape Vickers and for round shape Brinell indentation tips were used, respectively. Picosecond laser was also used for obtaining dimples with parabolic shape. To enable comparability between the imprints, outer diameter of dimples was set to 65 ± 5 μm and depth to ~10μm (with exception for Brinell imprints where depth was ~3μm). Additionally, influence of surface texturing sequence (before or after TiAlN hard coating deposition) was included. The purpose was to achieve fully coated dimples and dimples with uncoated surface. Since the coatings have different wettability to steel, it is expected that this could have additional effect on tribological properties. All samples will be analysed using stylus and 3D laser profilometers and related surface roughness parameters determined. Lubricated tests will be performed in block-on-ring configuration under different contact conditions using PAO8 oil as a lubricant. After the tests the results of all textured samples will be compared with untextured and uncoated samples. Correlation between roughness parameters and tribological properties of textured surfaces will also be determined.

HIGH TEMPERATURE DENSIFICATION INDUCED INTERCALATION OF Ti IN $Ti_{1+X}S_2$ THERMOELECTRICS

Tilen Sever, Boštjan Jančar, Danilo Suvorov
Advanced Materials Department, Jozef Stefan Institute, Jamova 39, 1000, Ljubljana, Slovenia
E-mail: tilen.sever@ijs.si

Thermoelectric materials based on non-toxic and low-priced titanium disulfide ceramics has been recognized as one of possible alternatives for best performing intermetallics at low and medium temperatures (e.g. Bi_2Te_3). Several studies have demonstrated the great potential of this compound below 400 °C[1,2,3], a power factor over 1.7 mW/mK^2 at room temperature, and thermoelectric figure-of-merit (ZT) up to 0.5 at 700 K have been reported.[1] However, it is well known that TiS_2 tend to grow metal rich and the excess Ti atoms intercalate into the van der Waals' gap. The off-stoichiometry is the main reason for variations in the physical and thermoelectric properties of TiS_2. It was recently pointed out that understanding the influence of Ti/S stoichiometry on the thermoelectric properties of TiS_2 is of fundamental importance.[1]

The synthesis of stoichiometric TiS_2 is rather complex, atmosphere, pressure, temperature and synthesis conditions are among many factors which can affect sulfur volatilization. Despite nearly stoichiometric TiS_2 was prepared by various groups[1,4], impact of the high temperature densification on the sulfur losses has not been considered quantitatively. We have synthetized nearly stoichiometric TiS_2 powder by direct reaction of elements and investigated the influence of spark plasma sintering (SPS) conditions (temperature, pressure and time) on the Ti/S stoichiometry. We have found that even short high temperature processing could induce intercalation of Ti and that densification conditions could have a major impact on the thermoelectric properties of bulk TiS_2.

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PHASE AND MICROSTRUCTURE DEVELOPMENT IN PEROVSKITE MATERIALS FOR SOFC ANODES PREPARED BY CARBONATE COPRECIPITATION METHOD

Klementina Zupan, Marjan Marinšek, Tina Skalar
Faculty of Chemistry and Chemical Technology, University of Ljubljana, Večna pot 113, 1000 Ljubljana, Slovenia
E-mail: klementina.zupan@fkkt.uni-lj.si

Most SOFC development has been based on nickel yttria stabilized zirconia anodes. Such materials have excellent catalytic properties for fuel oxidation, high electrical conductivity, good mechanical strength and appropriate thermal expansion coefficient compatible with other cells components. Unfortunately, cermet anodes based on doped zirconia exhibit some disadvantages, i.e. catalysing side reaction of carbon deposition during hydro-carbon fuel oxidation and susceptibility to sulphur poisoning. Perovskite type compounds based on lanthanum-strontium-manganese-chromium oxide can serve as an alternative material. Since optimal perovskite composition is still not known, ceramics $La_{1-x}Sr_xMn_yCr_{1.y}O_{3\pm\delta}$ (x from 0 to 0.3 and y from 0.4 to 0.6) were prepared by coprecipitation method. Crystalline phase formation was followed by X- ray powder diffraction and Ritveld refinement. Quantitative microstructure analysis was performed on SEM micrographs of samples sintered at different temperatures.

STRUCTURE AND MECHANICAL PROPERTIES OF DUCTILE IRON WITH DIFFERENT INITIAL MATRIX AFTER NANOSTRUCTURIZATION HEAT TREATMENT

E. Skołek, P. Skoczylas, K. Wasiluk, W. Świątnicki, D. Myszka
E-mail: emilia.skolek@nanostal.eu

The aim of the study was to compare the microstructure and mechanical properties of two kinds of ductile iron: perlitic-ferritic ductile iron and ausferritic ductile iron, which were subjected to austempering heat treatment in the range of bainitic transformation. The final austempering led to produce in both kinds of samples the same type of microstructure consisting of carbide-free bainitic ferrite laths separated by the layers of the residual austenite. It has been shown that, the thickness of bainite laths and austenite layers was similar, regardless of the initial state of the ductile iron. However the austempering applied to the samples with ausferritic matrix allowed to produce a higher amount of the residual austenite. Both kinds of samples were subjected to mechanical tests such as hardness, impact strength and tensile strength. The samples containing higher amount of austenite exhibited better mechanical properties as compared to the material without the pre-heat treatment.

EFFECT OF DIRECT COOLING CONDITIONS ON MICROSTRUCTURE AND PROPERTIES OF HOT-FORGED HSLA STEELS FOR MINING APPLICATIONS

Piotr Skubisz, Łukasz Lisiecki, Tadeusz Skowronek, Artur Żak
AGH University of Science and Technology, Department of Metals Engineering and Industrial Computers Science, 30 Mickiewicz Ave, Cracow, Poland
Ferrous Metals Institute, 12-14 K. Miarki, Gliwice, Poland
E-mail: pskubisz@metal.agh.edu.pl

Hot deformation and controlled direct cooling on hardening of medium carbon HSLA steel with micro additions of alloying elements Ti and/or V is presented. The study of the effect of thermomechanical processing conditions on grain refinement and precipitation kinetics oriented at replacement of conventional reheating-requiring heat treatment with cost-effective technology are presented. The idea of the work is to utilize accelerated controlled cooling to amend for lower carbon and hardenability-related alloying elements with employing experimentally designed heats, varying in Mo level, which after direct cooling are meant to meet mining industry microstructure-properties requirements.

On the basis of numerical analysis of thermo-mechanical parameters and temperature progression, hot forging and direct cooling conditions were selected to achieve assumed structural components, morphology and dispersion of both grain and precipitates. Numerical modeling of the direct heat treatment in QForm3D, including deformation, microstructure development and phase transformation, allowed prediction of transformation products and data acquisition for modeling of microstructure development and carbides and carbonitrides precipitation kinetics and formed a basis for experimental controlled cooling tests on continuous cooling laboratory conveyor. The cooling conveyor, being in fact a simulator of an industrial cooling line. was employed for design of industrial processing cycles as well as, experimental sampling of forging, carried out for selected hot forging and controlled cooling schedules with different agents, including accelerated air, mist and spray, applied to industrial process of drop forging of a miners' link, which forms a case study for evaluation of the effectiveness of the selected processing routes.

Besides microstructure-property relations, a vital problem of nonuniformity and reproducibility of obtained properties is addressed for varying in locations processing routes in as-forged undeformed and dynamically recrystallized material under conditions. The required level of strength and plasticity was accomplished by producing fine pearlite/bainite structure with grain boundary ferrite and grain size controlled by proper dispersion carbides/carbonitrides. Evaluation included tensile properties and metallographic work, which allowed formulation of conclusions of the effect of direct-cooling conditions on microstructure and grain substructure, as well as their mutual synergic effect in controlling the microstructure, as well as guidelines for transfer of the locally established process parameters into technological conditions.

EFFECT OF THERMOMECHANICAL TREATMENT ON INTERGRANULAR CORROSION OF Al-Mg-Si-TYPE ALLOY BARS

Peter Sláma, Jan Nacházel
COMTES FHT. a.s., Průmyslová 995, 33441 Dobřany, Czech Republic
E-mail: peter.slama@comtesfht.cz

Al-Mg-Si-type alloys (6xxx-series alloys) exhibit good mechanical properties, formability, weldability and good corrosion resistance in various environments. They often find use in automotive industry and other applications [1, 2]. Some alloys, however, particularly those with higher copper levels, show increased susceptibility to intergranular corrosion.

Intergranular corrosion (IGC) is typically related to the formation of microgalvanic cells between cathodic, more noble phases and depleted (precipitate-free) zones along grain boundaries. It is encountered mainly in AlMgSi alloys containing Cu, where it is thought to be related to the formation Q-phase precipitates ($Al_4Mg_8Si_7Cu_2$) along grain boundaries. [3–7]. In these studies, the enhancement of resistance to intergranular corrosion through modified heat treating (artificial aging) was explored. Good results were achieved by overaging and two-stage aging.

The present paper describes the effects of mechanical working (pressing, drawing and straightening) and artificial aging on intergranular corrosion in rods of the 6064 alloy. The resistance to intergranular corrosion was mapped using corrosion tests according to EN ISO 11846, method B.

It was found that the most profound effect on corrosion resistance is that of mechanical working.

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EXPERIMENTAL INVESTIGATIONS OF FLEXURAL RESPONSE AND CRACK DEVELOPMENT OF POLYPROPYLENE FIBER REINFORCED ULTRA-HIGH PERFORMANCE CONCRETE AFTER EXPOSURE TO ELEVATED TEMPERATURE

Piotr Smarzewski, Danuta Barnat – Hunek
Lublin University of Technology, Faculty of Civil Engineering and Architecture, 40 Nadbystrzycka Str., 20-618 Lublin
E-mail: psmarzewski@wp.pl

Exposure to high temperatures has a negative effect on the mechanical properties of concrete. The damage mechanisms of concrete at elevated temperatures depends on the pore pressure effect, the thermal mismatch and the decomposition of hydrates [1]. Numerous studies have reported on the various effects of the high temperature on the mechanical properties of polypropylene fiber reinforced concrete [2]. This study has investigated the changes that might occur on the post-crack flexural response. The flexural toughness test was carried out on two types of concrete: plain ultra-high performance concrete (UHPC) and ultra-high performance concrete with polypropylene fiber (FRUHPC) at 0.5 %, 1 %, 1.5 % and 2 % by volume fractions. Before the flexural test, the specimens were placed in the furnace chamber and exposed to elevated temperatures of 400 °C, 600 °C and 800 °C. The results of the observations of scanning electron microscope (SEM) micro-crack development and pores distribution in UHPC and in FRUHPC were presented. In the macro-crack analysis, under flexural load, non-contact ARAMIS system for three-dimensional measurements of strain and displacement was used, Fig. 1.

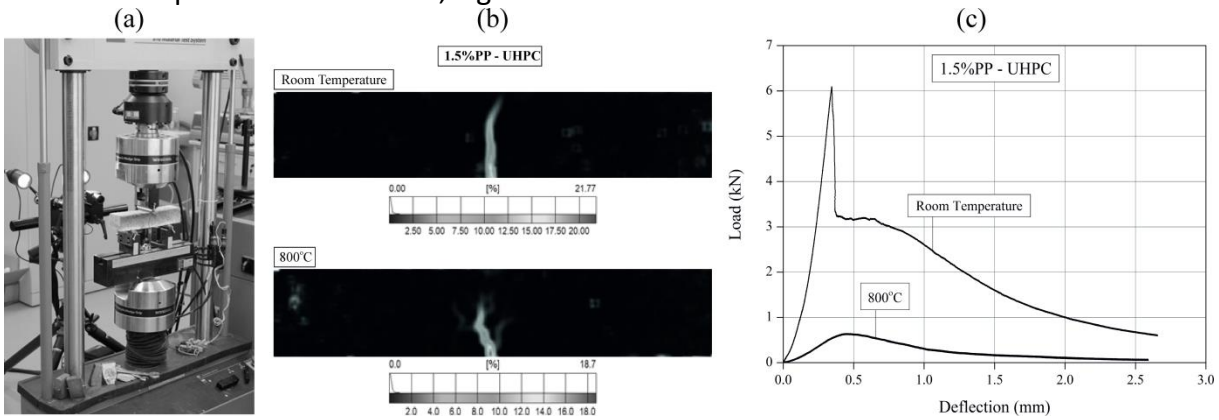

Fig. 1. Three-point bending test of 1.5% polypropylene FRUHPC specimen: (a) experimental set up, (b) strains under maximum load, (c) flexural responses of UHPC with 1.5% PP

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CERAMIC FIFFLED BIO-PLASTIC COMPOSITE PATCH ANTENNAS AT 2.45 GHZ ISM BAND FOR BIOMEDICAL APPLICATIONS

M. Samsuzzaman, M. T. Islam, M.R.I Faruque
Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia
E-mail: sobuzcse@eng.ukm.my

Bio-polymer-based composite materials have become attractive candidates for sustainable industrial development. Further, to the development of bio-inspired environ-mentally friendly composite materials for contemporary industrial advancement, bio-based plastics have shown their potential in the past decades for microwave-circuit design. Bioplastics have been used for electric circuits, especially for packaging purposes, in replacing fossil petroleum-based plastics.Several researchers have studied printed microstrip patch antennas on sandwich/stacked/multilayer substrates. Their main advantages are gain and bandwidth enhancement in small patch antennas with a minimum increase in overall size. In this invention, a compact simple structure Y-shape patch antenna are proposed for industrial scienctific and medical (ISM) band (2.4–2.48 GHz) applications. To make the designed antenna sutable for implanatation, it is embedded in biocompatible ceramic filled Bio-polymer-based composite materials substrate. The proposed antenna consists of Y-shaped patch in the top of the susbtrtae and partial ground plane in the bottom of the substrate. The effects of different configurations of the radiating patch and the ground plane on the reflection coefficient have been analysed. The proposed antenna achieves -10 dB impedance bandwidth of 166 MHz (2350–2516 MHz). The antenna prototype has achieved maximum gains of 2.1 dBi with average radiation efficiencies of 80.3 % in the operating band. The size of the antenna is 28.5 x 30 x 1mm^3. Also the antenna was simulated by immersing it in a phantom liquid, imitating the electrical properties of the human muscle tissue. Details of the materials structure and proposed designed are investigated and discussed.

STUDY OF MACRO-SEGREGATIONS IN THE CONTINUOUSLY CAST BILLET

Karel Michalek[1], Ladislav Socha[1], Vlastimil Vodárek[2], Hana Francová[3], Karel Gryc[1], Markéta Tkadlečková[1], Ladislav Válek[4]
[1]VŠB – Technical University of Ostrava, FMME, Department of Metallurgy and Foundry, 17. listopadu 15/2172, 708 33 Ostrava – Poruba, Czech republic
[2]VŠB – Technical University of Ostrava, FMME, Department of Material Engineering, 17. listopadu 15/2172, 708 33 Ostrava – Poruba, Czech republic
[3]VŠB – Technical University of Ostrava, FMME, Department of Physical Chemistry and Theory of Technological Processes, 17. listopadu 15/2172, 708 33 Ostrava – Poruba, Czech republic
[4] ArcelorMittal Ostrava a.s., Research, Vratimovská 689, 707 02 Ostrava-Kunčice, Czech republic
E-mail: karel.michalek@vsb.cz

Steel crystallization occurs during casting and following solidification of continuously cast billets. Directional material solidification, the grain size, chemical heterogeneity and existence of non-compactness can negatively affect the characteristics of final material. Relatively big homogeneity in distribution of sulphur and other elements and also the absence of more thickly sweated areas in the whole cross-section are connected with the fast solidification of billet. Extent and removing of impurities is mainly related to the content of phosphorus and sulphur in steel, steel temperature and also to the cooling intensity of the billet. Local chemical heterogeneity occurs in the billet axis, especially in the steels with higher carbon content, where the possibility of inner hollows formation is bigger [1, 2].

The paper shows the results of study of macro-segregation from the cross section of billet Ø 160 mm continuously cast for demanding pipe quality aimed for production of seamless pipes. At first, macro-structural analysis of longitudinal cut of the round billet was made for the study of macro-segregation in the continuously cast billet. Then, micro-structural analysis was carried out at using of quantitative RTG microanalysis by the help of EDX analyser. The results from micro-structural analysis were subsequently complemented by the analysis of carbon and sulphur content with the aim of evaluation of chosen segregation parameters in the micro-samples taken from the particular areas of macro-etching. Obtained primary results will be used not only for verification of numerical modelling results of continuously casting of billets. The work was created within the solution of projects SP2015/78, SP2015/70 and LO1203 „Regional materials science and technology centre – Program of sustainability".

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NON-TRADITIONAL WHITEWARES BASED ON CALCIUM ALUMINATE CEMENT

Radomir Sokolar
Brno University of Technology, Faculty of Civil Engineering, Veveri 95, 602 00 Brno, Czech Republic
E-mail: sokolar.r@fce.vutbr.cz

Whiteware is traditional ceramic materials with low porosity and white colour of the fired body used for porcelains or sanitary ceramics. Typical raw materials mixture for the production of whitewares consists of kaolins or clays, quartz and feldspar. The addition of calcium aluminate cement as a substitute for kaolins (clays) exhibits a relatively high-green strength and lowers the density due to formation of anorthite in all the fired bodies [1].

The aim of the article is to introduce the differences in the properties of whiteware (porosity, strength, thermal expansion coefficient) when pure calcium aluminate cement or combination of the binders – mixture of kaolin and calcium aluminate cement – instead of kaolin is used. The results will be discussed in connection with the microstructure of the fired body of prepared whitewares (mineralogical composition).

Calcium aluminate cement with high content of Al_2O_3 (over 50 %) in whitevare raw material mixtures may be an interesting alternative to kaolin for higher strength of green body, higher whiteness body after firing and at its lower coefficient of linear thermal expansion. Using calcium aluminate cement reduces the sintering activity of the body (the bodies must be burned at a higher temperature) and significantly changes its mineralogical composition – anorthite is the main mineralogical phase instead of mullite which is typical for a standard porcelain bodies made from raw material mixtures based on kaolin. Anorthite type of porcelain body is very suitable for high strength of the fired body [2].

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PHASE TRANSFORMATIONS IN HSLA STEEL WELDS RELATIVE TO WELDING PARAMETERS

Sanja Šolić[1], Zdravko Schauperl[2], Davor Kolednjak[3]
[1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
[2]UNIZG Faculty of Mechanical Engineering and Naval Architecture, I. Lučića 5, 10000 Zagreb, Croatia
[3]Inženjering za naftu I plin d.o.o., Ul. Savezne Republike Njemačke 10, 10000 Zagreb, Croatia
E-mail: sanja.solic@imt.si

Microalloyed low carbon steels, originally termed High Strength Low Alloy (HSLA) steels are widely used in petrochemical industry because of their good combination of mechanical properties, high strength and impact toughness, and good weldability, especially in the field work.
Microalloying is used primarily for construction steels with high yield strength, sufficient reserve of plastic deformation, minimal tendency to brittle fracture and good weldability. One of the HSLA steels mainly used in recent years for high pressure pipelines is API 5L X80 steel that is produced by thermomechanically controlled rolling process (TMCP) with accelerated cooling (ACC). The aim of TMCP is to get the fine and uniform Acicular Ferrite microstructure instead of Ferrite/Pearlite banded microstructure of conventional steels. According to this fine and uniform Acicular Ferrite microstructure, TMCP steels have higher strength and better toughness than conventional normalized steels.
Changes of temperatures during the welding of TMCP API 5L X80 steel are causing the discontinuity of the crystal structure in the weld area and consequently change of material properties with increased sensitivity for crack formation and propagation. By optimization of welding parameters it is possible to control the heat cycles in the weld material and to influence the phase transformations and the microstructure of the weld and the heat affected zone. This paper focused on the influence of heat input, preheating temperature and the volume of CO_2 in the shield gas on the phase transformations and microstructural changes in the weld material and in the heat affected zone of API 5L X80 steel. The accent of the research is on the influence of these welding parameters on formation of oxide inclusions and the amount of Acicular Ferrite in weld material and HAZ that is proved to have positive influence on the toughness of the welded joints.

DEPOSITION OF HARD YET MODERATELY DUCTILE Mo_2BC COATINGS BY PULSED-DC MAGNETRON SPUTTERING

Pavel Soucek[1], Petr Vasina[1], Vilma Bursikova[1], Lukas Zabransky[1], Jiri Bursik[2], Vratislav Perina[3]
[1]Department of Physical Electronics, Faculty of Science, Masaryk University, Brno, Czech Republic
[2]Institute of Physics of Materials, Academy of Sciences of the Czech Republic, Brno, Czech Republic
[3]Nuclear Physics Institute, Academy of Sciences of the Czech Republic, v.v.i., Rez, Czech Republic
E-mail: soucek@physics.muni.cz

Standard ceramic materials nowadays used as protective coatings such as TiN, TiAlN, c-BN, etc., exhibit high hardness and high stiffness. However these are often connected to brittle behavior of the coating thus limiting the lifetime of the coating and of the coated tool as well. To overcome these limitations, a new generation of materials with high hardness and moderate ductility is sought for.

Recently, nanolaminate Mo_2BC coatings were predicted to have these advantageous properties [1]. However deposition conditions so far necessary to deposit Mo_2BC coatings are a limiting factor. First, deposition process utilizing combinatorial DC magnetron sputtering required substrate temperature of 900 °C was reported [1]. Secondly, a low temperature synthesis method reducing the substrate temperature to 380 °C required using HiPIMS with compound Mo_2BC target [2]. Both of these methods pose significant problems with industrial scale production. High deposition temperatures that are at or above tempering temperature of the tools would worsen the mechanical properties of the coated tools and HiPIMS technology is still not widely used due to its high cost and relatively complicated operation.

In this contribution simultaneous magnetron sputtering of Mo, C and B_4C targets, where two targets are driven by DC and one is driven by pulsed DC to obtain higher energy ions in the plasma to promote crystallization of the Mo_2BC material, is used. The substrates can be further biased to increase the energy flux onto the substrate, also additional heating can be used. Superhard crystalline Mo_2BC coatings were prepared in this setup and the effect of the pulsing parameters on the properties of the coating is described with emphasis on the structure and the mechanical properties.

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IDENTIFICATION OF ELASTIC MATERIAL PARAMETERS OF UNIDIRECTIONAL COMPOSITE USING MICROMODEL WITH REAL TOPOLOGY

Hana Srbová, Vladimír Lukeš, Tomáš Kroupa
University of West Bohemia in Pilsen, Univerzitní 22, 306 14 Plzeň, Czech Republic
E-mail: hsrbova@kme.zcu.cz

Real fiber and matrix volume ratios of unidirectional fiber composites were identified from images obtained by scanning electron microscopy (SEM). Fiber and matrix areas were analyzed using Matlab and its Image processing toolbox. Determined volume ratios were used to propose geometry of a micromechanical representative volume element. An algorithm assuring irregular fiber distribution in the representative volume element cross section and periodicity in the cross section plane was used. Mesh of single-layer representative volume element was built in Abaqus/CAE.
Tensile tests of specimens with different fiber orientations were processed and effective moduli were determined from the measured force-displacement dependencies. Elastic material parameters of fibers and matrix were then identified using two approaches where the difference between measured and calculated effective modules was minimized. In the first approach optiSlang optimization software and finite element code Abaqus with periodically constrained representative volume element were used. In the second approach the asymptotic homogenization in SfePy software was used for the numerical computation on microscopic scale.

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THE EFFECT OF Mn ON THE HIGH-TEMPERATURE OXIDATION BEHAVIOR OF AN Fe-Si-Mn-Al ALLOY

Darja Steiner Petrovič[1], Gašper Novak[2], Aleš Nagode[3], Djordje Mandrino[1]
[1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
[2]RCJ, d.o.o., Cesta Franceta Prešerna 61, 4270 Jesenice, Slovenia
[3]University of Ljubljana, FNSE, Aškerčeva 12, 1000 Ljubljana, Slovenia
E-mail: darja.steiner@imt.si

Due to the technical importance of Fe–Si alloys and an increasing need to improve their magnetic properties, the aim of the present study is to determine the high-temperature oxidation behavior of the hot-rolled Fe–Si–Mn–Al alloy.

Binary Fe–Si alloys containing more than about 2 mass % Si are ferritic (α-ferrite) at all temperatures up to the melting point.

However, the alloying with Mn can significantly influence the magnetic behavior of silicon steel. Furthermore, Mn as an alloying element stabilizes austenitic structure of iron. In the steel, Al and Mn also form the non-metallic inclusions AlN and MnS, respectively.

In this work, the influence of 1 mass % of Mn on the formation of high-temperature oxides on surface of the Fe–Si–Mn–Al alloy for non-oriented electrical sheets is investigated. Thermodynamic calculations by ThermoCalc can also be very helpful in interpreting the existence of equilibrium phases as well as phase transformations in the selected commercial alloy. XRD at different temperatures, from hot rolling temperature (1200 ^{o}C) down to room temperature was used to actually observe these phases and phase transformations.

CONTINUOUS CASTING OF NITINOL

Aleš Stambolić[1,2], Ivan Anžel[3], Gorazd Lojen[3], Aleksandra Kocijan[1], Rebeka Rudolf[3,4], Monika Jenko[1,2]
[1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
[2]Jožef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana, Slovenia
[3]University of Maribor, Faculty of Mechanical Engineering, Smetanova 17, 2000 Maribor, Slovenia
[4]Zlatarna Celje d.d., Kersnikova 19, 3000 Celje, Slovenia
E-mail: ales.stambolic@imt.si

Continuous casting is a manufacturing process where molten metal is solidified into a semi-finished product. Metal is melted in the crucible and then cast through a mould. The casting travels downwards and its length increases with time. Continuous casting is characterized by high cooling rates which allow a very short time for the diffusion processes and may lead to an extremely fine microstructure that increases the material's toughness. This process is used most frequently to cast steels, aluminium and copper. On the other hand, continuous casting of nitinol is studied poorly. Nitinol is well known for its properties, like shape memory effect, superelasticity, high tensile strength, good fatigue and corrosion resistance and biocompatibility. The main problems with continuous casting of nitinol are the high reactivity and affinity for oxygen of titanium and great hardness and toughness of nitinol that makes it very hard to form a desired shape with this material.
Nitinol was prepared with vertical continuous casting. Ni and Ti were melted in a graphite crucible with a vacuum induction furnace at a temperature above 1400 °C. These electromagnetic waves were also used for stirring the alloy. The nitinol was cooled and cast through a zirconia mould at a pre-defined casting rate. The final product was nitinol rods of different lengths with 1 cm diameter. The product was further characterized for its microstructure using a scanning electron microscope (SEM) and composition using an X-ray fluorescence spectrometry (XRF).

INVESTIGATIONS OF WEAR RESISTANT ALD/PVD HYBRID COATINGS ON SINTERED TOOL SUBSTRATE

Marcin Staszuk, Daniel Pakuła
Institute of Engineering Materials and Biomaterials, Silesian University of Technology, Konarskiego Street 18A, 44-100 Gliwice, Poland
E-mail: marcin.staszuk@polsl.pl

The proposed paper is an important investigation direction for the development of PVD coatings in particular on ceramic substrates, which, due to their dielectric properties are difficult materials to cover using this technique. However, PVD coatings properties and benefits of application these coatings for cutting tools, such as high microhardness and abrasion resistance, low coefficient of friction of the coated tool with the working material or the oxidation resistance and as well preventing from create built-up on a tool is connected with the possibility of working without the use of a cooling lubricant liquid are an important argument, acting in favor of the development of this area and the use of PVD coatings on ceramic tools can bring real economic and ecological effects. However, in order to bring PVD coatings intended effect of outlet it is important to take care of one of the fundamental property that is their adhesion to the substrate. So modern and innovative direction of scientific exploration is the main assumption that encourage authors to take proposed topic of this research project, and the obtain results of investigations will show the path for further development in the field of thin wear-resistant coatings on ceramic tool.
The main aim of this research is an investigation of the structure and mechanical properties the coatings deposited by hybrid process contained the atomic layer deposition (ALD) and cathode arc evaporation (CAE-PVD) on sintered carbides and tool ceramics multipoint cutting tools. The concept of this investigation involves the execution and investigation the ALD + PVD hybrid coatings on sintered carbides and sialon ceramic substrate, and determination the influence of ALD interlayer on adherence investigated coatings. Critical load Lc, which is the coats adhesion measure, was determined by the scratch test method and tribological test made with the „pin-on-disk". Observations of surface topography and coatings fracture were performed by using the scanning electron microscope and the atomic force microscopy. The roughness was determined by using the atomic force microscopy and profilographometer.

ELECTRON MICROSCOPY INVESTIGATION OF CEMENT-BASED MATERIALS MODIFIED BY THE ADDITION OF α-ALUMINA NANOPARTICLES

[1]Mateja Štefančič, [2]Nina Daneu, [1]Ana Mladenovič
[1]Slovenian National Building and Civil Engineering Institute, Dimičeva 12, 1000 Ljubljana, Slovenia
[2]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia
E-mail: mateja.stefancic@zag.si

Several solutions have been suggested which could be used to effectively address the problem of high energy consumption and CO_2 emissions in the production of cement and concrete. One of them is to decrease the cement content in concrete by adding nano- and micro-sized particles (fillers), in order to increase the latter's strength and to decrease the quantity of concrete needed for specific applications (Hosseini et al., 2011). Compared to cementitious systems with reactive fillers (e.g. SiO_2, $CaCO_3$), systems with inert fillers are not nearly as well-explored or understood (Rashad, 2013). In this study the effects of an inert filler, i.e. α-alumina (Al_2O_3), on the distribution of hydration products and on the morphology, crystallinity, and composition of mineral phases at the contact between the nanoparticles and the cementitious matrix have been examined, as well as the correlation between the microstructure and the mechanical properties of a 28-days-hydrated cement matrix with different amounts of added alpha-alumina nanoparticles (2, 4, 6, 8, 10 % by weight of cement). The microstructure of the samples was analyzed by field-emission scanning and transmission electron microscopy (FE-SEM and TEM), and their strength was measured according to the standard SIST EN 196-1 (2005), except that the water to cement ratio of the pastes and the mould dimensions were adapted to the used mix design. The results of the SEM and TEM analyses showed that the addition of nanoparticles promotes densification of the cementitious matrix, which is reflected in the increased strength of mixtures with added nanoparticles. The latter act as nucleation sites for intermixed products of hydration (calcium-silicate-hydrate gel, portlandite, AFt, AFm), and provide support to the porous, low density main hydration product, i.e. the calcium-silicate-hydrate gel. The results of the TEM analyses showed that the α-Al2O3 nanoparticles are tightly embedded in an amorphous, foil-like, calcium-silicate-hydrate gel. The interface between the nanoparticles and the surrounding gel is sharp, without any pores or reaction products at the contact. The change in porosity next to the contact is indistinguishable from the porosity of the bulk gel phase. The observed improvement in the strength of the investigated mixtures can be directly related to the amount of inert filler, in the form of α-Al2O3 nanoparticles, which was added to the mixture.

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THE EVALUATION OF DEGREE DEGRADATION BY USING IMPACT-ECHO METHOD IN CIVIL ENGINEERING

Daniela Štefková, Kristýna Timčaková,Libor Topolář
Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, Brno 602 00
E-mail: stefkova.d@fce.vutbr.cz

Non-destructive method such as Impact-echo is based on the acoustic properties of the material which are dependent on its condition. It allows studied progress development of micro-defects in the structure of the material. This acoustic method allows to identify and to locate defects and is thus suitable for monitoring the building structure condition. Application of this method is wide, it can be used in engineering, power engineering and in many industries as well as in construction industry [1].

Impact-echo uses a short-time mechanical impulse (a hammer blow) which is applied to a surface of the test sample and is detected by means of piezoelectric sensors placed on surface of sample, too. The impulse is reflected by the surface but also by micro-cracks and defects of the specimen which are under investigation. From thus obtained signal is determined the frequency spectrum and is found the dominant resonance frequency by using Fast Fourier Transformation. The dominant frequencies give an account of the condition of the structure of the structure or to determine the location of flaws, at which the waves are rebounded. As a rule, the signal is digitized by means of a data processing system and is transferred into a computer memory [2]. The signal response is taken by a piezoelectric sensor MIDI and it is brought to the input of an oscilloscope TiePie engineering Handyscope HS3 two-channel with resolution 16 bits.

This paper reports the results of measurements by Impact-echo method on three application in civil engineering. The results are obtained in the laboratory during:

- the hardening process in quasi-brittle materials such as alkali-activated slag mortars
- the degradation of concrete samples by corrosion caused by the action of chlorides
- the degradation of composite materials based on cement by high-temperature

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MELTING FRONT PROPAGATION IN AN ORGANIC PHASE CHANGE MATERIAL – SIMULATIONS AND LAB-SCALE EXPERIMENT

J. Štětina, P. Charvát
Brno University of Technology, Technicka 2896/2, 616 69 Brno, Czech Republic
E-mail: stetina@fme.vutbr.cz

Phase change of a material is a process encountered in many technical applications. In some cases a precise knowledge of the position of the phase change front is quit important. Arias et al.[1] reported a study of particle segregation due to the motion of the solidification front in phase change materials. Soares et al.[2] investigated the melting process and the solidification front in a vertical stack of cavities, which were filled with a phase change material. Patil et al.[3] presented an analysis of steel composition on solidification front in ingot steel casting.

The present paper reports investigation of the melting front propagation in a quasi 1D case. The investigated case was a cube of phase change material (PCM) with a heat flux introduced on one of its side. The investigations were performed both numerically and experimentally. The commercial off-the-shelf simulation tools ANSYS and COMSOL were used for numerical investigations. The situations with the constant temperature and the constant heat flux at the side with the heat flux introduced were investigated. The remaining walls were considered adiabatic (ideal case) and with ambient temperature and heat transfer coefficient (realistic case). Beside the numerical investigations, a lab scale experiment was prepared and conducted in order to monitor the melting front and thus to obtain experimental data for validation of computer simulations. The cube of a PCM was held in a transparent container so that the propagation of the melting front could be monitored. An organic PCM with the melting temperature of 28 °C was used. Such a low temperature was chosen with regard to surrounding boundary conditions. The container with the PCM was placed in an environmental chamber where the ambient temperature was maintained just below 28 °C. At that temperature the monitoring equipment (cameras, data acquisition modules) as well as the researcher conducting the experiments could be located directly in the environmental chamber.

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ADSORPTION PROPERTIES OF SINTERED CARBON STRUCTURED NANOMATERIALS

Strokova Natalia[1], Savilov Serguei[1], Lunin Valery[1], Lu Li[2], Aldoshin Serguei[3]
[1]Chemistry Department, M.V. Lomonosov Moscow State University, Leninskie gory, 1-3, Moscow, 119991, Russia
[2]Department of Mechanical Engineering, National University of Singapore, Block EA, #07-08, 9 Engineering Drive 1, 117575, Singapore
[3]Faculty of Fundamental Physical and Chemical Engineering, M.V. Lomonosov Moscow State University, Leninskiye Gory, 1, GSP-1, Moscow, 119991, Russia
E-mail: natalia.strokova@gmail.com

Different types of porous carbon structures can be applied in the field of electrochemical energy storage as electrode materials in double-layer ultracapacitors. Having different characteristics, from the viewpoint of wide operating voltage the electrochemical devices with non-aqueous electrolytes are more promising. The electrodes consistent of them have to demonstrate appropriate to electrolyte ions size porosity, high surface area as well as electrical conductivity and solidity. To create a new type of such electrodes spark plasma sintering of structured carbon materials was proposed. It yielded to conductive monolith formation with variable porosity and surface area cca. 15 % smaller that starting material had.

Adsorption properties of sintered and started materials respective to ethanol, acetonitrile, heptane, benzene and 1-methylimidazole were studied by DVS Advantage instrument (SMS, UK). Dry nitrogen carrier gas with vapours of compound under investigation passed over the carbon sample at well-defined flow rate and temperature. The sample mass readings from the microbalances revealed the vapour adsorption/desorption behaviour of the material. Experimental heats of sorption of all the solvents were calculated after measurements at 20, 30 and 40 °C. Two powder samples (carbon nanotubes with 5 nm diameter and 3 layers graphite particles (carbon flakes)) as well as products of they sintering under 1600 ^{o}C were studied. Graphite powder was used as a reference non-porous substance.

According to Raman spectroscopy compacted carbon materials demonstrated less defect structure. Shape of adsorption-desorption isotherms shows the presence of micro- and mesopores in all of the materials under discussion; sintered samples also revealed reduction of total pores volume to 73.3 % for CNT and 39.2 % for carbon flakes. The uptake of all solvents on powder samples was greater than on compacted ones because of sealing of pores. The values of ΔH_{ads} obtained for 1-methylimidazole on CNT was –21.9 kJ/mol, on carbon flakes –13.9 kJ/mol. It means that consolidated electron system and polarizability of CNTs provide optimal adsorption conditions for same aromatic substrate than carbon flakes, having more defective structure. The heat of sorption of 1-methylimidazole on CNT tablet is -13 kJ/mol that is almost twice lower than for powder CNT but at the same time for sintered carbon flake it valued -26.1 kJ/mol that is larger than for appropriate powder. In can be arisen by structure ordering during spark plasma sintering [1].

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INVESTIGATION OF SUITABLE FLAME STRAIGHTENING PROCEDURE FOR TWO COMMONLY USED STRUCTURAL STEELS

Marjan Suban, Andrej Zajec, Borut Bundara, Robert Cvelbar
Institute of metal constructions, Mencingerjeva 7, 1000 Ljubljana, Slovenia
E-mail: marjan.suban@imk.si

According to standard EN 1090-2 distortion of steel construction parts can be corrected by flame straightening. In everyday practice this operation is usually done in workshop by skilled personnel. Within the requirements of standard EN 1090-2 the process of flame straightening has to be controlled at least for most demanding execution classes EXC3 and EXC4. Appropriate procedure shall be developed for process of local application of heat, ensuring that the maximum material surface temperature and the cooling rate are controlled and within the prescribed limits. Based on these fundamental requests, procedure developed for two different, most commonly used structural steels was investigated. Influence of flame straightening on mechanical properties of base material for steels S355J2 and S690QL is more in detail presented and discussed in the paper.

POLYVINYL ALCOHOL: PREPARATION OF A POLYMER INK FOR PATTERNING OF SUBSTRATES BY PIEZOELECTRIC DROP-ON-DEMAND INKJET PRINTER

Pavol Šuly[1,2], Petr Krcmar[1,2], Jan Maslik[1,2], Pavel Urbanek[2], Ivo Kuritka[1,2]
[1]Polymer Centre, Tomas Bata University in Zlín, Faculty of Technology, Namesti T. G. Masaryka 275, 762 72 Zlin, Czech Republic
[2]Centre of Polymer Systems, Tomas Bata University in Zlín, Tr. Tomase Bati 5678, 760 01 Zlin, Czech Republic
E-mail: suly@ft.utb.cz

Inkjet printing technology (IJP) is considered one of the most promising deposition techniques in nowadays. It allows highly precise deposition of functional materials to the required place of substrate and cost saving printing process, especially when the drop-on-demand manner is used. Moreover; it represents the perfect technique for controlled deposition of polymer material, especially for polymer solutions because of their low viscosity and better process ability.[1] IJP has been successfully used for preparation of electronics devices as organic light-emitting diodes (OLEDs), thin film transistors (TFTs), or printed electronics as solar panels, circuit, radio frequency identification devices (RFID), sensors, and other. Additionally, IJP has been also used in biological and pharmaceutical application.[2, 3] Polyvinyl alcohol was chosen because of its versatile application potential; moreover, it is harmless for human body what only increase its usability in bio-applications. In this work, the polyvinyl alcohol was dissolved in different polar solvents such as water, alcohols and other organic solvents separately or in mixture. The crucial ink parameters, viscosity and surface tension, of prepared solutions were determined. The solutions with the best properties were printed by piezoelectric drop-on-demand Dimatix DMP 2800 series material printer. Pre-defined and personally defined motives were chosen as patterns. The printing conditions were optimized in order to obtain patterns with the shape and resolution as good as possible. Finally, the printed patterns were analyzed by selected methods.

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MODIFICATION OF TITANIUM WITH SILVER VIA TOLLENS METHOD

Barbara Szaraniec[1], Rafał Pokrowiecki[2], Kamila Frąckowiak[1], Jan Chłopek[1]
[1]AGH University of Science and Technology, Department of Biomaterials, Mickiewicza 30, 30-059 Krakow, Poland
[2]Jagiellonian University Medical College – University Dental Clinic, Department of Oral Surgery, Montelupich 4, 31-155 Krakow, Poland
E-mail: szaran@agh.edu.pl

Titanium and its alloys are commonly used in regenerative medicine. Despite high success rate of implantation procedures, infections associated with artificial materials are a serious risk of treatment failure. The goal of a modern biomaterials engineering is to decrease the rate of implant associated infections by proper modification of materials surface. The aim of this study was to create biomimetic titanium surface incorporated with silver nanoparticles, evaluate the impact of silver nanoparticles addition on the surface physicochemical properties and assess antimicrobial effect of modified titanium against S. Aureus and E. Coli. Titanium grade 2 (Torresin Titanio-Metalli S.R.L.) specimens were modified by double acid etching in HF and HNO_3. Then, specimens were etched in 10M NaOH solution. Silver nanoparticles were incorporated on biomimetic surface by means of Tollens reaction – chemical coating method. Surface characteristics such as roughness, micro/nanostructure and wettability were investigated. To examine the release behaviour of Ag^+ from the surface, specimens were immersed in water and analyzed by inductively coupled plasma mass spectroscopy (ICP-MS). The ability to induce apatite precipitation in Simulated Body Fluid (SBF) was tested in order to investigate bioactivity of the treated samples. Etching procedure presented in this paper enabled to obtain nanometric surface with only slightly increased mean surface Ra values. However, it significantly decreased mean contact angle values, therefore etched titanium (Ti) samples presented superhydrophilic surfaces. Silver incorporation did not affect surface wettability and Ti-Ag samples preserved superhydrophilicity. When immersed in water, the surfaces continuously released silver ions. As it visible, the amount of released silver is proportional to soaking period. An initial burst release was observed during first 24h of incubation, then silver release rate decreased gradually in time. Antimicrobial properties of the specimens modified with silver nanoparticles were confirmed – inhibition zones for both S. Aureus and E. Coli were bigger than 1.5 mm. No inhibition zones were observed around control group. This indicates that antimicrobial properties are tightly connected to silver ions diffusion into the medium. Apatite formation was observed on the surface of both, nanosilver modified and control group, specimens' surface. It can be concluded that surface modification procedure presented in this paper is a successful modification method that can provide titanium with antimicrobial and bioactive properties.

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RHEOLOGICAL PROPERTIES OF ALUMINA CERAMIC SLURRIES FOR CERAMIC SHELL MOULDS FABRICATION

Joanna Szymanska, Pawel Wisniewski, Marcin Malek, Jaroslaw Mizera
Faculty of Materials Science and Engineering, Warsaw University of Technology, Woloska 141 Street, 02-507 Warsaw
E-mail: joanna.szymanska.pl@gmail.com

Nowadays ceramic moulds are widely applied in aviation industry to cast complicated shape details made of Ni superalloys. In general, Bridgman method is an appropriate way to obtain required strength at high temperature in investment casting process.

This research concerns mainly rheological properties of ceramic slurries prepared from water-dispersed nano aluminum based binder and corundum matrix applied for “prime coat” fabrication in ceramic shell moulds. Nano Al_2O_3 based binder does not react with the alloy components so it was applied instead of the commonly added colloidal silica based binder.

Alumina powders were used with granulation of 030 and 200 Mesh. Modification of rheological properties of prepared slurries were also based on addition of polyacrylic binder.

Aim of this investigation was to study an influence of solid content, supportive materials and various proportions of 030 and 200 Mesh Al_2O_3 powders on technological properties of ceramic slurries with nano aluminum based binder (with particles size equal to 16 nm).

Ceramic slurries with solid phase content 77 % by weight and polymer amounts 6,10 and 15 wt % with respect to the alumina for different powders ratio 35:65 and 65:35 (200:030) were prepared in mechanical mixer within 96 h with speed 160 rpm. During the slurry preparation pH, density, temperature, plate weight test and Zhan cup 4# viscosity were controlled every 24 h. After 96 hours of mixing rheological properties such as dynamic viscosity and shear stress were also defined. Morphology and chemical properties of corundum powders and polymer were characterized by SEM and TEM images, chemical composition, X-ray diffraction, powder grain size distribution and thermal analysis.

Obtained results of corundum based ceramic slurries indicate that application of polymeric binder with various concentrations basing on nano alumina oxides presents different properties in comparison to other commonly used binders. The investigation proves that studied materials are very promising for shell moulding in the investment casting process.

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THE $Ba_{0.975}$ $Pb_{0.025}$ $(Zr_YTi_{1-Y})O_3$ FERROELECTRIC COMPOSITIONS

K. Taïbi[1], F. Si Ahmed[1], O. Bidault[2]
[1]Laboratoire de Cristallographie-Thermodynamique, Faculté de Chimie, USTHB, BP32 El-Alia, 16111 Alger, Algérie
[2]Laboratoire interdisciplinaire Carnot de Bourgogne Université de Bourgogne /UMR 6303 CNRS, Dijon, France
E-mail: kameltaibi.dz@gmail.com

The complex perovskite $AA'(BB')O_3$ are known to exhibit normal and/or relaxor ferroelectric behaviour. Many investigations have been devoted to the study of relaxation parameters in such materials in order to achieve their use in capacitors and actuators [1,2]. However, most of these materials are lead-based ceramics which present a disadvantage due to the toxicity of PbO. So, for environmental and health reasons, manufacture of such materials are more and more constrained to eliminate the lead content from these compounds.

Therefore, to develop environment friendly materials, great deals of lead free materials or lead reducing compositions were examined. Among these, $Ba(Zr_yTi_{1-y})O_3$ (BZT) or $Pb_{1-x}Ba_x(Zr_yTi_{1-y})O_3$ (PBZT) ceramics have been found very interesting owing to their attractive ferroelectric performances. However, The first one (BZT) revealed less performant dielectric characteristics, while the second (PBZT) compositions contain relatively high lead content and remain not suitable for environmental devices. In the other hand, the simultaneous Ba-Pb and Zr-Ti substitution give rise to the better dielectric constant in comparison to undoped barium zirconate titanate (BZT). Moreover, these substituted materials were characterized by a decrease in Curie temperature and an increase of room temperature dielectric constant. In this work, we present the results of new compositions of ferroelectric or relaxor ferroelectric behaviour with very low lead content. The compositions explored were $Ba_{0.975}Pb_{0.025}(Zr_yTi_{1-y})O_3$ (BPZT) with y = 0.20–0.40. The effects of simultaneous cationic substitution of zirconium for titanium in the B site and of lead for barium in the A site for $BaTiO_3$ perovskite lattice on symmetry and dielectric properties were investigated. Ceramic samples were prepared by conventional mixed oxide method. Room temperature XRD analysis allowed us to determine the limits of solid solution. Dielectric measurements were performed on ceramic disks. For all samples, the temperature (85–500 K) and frequency (10^3–2.10^5 Hz) variations of the dielectric characteristics were investigated. A relaxor-like behavior with frequency dispersion is observed at high Zr content for a very low lead content which is suitable for environment devices applications.

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SURFACE TREATMENT OF HEAT-TREATED CAST MAGNESIUM AND ALUMINIUM ALLOYS

T. Tański, M. Wiśniowski, W. Matysiak
Institute of Engineering Materials and Biomaterials, Silesian University of Technology, Konarskiego Str 18A, 44-100 Gliwice, Poland
E-mail: tomasz.tanski@polsl.pl

Modern coating systems deposited on surface layers of structural light materials are currently one of the most important issues in up-to-date material engineering, where vacuum techniques are often used for improvement of mechanical and functional properties of the produced surface layers. Presented in this paper gradient and monolithic coatings of the type: Ti/Ti(C,N)/CrN, Ti/Ti(C,N)/(Ti,Al)N, Ti/(Ti,Si)N/(Ti,Si)N, Cr/CrN/CrN, Cr/CrN/TiN and Ti/DLC/DLC were deposited onto magnesium and aluminium alloys substrates by the cathodic arc evaporation method (PVD) and plasma assisted process (CVD). Additionally a thin metallic layer – in micrometre size – (Cr and Ti) was deposited prior to deposition of the finally gradient coatings to improve its adhesion to the substrate. This work presents the investigation results concerning the obtained surface layer microstructure and its mechanical properties, especially the microhardness and wear resistance of the obtained bi-layer coatings (gradient/multicompound) deposited onto the light alloys substrates using chosen PVD and CVD methods, especially to meet the requirements set by the light metals substrate – low temperature and duration. Structure investigations of the deposited coating were performed using scanning electron microscopy (SEM), glow discharge optical emission spectrometry (GDOS), whereas the mechanical and functional properties were examined by appliance of the ball-on-disk method for the wear resistance determination, and microhardness for the functional usability of the coatings. The main findings are, that the fracture morphology is characterized by a lack of columnar structures in the obtained coatings. The metallographic examinations carried out give also grounds to state, that the coatings were deposited uniformly over the whole sample onto the investigated substrate materials, the measured thickness is characteristic for this produced coating type, it was also found that the particular layers adhere tightly to each other and to the light metal substrate. The investigation results obtained especially for the PVD method makes it possible to obtain interesting solutions which is very attractive for appliance in the automobile and aviation industries for elements where high functional properties like hardness and wear resistance are crucial for long time service.

THE TRIBOLOGICAL PROPERTIES OF SURFACE LAYER STEEL C45 AFTER LASER HARDENING

[1]Wojciech Tarasiuk, [1]Jan Piwnik, [2]Bozena Szczucka-Lasota
[1]Bialystok University of Technology, Mechanical Faculty, Bialystok, Poland, str. Wiejska 45C, 15-351 Bialystok
[2]High School of Labor Safety Management in Katowice, Faculty of Technical Science and Quality, Katowice, Poland
E-mail: w.tarasiuk@pb.edu.pl; j.piwnik@pb.edu.pl; bszczucka-lasota@wszop.edu.pl

Laser hardening process is very often used to apply a hardness or wear-resistant layer of base metal [1]. It is generally used in the production of agricultural machinery working elements. The steel C45 is selected for study. It is used for heavily loaded machine elements, which may be exposed to varying loads.

The paper presents results of research tribological properties laser hardened steel C45. Parameter influencing on the quality of the hardened surface was laser head speed. The study was conducted on friction tester pin-on-disc type T-11[2], and a counter sample disc was silicate. Parameter determining the quality of the surface layer is the intensity of wear [3]. Based on the results we obtain information about the laser head speed to temper steel C45 so as to maintain a high resistance to wear.

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EVOLUTION OF MICROSTRUCTURE DURING HOT ROLLING ALLOY INCONEL 625

Franc Tehovnik, Jaka Burja, Franci Vode, Bojan Podgornik, Boštjan Arh
Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
E-mail: franc.tehovnik@imt.si

Inconel nickel-chromium alloy 625 is used for its high strength and outstanding corrosion resistance. The strength of Inconel alloy is derived from the stiffening effect of molybdenum and niobium on its nickel-chromium matrix; thus precipitation-hardening treatments are not required. This combination of elements is also responsible for superior resistance to a wide range of corrosive environments of unusual severity as well as the high-temperature effects such as oxidation and carburization.
This research provides an overview of structural changes that occur during hot rolling of superalloys Inconel 625, because it is well known that microstructural control is paramount importance concerning mechanical properties of material. Microstructure also plays an important role in processing materials at elevated temperature. In this work the hot rolling of alloy, specifically the hot deformation behaviour, is investigated. Specimens were hot rolled at temperature of 1200 °C with different number of passes and the rolling loads were measured and recorded. Microstructural changes were examined, with the accent on recrystallization.

THE POSSIBILITIES OF NUS AND IMPACT-ECHO METHODS FOR STEEL CORROSION MONITORING IN CONCRETE

Kristýna Timčaková-Šamárková, Michal Matysík, Zdeněk Chobola
Brno University of Technology, Faculty of Civil Engineering, Veveri 331/95, 602 00 Brno, Czech Republic
E-mail: samarkova.k@fce.vutbr.cz

The corrosion of steel elements in reinforced concrete can cause considerable damage to civil engineering structures. Early detection of rust is therefore very important. The aim of this paper is to evaluate the possibility of using the nonlinear ultrasonic spectroscopy with a single exciting harmonic frequency and impact-echo method for monitoring corrosion of concrete-covered steel.

For research we manufactured concrete beams, which were reinforced with one standard reinforcing steel bar passing through the centre of the beam. After concrete curing and drying, the samples were exposed to 20 % carbon dioxide atmosphere. After concrete pH decreased below 9.6 throughout the sample volume, samples were immersing into a 5 % water solution of NaCl and subsequently placing into a drying oven. The measurement was carried out before carbonation of concrete, after it, and then after every 20 cycles of accelerated degradation by chlorides.

Nonlinear ultrasonic spectroscopy (NUS) methods are based on the fact that crack-induced nonlinearity makes a sensitive material impairment indicator. Impact-echo method uses a short-time mechanical impulse applied to the surface of the test sample which produces elastic waves. These waves spread throughout the sample and is reflected from the surface but also from micro-cracks and unobservable defects inside the sample.

To verify the correctness of the NUS and impact-echo method results, additional measurements were carried out (confocal scanning microscope and measurement the electrical resistance of the steel reinforcement).

It has been proved that both methods can be used for monitoring corrosion of concrete-covered steel.

ELECTROCHEMICAL CORROSION OF SELECTED WELDED JOINTS IN CHOSEN ENVIRONMENTS

Santina Topolska
Institute of Engineering Materials and Biomaterials, Silesian University of Technology, 18A Konarskiego St., 44-100 Gliwice, Poland
E-mail: santina.topolska@polsl.pl

Investigation of corrosion resistance of materials is realized either in natural conditions or in laboratory ones (artificial, simulating the natural conditions). To the second group of investigations, and exactly to the group of accelerated ones belong the electrochemical investigations. These investigations allow rapidly estimating corrosion processes occurring in metal elements under the influence of the analyzed environment. These investigations are applied for analyzing the resistance of materials to pitting corrosion and to crevice corrosion [1]. In the paper are presented results of investigations of the resistance to pitting corrosion of the steel of next grades: austenitic 316L and duplex 2205 [2, 3]. It was also analyzed the corrosion resistance of welded joints of these grades of steel. Two different types of joints were analyzed and namely:][type and 2Y type. The investigations were conducted in two different corrosion environments: in the neutral one (3.5 % sodium chloride) and in the aggressive one (0.1 M sulfuric acid VI).
The obtained results indicate on different resistance of analyzed grades of steel and their welded joints in relation to the corrosion environment. The austenitic 316L steel characterizes by the higher resistance to the pitting corrosion in the aggressive environment (0.1 M sulfuric acid VI) then the duplex 2205 steel. It was also found that the type of welded joint do not affect the level of corrosion resistance.

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SURFACE ROUGHNESS AND FIELD CORROSION RESISTANCE OF FERRITIC STAINLESS STEELS SHEETS

Matjaž Torkar, Aleksandra Kocijan, Bojan Podgornik, Boštjan Arh
Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
E-mail: matjaz.torkar@imt.si

Ferritic stainless steels are low cost, price stable, corrosion resistant steels and possible competitor to zinc coated steel. It is expected that application of ferritic stainless steels, compared to carbon structural steels can prolong the life time of the structure and reduce the maintenance costs. Due to the lack of data, a comparative study of corrosion resistance of hot rolled and cold rolled ferritic stainless steels, with different surface roughness was performed. The samples of ferritic stainless steels (1.4003, 1.4509, 1.4521 and 1.4621) of three producers, joined with welds and bolts, were exposed for 1 year to field corrosion test and evaluated. For samples with higher surface roughness a heavy corroded surface was observed, with the diameter of pits being up to 300 µm and the depth up to 28 µm. The pits were interconnected in a heavy corroded surface. At less corroded samples with lower surface roughness the diameter of pits was up to 120 µm with the depth up to 14 µm. In most cases welds were without corrosion damages in the weld and in the heat affected zone. However, in the case of bolted joints, below washers, either being teflon or stainless steel washer, individual and elongated pits were observed as a consequence of crevice corrosion. Comparison of corrosion below teflon and steel washers revealed less expressed corrosion below the teflon washers. It was established that lower surface roughness is beneficial for diminishing of corrosion attack but it is not the only condition. The test results revealed that beside surface roughness, products from different producers also differ in the quality of surface, which influences on the appearance of corrosion and corrosion resistance.

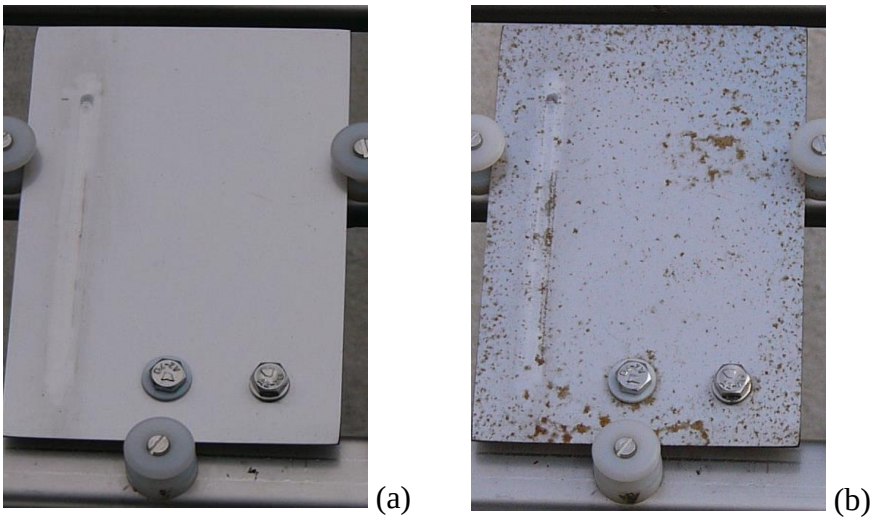

Figure: Steel 1.4003, cold rolled, producer 1, a) after 1 month, b) after 12 months of exposition to atmospheric corrosion

ANALYSIS OF COST REDUCTION IN HEAT TREATMENT OF FORGED PARTS IN CONTINUOUS FURNACE ACHIEVED BY COMPUTER SIMULATION

Miroslav Urbánek, Mikuláš Fedorko, Michal Duchek
COMTES FHT a.s., Prumyslova 995, Dobrany 334 41, Czech republic
E-mail: miroslav.urbanek@comtesfht.cz

As part of a research assignment, a manufacturing sequence (forging, trimming and heat treatment) for a forged part of a control system was optimised using computer simulations. The present paper describes the optimisation of the final operation, the heat treatment. In order to describe the real-world heat treatment process, two experiments were carried out. The first one involved on-site measurement of temperature in chosen locations of the real forgings in a continuous furnace. The purpose of this experiment was to map the heat treatment process. Several preparatory steps were undertaken. One of them led to the proposal of a thermal box for the ADAM module. This module was used for measuring the temperature of the forged part during heat treatment. The collected data was used as reference values for the computer simulation of heating in the furnace. The second experiment was conducted in a laboratory furnace where the temperature of a cylindrical specimen was measured. The goal was to obtain a temperature-time profile for fine tuning the numerical model of heat treatment by heat radiation. Based on these experiments, a numerical model was constructed. It described the heat treatment of the real forgings in the continuous furnace. The heat treatment was then optimized by computer simulation using the MSC.MARC/MENTAT software. The optimisation consisted of shortening the time in the furnace and/or reducing the temperature in the first zone. The optimisation criterion was the temperature field on the forgings after heating. The optimal variant of the process was successfully tested in the plant.

STUDY OF EFFECTS OF FORGING TEMPERATURE AND DEFORMATION ON MICROSTRUCTURE OF CLOSED-DIE-FORGED STEEL PART USING MATERIAL TECHNOLOGICAL MODELING

Filip Vančura, Ivan Vorel, Bohuslav Mašek
University of West Bohemia, Univerzitni 8, 306 14 Pilsen, Czech Republic
E-mail: vancuraf@seznam.cz

Closed-die forging is a quite complex process. To describe it properly, is necessary to know the values of many technological parameters. Even more complicated is the description of the entire manufacturing sequence, especially if thermomechanical treatment, controlled cooling, quenching from the forging temperature or another post-forge process is involved. The development of such a process usually requires a sufficient number of plant trials to map the capabilities of the technology, find the critical points and identify the optimal conditions. It is a financially and organizationally demanding endeavor requiring substantial resources. A promising and effective tool in this regard is material-technological modeling. When compared to FEM simulations, it allows the entire process to be predicted cost-effectively. In addition, the result of the prediction is not only a graph, or a "color image" but a real material sample. This is crucial where the evaluation of microstructure and mechanical testing are required. The article presents an example of material-technological modeling of closed-die forging of a part of microalloyed steel with the use of controlled cooling. The aim of the research was to find technological parameters that enable the requirements of the customer for the microstructure and mechanical properties to be met. The total true strain throughout the volume of the forging was mapped, as was the effect of various forging temperatures.

GROW OF HARD nc-TiC/a-C:H COATINGS BY DC DRIVEN AND HiPIMS PROCESS

Petr Vasina[1], Vilma Bursikova[1], Radek Zemlička[1,2], Mojmir Jilek[2], Petr Vogl[2], Katarina Bernatova[1], Josef Daniel[1], Jaroslav Hnilica[1], Tereza Schmidtova[1], Pavel Soucek[1]

[1]Department of Physical Electronics, Faculty of Science, Masaryk University, Brno, Czech Republic

[2]Platit a.s., Šumperk, Czech Republic

E-mail: vasina@physics.muni.cz

nc-TiC/a-C:H coatings consist of TiC crystallites embedded in an amorphous hydrogenated carbon matrix. Depending mainly on the chemical composition, the properties of these coatings can be tailored from hard coatings to tribological coatings, with coefficients of friction lower than 0.1. Hybrid PVD–PECVD process of sputtering of titanium target in a mixture of argon and acetylene gas is used for preparation of nc-TiC/a-C:H coatings.

The aim of this paper is to describe and understand non-monotonous dependence of cathode voltage, discharge current and other quantities on acetylene supply which was observed to take place at both dc driven laboratory scale device with planar magnetron and dc driven industrial scale device with rotating cylindrical cathodes. Analyses of the deposition plasma revealed that the hybrid PVD–PECVD process of titanium sputtering in argon and acetylene atmosphere does not show the hysteresis behavior as observed for reactive magnetron sputtering. Three distinctive zones were identified in the process evolution with the acetylene supply at the laboratory device with planar magnetron. Similarities and differences in the behavior of the deposition process with planar and cylindrical sputtering target were identified. The evolution of the deposition process was correlated with the evolution of the state of the sputtering target for both studied cases.

Comparing dc-driven laboratory process with planar magnetron with HiPIMS process at the same average power, the significant difference of the acetylene supply to grow the coatings of the same composition at the same sputtering system was identified. At HiPIMS process, much lower acetylene supply is needed compared to dc-driven process to achieve the same coating composition.

CORROSION DETERMINATION OF REINFORCEMENT USING ELECTRIC RESISTANCE METHOD

Miroslav Brodňan, Peter Koteš, Jan Vaněrek, Rostislav Drochytka
Brno University of Technology, Faculty of Civil Engineering, Veveří 95, 602 00 Brno, Czech Republic
University of Žilina, Faculty of Civil Engineering, Univerzitná 1, 010 26 Žilina, Slovakia
E-mail: vanerek.j@fce.vutbr.cz, brodnan@fstav.uniza.sk

Nowadays, there is a tendency of a proper examination of the corrosion state of steel reinforcement by non-destructive methods in the branch of reinforced concrete structures. After the determination and validation process of achieved data, the adequate type of remediation could be developed. In laboratory experimental work, the determination of reinforcement corrosion using electric resistance method were made when steel bars were embedded in the concrete beams of 50 mm × 50 mm × 360 mm. After that, they were exposed to accelerated corrosion conditions to ensure their corrosion process.

Electric resistance measurement method can determine the real decrease of reinforcement exposed to corrosion conditions, but the knowledge of input resistance data is the premise of its usage. Important restriction of this method is a fact that measured reinforcement has to have both of ends available for connecting measurement contacts. Principle of this method is based on basic theory regarding the relation of electric resistance onto the reducing cross-section of each conductor. By change of electric resistance is possible to consequently determine corrosive decrease of embedded steel reinforcement.

For comparison, the non-destructive measurements were compared to data from consequent destructive tests in the laboratory conditions. The steel bars were removed from each concrete beams to detect the real corrosion decrease of cross-section by weight decrease evaluation process.

Next part of research was focused on corrosion simulation of steel reinforcement in reinforced concrete. The cracking response of the reinforced concrete beams due to the corrosion effect of steel reinforcement was analyzed. The effect of corrosion was simulated by the nonlinear numerical analysis with the program ATENA 2D and 3D.

TEMPERATURE MEASUREMENTS AND SIMULATIONS IN METALLIC INDUSTRY

Franci Vode, Bojan Podgornik, Franc Tehovnik, Borut Žužek, Boštjan Arh, Jaka Burja
IMT, Lepi pot 11, SI-1000 Ljubljana
E-mail: franci.vode@imt.si

In metallic industry, metals are frequently and repeatedly reheated prior to various reshaping techniques or simply for heat treatment of semi/finished products. Regardless of the reheating process, actual stock temperature being reheated effects the product microstructural and mechanical properties. For tighter product microstructural and consequently mechanical properties, tighter stock temperature knowledge and further tighter control is essential. Since reheating processes in industry are more and more subject of energy and/or capacity/through-put optimizations, these processes are more and more far from thermodynamic equilibrium. Consequently stock temperature is not homogeneous and resulting product properties distribution of the stock depends on stock temperature distribution during or at the end of the reheating process.

Some segments of production still wait for commercially available and accurate enough continuous temperature measurements, e.g. casting temperature in ladle and in mould, which are of immense importance for the continuous casting process. Temperature measurements in liquid metals are far more demanding compared to temperature measurements in solid metals. However, for continuous temperature measurements in solid state remains a problem of heat conduction and spatial temperature distribution in stock, e.g. billet. Radiative temperature measurements measure temperature only on the stock surface, while interior stock temperature can be accurately measured by thermocouples. For continuous furnaces for thicker stock reheating such thermocouple measurements are possible, but are expensive and require quite some preparation of stock and other equipment. But the situation in such furnaces is on the other hand practical for use of mathematical model for calculation of stock temperatures, since geometry of stock and furnace are available, alloy data are available and the most important, furnace temperature are always available as measured data instantly and quite accurately. The knowledge of spatial stock temperature distribution via mathematical model therefore offers effective and useful spatial stock temperature distribution data for engineers as well as for R&D for resolving complicated situations and problems.

ELECTRON BEAM WELDING OF 42SiCr HIGH-STRENGTH STEEL

Ivan Vorel, Jana Čubrová, Štěpán Jeníček, Bohuslav Mašek
University of West Bohemia, Research Centre of Forming Technology,Univerzitní 22, 306 14 Plzeň
E-mail: frost@vctt.zcu.cz

Welding of high-strength steels is a widely discussed application oni a global scale. It is because of the thermally induced processes that take place in the microstructure of the materials being welded. These processes cause mechanical properties of the weld metal and the heat-affected zone to degrade, which may impair the quality of the fabricated structure. The present paper explores the effects of electron beam welding on mechanical properties of an AHS steel. Specimens of high-strength martensitic-austenitic 42SiCr steel have been used. Their ultimate strength was more than 2100 MPa and the A5 mm elongation was higher than 15 %. These specimens were welded and then tested in tension. Their microstructure was examined as well. The analysis showed that the material retained high ultimate strength of more than 1780 MPa combined with an elongation level of 6 %.

ELECTROCALORIC EFFECT IN $0.9Pb(Mg_{1/3}Nb_{2/3})O_3$-$0.1PbTiO_3$ BULK CERAMICS WITH GRAIN SIZES IN MICRON RANGE

Marko Vrabelj[1,2], Hana Uršič[1,2], Zdravko Kutnjak[1,2], Brigita Rožič[1], Silvo Drnovšek[1], Andreja Benčan[1,2], Vid Bobnar[1,2], Lovro Fulanović[1,2], Barbara Malič[1,2]
[1]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia
[2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia
E-mail: marko.vrabelj@ijs.si

The electrocaloric (EC) effect may be defined as an adiabatic and reversible temperature change that occurs in a polar material upon application of an external electric field. It is directly related to the polarization change with the electric field, so it is especially strong in ferroelectrics and relaxors.[1,2] The (1-x)$Pb(Mg_{1/3}Nb_{2/3})O_3$–x$PbTiO_3$ (PMN-100xPT) ceramics of selected compositions are expected to exhibit a large EC affect due to their excellent dielectric properties, such as high dielectric permittivity and polarization, and a large change of polarization with temperature.[3,4] Despite many studies on the EC materials it is still not clear how the microstructure of the material, like grain size and porosity influence the EC properties of the materials. Therefore, we prepared the PMN–10PT bulk ceramics with similar densities and different grain sizes by changing the sintering temperature and time and analyzed their phase composition, microstructure, dielectric and EC properties.

The powders were prepared by mechanochemical activation from constituent oxides. Powder compacts were sintered from 1150 °C to 1250 °C and from 2 h to 16 h in the presence of the packing powder of the same composition and reached relative densities exceeding 95 %. All samples had homogeneous microstructures with grain sizes from 2.8 μm to 9.4 μm.

The highest measured EC temperature change for the ceramic with 3.6 μm grains was 3.45 °C at 127 °C and 160 kV/cm, which is the highest reported value until now for Pb-based perovskites. The influence of the grain size on the dielectric and EC properties of PMN–10PT is discussed in the contribution.

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RARE-EARTH MODIFICATION OF $BiFeO_3$ CERAMICS AND THEIR COMPOSITION-STRUCTURE-PROPERTY RELATIONSHIPS

J. Walker[1], A. Bencan[1], H. Ursic[1], B. Malic[1], H. Simons[2], V. Nagarajan[5], T. Rojac[1]
[1]Electronic Ceramics Department, Jozef Stefan Institute, Jamova Cesta 39, SI-1000 Ljubljana, Slovenia
[2]DTU Physics, Technical University Denmark, Building 308, Kgs. Lyngby, Denmark, DK-2800
E-mail: julian.walker@ijs.si

The substitution of rare-earth (RE) oxides at the A site of the perovskite in bismuth ferrite ($BiFeO_3$ or BFO), induces a compositionally dependent polar-to-non-polar phase transition[1]. Compositions close to this phase boundary in RE-BFO have the potential to exhibit morphotropic phase boundary (MPB)-like electromechanical property enhancements, which have been demonstrated in epitaxial thin films [2]. The proximity of both polar and non-polar phases at the phase boundary also has the potential to enhance piezoelectric responses by polarization extension, a mechanism that is very weak or absent at room temperature in, for example, classical ferroelectrics such as $Pb(Zr,Ti)O_3$ (PZT)[3]. Additionally, RE-BFO ceramics are of specific interest because of their potential for applications as lead-free alternatives to the most widely used PZT piezoelectric ceramics and as high temperature piezoelectrics [4].

In this work we demonstrate effective methods for reproducible synthesis of these RE-BFO ceramic materials using a mechanochemical-activation assisted method to produce highly chemicaly homogeneous ceramics. By producing ceramics with a range of RE compositions we were able to evaluate specific features of the composition-structure-property relationship with particular focus on the compositional influence on crystal structure and ferroelectric switching behavior at high electric fields. The identification of a structural transition under an applied electric field in this system emphasized the critical importance for providing a model for piezoelectric behavior in these RE-BFO systems.

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WEAR RESISTANCE OF NANOSTRUCTURED AUSTEMPERED DUCTILE IRON

Kamil Wasiluk[1], Emilia Skołek[1], Krzysztof Kulikowski[1], Dawid Myszka[2]
[1]Warsaw University of Technology, Faculty of Materials Science and Engineering
[2]Warsaw University of Technology, Faculty of Production Engineering
E-mail: kamil.wasiluk@nanostal.eu

Unique microstructure of austempered ductile iron (ADI), consisted of bainitic ferrite plates surrounded by matrix of carbon-enriched retained austenite, provides optimized combination of mechanical properties. Recent works [1,2] show that, for certain chemical composition of ADI, it is possible to obtain a great refinement of the microstructure, even to nanometric scale, by careful design of heat treatment parameters.

The aim of this study was to compare the influence of microstructure refinement of ADI matrix on wear resistance. For this purpose, experimental heat treatment was performed on ductile iron samples in order to produce nanoauferritic matrix. For comparison, a set of samples of conventional ADI of same chemical composition are prepared. Microstructural observations were performed using the transmission electron microscope (TEM). Hardness measurements and wear resistance tests were made in order to determine surface properties.

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INVESTIGATIONS OF THE PROPERTIES OF CERAMIC PROPPANTS IN GREEN STATE OBTAINED IN SPRAY DRYER

Pawel Wisniewski, Joanna Szymanska, Dorora Zarzycka, Macin Malek, Jaroslaw Mizera,
Krzysztof Jan Kurzydlowski
Warsaw University of Technology, Faculty of Materials Science and Engineering, Woloska 141, 02-507 Warsaw
E-mail: p.wisniewski@inmat.pw.edu.pl

Proppants are ceramic materials applied in hydraulic fracturing during extraction of shale gas. Granulates pumped with liquid into the deposit causes destruction of the rock structure. The role of proppants is to avoid closing of formed pores and as result enable gas migration from the deposit. Due to processing requirements and conditions in formations, proppants should be characterized by suitable physico- mechanical properties.
Ceramic proppants have been produced by the spray drying and mechanical granulation methods with the use of naturally occurring raw materials i.e. clay, bauxite and kaolin.
The aim of this work was to elaborate composition and preparation method of ceramic granulates. In this paper results of properties studies of obtained proppants are presented. The influence of raw materials composition and the type of polymeric binder was examined. Two types of green proppants obtained in spray dryer without binder and with poly(vinyl alcohol) in amount of 5 wt % with respect to the powder were tested. The properties: bulk density, roundness and sphericity coefficient, grain size and also structure and morphology of proppants were investigated by Scanning Electron Microscopy (SEM) with Energy Dispersive Spectroscopy (EDS). The results indicate that composition of raw materials and type of binder have an essential effect of proppants properties in green state.

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THE INFLUENCE OF HOT DEFORMATION ON THE MICROSTRUCTURE AND SELECTED PROPERTIES OF Ti6Al4V ALLOY OBTAINED FROM P/M AND BY CASTING

Marek Wojtaszek[1], Tomasz Śleboda[1], Grzegorz Korpała[2]
[1]AGH University of Science and Technology,Faculty of Metals Engineering and Industrial Computer Science, Al. A. Mickiewicza 30, 30-059 Krakow, Poland
[2]A Technische Universität Bergakademie Freiberg, Institut für Metallformung, Bernhard-von-Cotta-Str. 4, 09599 Freiberg, Germany
E-mail: mwojtasz@metal.agh.edu.pl

Ti6Al4V alloy shows low density, excellent corrosion resistance and attractive mechanical properties [1,2]. Ti6Al4V alloy structural parts are mainly produced by forging of cast preforms. An alternative method of producing such preforms can be powder metallurgy. The combination of powder metallurgy and metal forming techniques makes it possible to use the advantages of both of them [3].

Quantitative and qualitative evaluation of the influence of the applied sample morphology as well as parameters of deformation on the microstructure and selected properties of Ti6Al4V alloy after deformation were discussed in this study. Both cast Ti6Al4V alloy and powder compacts were used as the material under investigation. P/M preform was produced from the mixture of elemental powders of titanium, vanadium and aluminium, by hot compaction. The measurements showed that the obtained compacts were free from porosity, which was confirmed by metallographic examination. The samples of compacts as well as cast alloy were subjected to plastometric tests under various conditions. The influence of the state of the investigated Ti6Al4V alloy on the character of flow curves was determined. The microstructure as well as selected properties of the samples after deformation were evaluated and compared with those obtained for cast material having the same chemical composition. Basing on the results of plastometric tests, the suitable thermo-mechanical parameters of forging of Ti6Al4V alloy were determined. The charge for hot forging was machined from the compacts and from cast material, and both kinds of forging stock were hot forged. Geometry of the forging stock as well as the parameters of heating the preform prior to deformation, forging and cooling after forging process, were the same for both kinds of the materials. The microstructure as well as hardness of the forgings were compared.

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THERMOGRAPHIC ANALYSIS OF THE WELDING CONNECTIONS MADE BY TIG

M. Woźny, K. Maś, M. Marchewka, D. Płoch, E.M. Sheregii
Centre for Microelectronics and Nanotechnology, University of Rzeszow, S. Pigonia 1, Poland
E-mail: mwozny@ur.edu.pl

The TIG welding is used in the aerospace industry very widely and it is very important to predict the distribution of heat in both the weld being performed and combined materials. That enables to determine the quality of the weld, the number of defects and allows to minimalize the resulting thermal stress during the process. An application of the infrared camera FLIR SC 7000 with filters to measure the emission from area with welding, is presented in this paper. The experimental system allows to register and analyze the temperature field distribution in welded components in real time. The data collected are used for calculations of the thermal stresses around weld. The result of thermo-stresses distribution obtained enables to diagnose the quality of weld as well as to optimize the conditions of welding process.

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ELECTROMAGNETIC SHIELDING EFFECTIVENESS AND FRACTURE BEHAVIOR OF LAMINATED (Ni–NiAl3) COMPOSITES

Tuba Yener[1], Şuayb Çağrı Yener[2], Sakin Zeytin[1]
[1]Sakarya University, Engineering Faculty, Department of Metallurgy and Materials Engineering, Serdivan, Sakarya
[2]Sakarya University, Engineering Faculty, Department of Electrical and Electronic Engineering, Serdivan, Sakarya
E-mail: syener@sakarya.edu.tr

Layered metallic-intermetallic laminate (MIL) composites are new multifunctional materials group based on open air reaction sintering of chemically active metal foils under pressure. They are designed to optimize the desirable mechanical properties of intermetallics by incorporating layers of ductile reinforcement. Combination of these type of materials make the MIL composites candidate for armament industry as armor materials which require improved mechanical and electromagnetic properties.

In this research, Ni-NiAl3 multilayers composites were produced through reactive sintering in open atmosphere by using Ni and Al foils with 250 µm initial thickness. Sintering has performed at 700 °C under 2 MPa pressure for 6 hours. Microstructure and phase characterization of the samples were performed by scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS) and x-ray diffractometry (XRD). Hardness values of samples were determined by using Vickers Indentation Technique for intermetallic and metallic region as 765 ± 60 HV, 110 ± 10 HV, respectively. For mechanical examinations, perpendicular load applied to composite for observing the fracture behavior of the metallic intermetallic laminate composites. SEM fracture surface analyses indicated that, cracks initiated in the intermetallic region, and crack propagation stopped when it comes to ductile nickel phase. By using laminate design and proper composites, it is aimed to produce intermetallic NiAl3 phase during process for giving high hardness to the composite, while unreacted nickel providing moderate ductility.

Electromagnetic interference can lead adverse consequences such as malfunction or crashing of electronic systems and computers, unintentionally firing of electrically explosive devices, be the cause for loss secret information to an enemy. In this respect, electromagnetic shielding is vital in military applications. In this study, shielding effectiveness measurements have been performed by using Agilent ENA 5071C Network Analyzer. MIL composite exhibits over 50 dB electromagnetic shielding effectiveness against a very wide frequency range from a few GHz to over 18 GHz. That shielding level means even 99.999 % of the incident power is prevented by the produced composites. Measurement results are promising for MIL composites to be appropriate candidate materials for military applications with their electromagnetic as well as mechanical properties.

EFFECT OF HOLDING TIME ON THE PRODUCTION OF Nb-NbAl3 METALLIC INTERMETALLIC COMPOSITES VIA ELECTRIC CURRENT ACTIVATED SINTERING

Muhammed Aybey, Tuba Yener, Mediha Ipek, Sakin Zeytin
Sakarya University, Engineering Faculty, Department of Metallurgy and Materials Engineering,
Esentepe Campus, 54187, Adapazari, Sakarya, Turkey
Email: tcerezci@sakarya.edu.tr

A recently developed powder metallurgy processing technique – Electric Current Activated (Assisted) Sintering (ECAS) was employed to produce metallic-intermetallic Nb-$NbAl_3$ composites. In this study, to produce Nb-$NbAl_3$ (metallic-intermetallic) in situ compostites, Nb (99.8 % purity, less than 44 μm) and Al (99.5 % purity, less than 44 μm) elemental powders were mixed in the stoichiometric ratio corresponding to the Nb-Al phase diagram. Effect of different processing time, for 10, 30, 60 seconds, under maximum of 2000 Amper and 1.5–2.0 Voltage was investigated. Scanning electron microscopy and X-Ray diffraction analysis were used to characterize produced samples. X-Ray diffraction studies revealed that the dominant phases are $NbAl_3$ and Nb. A trace amount of residual aluminum also detected in the samples. Scanning electron microscopy examinations showed a dense microstructure (Fig. 1) with very low amount of porosity. Micro hardness of test materials sintered for 60 s via electric current activated sintering was about 405 HV ± 66 HV 0.05.

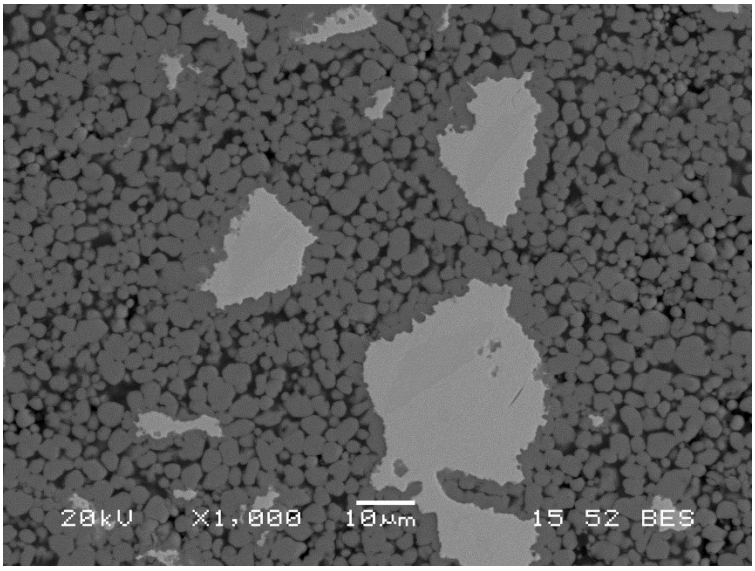

Fig.1. Nb-NbAl3 in situ composites sintered via ECAS for 60 s

ANTIBACTERIAL SURFACE TREATMENTS APPLIED TO WOODEN MATERIALS WITH NANO Ag PARTICLES AND TiO_2

Hüsnügül Yilmaz Atay
Faculty of Engineering, Muğla Sıtkı Koçman University, Kötekli Muğla, 48000, Turkey
E-mail: hgulyilmaz@gmail.com

Supplying antimicrobial flooring product protection, buildings help prevent the growth of mold and mildew as the best defense against disease is prevention. When it is evaluated in the means of their utilization fields, wooden materials have important places in building sector. They are used more efficiently with respect to the technological development and there is no doubt of the importance of hygiene on their surfaces. In this study, surface treatment has been applied to MDF board and Particle board as wooden based materials to interpolate antibacterial property with Nano Ag particles. Before surface treatment, Ag particles had been synthesized by a reduction method in Nano size [1,2]. Phase and microstructural analysis of the particles were undertaken by using XRD and SEM-EDS. The particles with different particle size and content levels were subsequently added to cellulosic and polyurethane paints to see the size and concentration dependence. After fabrication of Nano-Ag particles reinforced wooden samples, they were characterized using FTIR and SEM-EDS. Antibacterial tests were undertaken as a main objective of this research. The size distribution and Nano-Ag content effects are measured regarding the antibacterial property. It was concluded that the antibacterial properties were improved as the Nano-Ag particle size was reduced. Moreover, the change in the loading level affected antibacterial property in different ways.

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INFLUENCE OF NANO-SIZED COBALT OXIDE ADDITION ON THE STRUCTURAL AND ELECTRICAL PROPERTIES OF NICKEL MANGANITE BASED NTC THERMISTORS

Gökhan Hardal, Berat Yüksel Price
Istanbul University, Engineering Faculty, Metallurgical and Materials Engineering Department, Avcilar, Istanbul, Turkey
E-mail: berat@istanbul.edu.tr

Sensors for monitoring and controlling temperature are important not only in our daily life but also in many industrial and laboratory applications such as aerospace and automotive industries, circuit compensation, cryogenic systems etc.[1]. NTC thermistors are useful for precision temperature measurements as its resistance decreases with increasing temperature[2]. The most extensively used negative temperature coefficient (NTC) thermistor materials are nickel manganite-based semiconducting materials which exhibit the spinel-type crystal structure with the general formula AB_2O_4 [3]. The electrical properties of nickel manganite-based NTC thermistors is highly dependent on the ratio of the compositions (type and amount of additives), initial particle size of raw materials and processing conditions (selected synthesis method, calcination and sintering temperature, sintering time etc.). Previous studies have been focused on the effect of composition ratios and different production routes on the electrical properties of various metal oxide doped NTC thermistors. In this work, cobalt substituted nickel manganite based NTC thermistors were fabricated by the conventional solid-state reaction method. The particle size of the Co_3O_4 powder was less than 50 nm, purchased from Sigma–Aldrich. Co_3O_4, NiO and Mn_2O_3 powders were weighed according to the compositions of $NiMn_2O_4$ and $Ni_{0.5}Co_xMn_{2.5-x}O_4$ (where x= 0.5, 0.8 and 1.1). The raw powder mixture was ball-milled using ZrO_2 balls as a grinding media with ethyl alcohol in a jar for 5 h. The obtained slurries were dried and powders were calcinated at 900 ^oC for 2 hours. The powders were pressed to form disc shaped specimens and then sintered at 1100 and 1200 ^oC for 5 h employing a 360 ^oC/h heating rate in air then cooled naturally in the furnace. The sintered samples were coated with silver paste to form electrodes. The electrical resistance was measured in a temperature programmable furnace between 25 ^oC and 85 ^oC. The material constant “B” and sensitivity coefficient “α” values were calculated for the NTC thermistors.

This study is supported by Tübitak (The Scientific and Technical Research Council of Turkey), Project number 3001-114M860. We would like to thank Tübitak for its financial support.

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SOLVOTHERMALY SYNTHESIZED WEB-LIKE TiO_2/Au STRUCTURES

Tina Zabukovec Jezovšek[1,2], Marjan Bele[1], Miran Gaberšček[1], Goran Dražić[1,2]
[1]Laboratory for materials chemistry, National Institute of Chemistry, Ljubljana, Slovenia
[2]Josef Stefan International Postgraduate School
E-mail:goran.drazic@ki.si,tina.zabukovec@ki.si, marjan.bele@ki.si, miran.gaberscek@ki.si

In polymer electrolyte membrane (PEM) fuel cells the AuPt-based nanoparticles on carbon support materials are used as a catalyst material for oxygen reduction reaction (ORR). The problem is that these materials could lose its activity, due to sintering, migration or detachment and dissolution of metal particles into the electrolyte during long-term electrochemical measurements. In extreme cases, complete structural collapse of the electrode can be observed.[1] Degradation can be alleviated with synthesis of alternative, titanium-based oxides, which exhibit strong support-catalyst interaction and high stability in fuel cells.[2] In this work results regarding the synthesis of alternative titanium-based oxides are reported. We prepared TiO_2/Au with a single-step solvothermal synthesis at 180 °C for the period of 6 hours from titanium butoxide in ethanol using $Au(OH)_3$ as a gold precursor. The synthesized material had relatively low specific surface area of 34.9 m^2/g, determined with the BJH method, which could be explained with the fibrous morphology. Amorphous fibrous material crystallized into anatase after thermal treatment in furnace at 450 °C for 1 hour in reductive atmosphere. SEM micrographs revealed the fibres with the length of few hundred nanometers and up to 10 nm in diameter, forming web-like structures (Fig. 1). Using TEM we found, that fibres were consisting of 5 to 10 nm sized anatase nanoparticles with uniformly distributed (20 nm in diameter) gold particles on the surface of titanium dioxide (Fig. 2). The presence of nano-crystals of anatase phase was additionally checked and verified by electron diffraction which is shown in inset of Fig. 2.

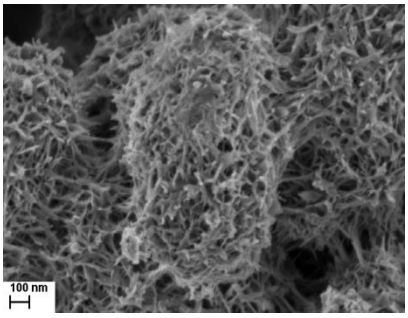

Fig.1: SEM micrograph of the web like TiO_2/Au structure.

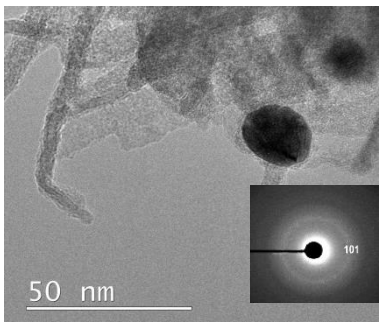

Fig.2: TEM micrograph of web like TiO_2/Au structure. Inset is selected area electron diffraction pattern with indicated 101 anatase ring.

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STUDY OF BEHAVIOR OF FIBROUS BASED INSULATION MATERIALS WITH HIGHER MOISTURE CONTENT

Jiří Zach, Vítězslav Novák, Jitka Hroudová
Brno University of Technology, Faculty Of Civil Engineering, Veveří 331/95, 602 00 Brno, Czech Republic
E-mail: zach.j@fce.vutbr.cz, novak.v@fce.vutbr.cz, hroudova.j@fce.vutbr.cz

Properties of thermal insulation materials are strongly influenced by content humidity. For fibrous thermal insulation materials are however thermal insulation properties also affected fundamentally bulk density. When properly selected bulk density for thermal insulation materials is can partially eliminate of the effect of negative effect moisture on thermal insulation properties. These factors are particularly important for fiber thermal insulation materials on natural basis. That contain even under normal conditions, a higher percentage of moisture.

STUDY OF Dy DIFFUSION IN HIGH-COERCIVITY Nd–Fe–B-TYPE MAGNETS FOR ELECTRIC-VEHICLE DRIVE APPLICATIONS

Kristina Žagar[1], Andraž Kocjan[1], András Kovács[2], Martial Duchamp[2], Rafal E. Dunin-Borkowski[2], Joachim Mayer[2,3], Paul McGuiness[1], Spomenka Kobe[1]
[1]Jožef Stefan Institute, Jamova c. 39, 1000 Ljubljana, Slovenia,
[2]Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons and Peter Grünberg Institute, Forschungszentrum Jülich, 52425 Jülich, Germany
[3]RWTH Aachen, 52074 Aachen, Germany
E-mail: kristina.zagar@ijs.si

In the present study, we report on the correlation between the magnetic properties and the distribution of the DyF_3 in the melt-spun $Nd_2Fe_{14}B$ ribbons coated with the DyF_3 suspension, spark-plasma sintered (SPS) and annealed. The magnetic properties were measured at room temperature using a Steingroever permeameter. The addition of the DyF_3 up to 2.2 wt % showed a positive and increasingly rapid effect on the coercivity (Hci) of the heat-treated samples. The maximum Hci of 1663 kA/m represents a 25 % increase compared to the untreated sample.

To observe the diffusion of DyF_3 as a function of heat-treatment process and correlate it with the magnetic properties, samples were investigated using aberration-corrected scanning transmission electron microscopy (FEI Titan 80-200). The analyses were carried out in the so-called wheel side regions of the SPS and the annealed samples. The energy dispersive X-ray spectroscopy (EDXS) maps of annealed samples revealed a Dy,Nd-Fe-B-rich shell structure around Nd-Fe-B core, while the SPS sample did not contained any Dy,Nd-rich shells around the Nd-Fe-B grains.

Since the reliability of the EDXS analysis is compromised by overlapping of the Fe-K, Dy-L and Co-K lines, the electron energy loss (EEL) spectra of the same grains were recorded in order to separate the contribution of these elements and to provide reliable compositional maps. To unwrap the spectra the vertex component algorithm was applied and thus we determined Fe-$L_{2,3}$/Co $L_{2,3}$, Nd-$M_{4,5}$, Dy-$M_{4,5}$, F-K and O-K maps. In the case of annealed sample we observed the Dy,Nd-Fe-B phase formation in the shell around the pure Nd-Fe-B (core) grains. We can conclude that the 25 % increase in Hci is strongly linked to the heat-treatment process where Dy diffuses along grain boundaries into the outer parts of Nd-Fe-B grains and partially substitutes Nd to form a core-shell-like grains.

THE INFLUENCE OF NITRIDING ON MICROSTRUCTURE AND PROPERTIES OF NICKEL BASED SUPERALLOY Ni-Cr-Co-Mo-2Ti-1,5Al

Malgorzata Zagorska, Ryszard Sitek, Jaroslaw Mizera, Krzysztof Jan Kurzydłowski
Faculty of Materials Science and Engineering, Warsaw University of Technology, Woloska 141, 02-507 Warsaw, Poland
E-mail: m.zagorska@inmat.pw.edu.pl

The tendency to increase the operating temperature of turbine aircraft engines requires the substitution of actually used materials. These should exhibit creep and heat resistance, susceptibility to cold and hot plastic forming and good fluidity. Operation and service costs are also taken into account, they can be lowered by designing massive engine parts consisting of smaller elements. Therefore, this material should also reveal good weldability. High-temperature oxidation is also an important risk to aircraft engine components. That's why material used for this elements should be characterized by corrosion resistance. Protective surface layers are commonly used in order to provide these properties.

The objectives of this work are: produce CrN layer on nickel base superalloy Ni-Cr-Co-Mo-2Ti-1,5Al in as cast state, investigation of layers properties and the influence of nitriding on the substrate microstructure and properties. Layers containing chromium nitride were manufactured by PACVD method at a temperature range 500–570 °C. Chromium nitride id characterized by high hardness, wear and corrosion resistance and temperature stability at 750 °C. The layers based on chromium nitride improve also creep and high cycle fatigue resistance of alloy.

Methods such as: light microscopy (LM), scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS) and X-Ray phase analysis (XRD) were used. In addition, microhardness and stereological analysis of alloy microstructure images were examined.

Acknowledgements
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MERCHANDISING VALUATION OF MODERN CONSTRUCTION MATERIALS MARKET DEVELOPMENT IN UKRAINE

P.V. Zakharchenko, O.M. Gavrysh, V.V.Onoprienko
Kyiv National University of Construction and Architecture, Department of Construction Merchandising and Commerce, 31 Povitroflotskyy Avenue, Room 362, Kyiv, Ukraine 03680
E-mail: tkd362@ukr.net

Porous materials such as porous concrete and porous clay blocks are the most promising as to erection of functional single-layer building envelopes.

Higher porosity of the material results in lower density of concrete and its better heat-insulating properties. Both construction and service properties of envelope as well as of the whole building (wall weight, foundation load, thermal conductivity, vapour permeability, sorption humidity of materials, envelope thermal resistance, specific energy loss by heating of a 1 m^2 area, comfort and building ecological compatibility) are closely related to the above. [1]

Porous concrete low density allows of manufacturing large blocks of 15–30 kg laid at one scoop, which decreases labour coefficient considerably. Decrease in number of bed and cross joints as well as in thickness (to 2–5 mm) make it possible to reduce heat loss by outwalls when using buildings. Thermal resistance of porous concrete of 600 kg/m^3 density is 1.5–2.5 times as much as thermal resistance of traditional wall materials.

The most effect of application of porous concrete products can be achieved during a long period of use of buildings due to 20–30 % decrease in the cost of heating. Since the minimum life of a building is 50 years and energy prices are constantly rising, the annual effect will increase.

Besides, porous concrete is fireproof; it does not burn or emit toxic components and it impedes flame spreading during a fire.

There is another construction technique, which is called ‘dry’ construction. Its main materials are gypsum plasterboards, fibre reinforced gypsum slab and timber-base panels.

The recent intense development of dry construction is first of all caused by its considerable advantages as compared with traditional ‘wet’ processes.

Thus modern construction has created an innovation product – a building with warm walls and the opportunity to design many functional rooms to provide comfortable life level.

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INVESTIGATION OF NON-METALLIC RARE-EARTH INCLUSIONS IN RE MODIFIED OCR12 TOOL STEEL

Klemen Zelič, Črtomir Donik, Jaka Burja, Matjaž Godec
Institute Of Metals And Technology, Lepi pot 11, Ljubljana, Slovenia
E-mail: klemen.zelic@imt.si

The motivation for investigation of non-metallic rare-earth inclusions in steel came from experiment of OCR12 cold work tool steel modification with rare-earth elements (RE). OCR12 is the steel from AISI D2 group. There are some papers that report the attempt to modify the tool steel with rare earth elements. However, there is no clear report in what form the RE elements appear inside AISI D2 tool steel. None of the authors does explicitly tell what happens to RE elements during the solidification. The complete theoretical model of RE modified AISI D2 tool steel solidification does not exist and our aim is to propose one.

The first goal of our investigation was to determine in what form the RE elements appear in the microstructure of OCR12 tool steel.

The samples were prepared by casting the 18 kg ingots of OCR12 modified by rare earth mischmetal that consist of Ce, La, Nd and Pr. Samples were cut out of ingots from the geometrical center. Chemical analysis on several points showed that the final material contained 0,26 wt % of RE elements.

The RE elements with their high mass number are much heavier than any other element present in OCR12 steel. Therefore, the regions rich in RE appear much brighter in backscattered electron image. It was shown by the backscattered electron image that RE elements are found inside the inclusions of the size 0,5 – 5 µm. Further, inclusions were investigated by EDS and WDS techniques to determine the chemical composition of inclusions. In accordance to our anticipation the inclusions are mostly oxisulfides. The detailed composition of inclusions was determined by HR TEM. It was confirmed by the electron diffraction patterns that the form of inclusions is $(RE)_2O_2S$.

ANALYSIS OF FIBER DISTRIBUTION, SIZE, AND VOLUME RATIO OF UNIDIRECTIONAL COMPOSITE PLATES WITH DIFFERENT THICKNESSES

Robert Zemčík[1], Hana Srbová[1], Kamil Ekštein[2], Ivan Pirner[3], Rostislav Medlín[4]
[1]University of West Bohemia, Faculty of Applied Sciences, Department of Mechanics, Univerzitní 8, 306 14 Plzeň, Czech Republic
[2]University of West Bohemia, Faculty of Applied Sciences, Department of Informatics
[3]University of West Bohemia, Faculty of Applied Sciences, Department of Cybernetics
[4]University of West Bohemia, New Technologies – Research Centre in the West Bohemian Region
E-mail: zemcik@kme.zcu.cz

This work focuses on the assessment of real fiber and matrix volume ratios of unidirectional fiber composites which can be used for the design of corresponding numerical models on micro-scale. Samples with polished cross-sections were prepared from three composite plates and they were analyzed using Scanning Electron Microscopy (SEM) previously. The plates were manufactured from the same prepreg material using autoclave technology. Each plate consisted of different number of plies. Images of various parts of the composite cross-sections obtained with SEM are analyzed using several image processing techniques programmed in Matlab, its Image Processing Toolbox, and C code. The results of this analysis are the center positions and radii of all fibers within the image. The fiber and matrix volume ratios are determined subsequently and mutually compared for different locations across the plates' thicknesses.

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INFLUENCE OF HEAT TREATMENT ON MECHANICAL PROPERTIES OF X12CRMOWVNBN10-1-1 STEEL

Borut Žužek[1], Fevzi Kafexhiu[1], Jaka Burja[1], Boštjan Arh[1], Bojan Podgornik[1], Vlado Perovnik[2], Tatjana Večko Pirtovšek[2]
[1]Institute of Metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia
[2]Metal Ravne d.o.o., Koroška cesta 14, 2390 Ravne na Koroškem, Slovenia
E-mail: borut.zuzek@imt.si

Nowadays when reduction of CO_2 emissions and increasing efficiency of thermal power station is one of the current issues the creep resistant steels are the main tool which can help us to make a step forward in the topic issue. The properties of creep resistant steel and their lifetime strongly depend on their heat treatment. The X12CrMoWVNbN10-1-1 is creep resistant steel usually produced in a rolled or forged bars after Electric Slag Remelted (ESR) process. The bars must be in quenched and tempered conditions to fulfill the mechanical properties. Final microstructure of investigated steel is martensite which must be obtained over the entire cross-section of the bars. Heat treatment of this steel is performed in three steps, consisting of austenizing and two step tempering.

The aim of our work was to investigate how the change of temperature of first and second tempering influence on the microstructure and mechanical properties of investigated steel. We have used two different temperatures of first and three different temperatures of second tempering in our investigation.

The results shows, that with increased temperature of second tempering, yield strength and tensile strength decreased, but the intensity of the decrease is more evident at lower temperature of first tempering. On the other hand impact toughness increases with increasing temperature of first and second tempering.

METAL PARTICLES SIZE INFLUENCE ON GRADED STRUCTURE IN COMPOSITE AL_2O_3-Ni

Justyna Zygmuntowicz, Aleksandra Miazga, Katarzyna Konopka, Waldemar Kaszuwara
Faculty of Materials Science and Engineering, 141 Wołoska St, 02-507 Warsaw, Poland
E-mail: justyna.zygmuntowicz@inmat.pw.edu.pl

The aim of this study was to investigate the effect of the nickel particles size on the changes in metallic phase content in the graded structure in the Al_2O_3-Ni composites. As the method of composite fabrication, centrifugal slip casting was chosen. This method allows to fabricate the graded distribution of Ni particles in the hollow cylinder composite sample. Functional graded material were prepared in the vertical rotation axis

In the experiments the following powders were used: α-Al_2O_3 TM-DAR from Taimei Chemicals (Japan) of an average particle size 133 nm and density 3.96 g/cm^3 and Ni powders from Sigma-Aldrich of an average particle size 3 µm and 8.5 µm. Aqueous based slurries (with 50 vol % content of solid phase) containing alumina and nickel powder (10 vol %) were tested. A composition of deflocculates i.e. diammonium citrate (p.a., Aldrich) and citric acid (p.a., POCH Gliwice) were used. Final sintering was conducted on all the specimens at 1400 °C in reducing atmosphere (N_2/H_2).

The obtained samples were characterized by X-ray diffraction studies (XRD), energy dispersive X-ray analysis (EDS), scanning electron microscopy (SEM). Morover, the quantitative analysis of the Ni particles distribution were made.

In the fabricated samples the graded structure were characterized by zones with diffrent Ni particles concentration. The size of the Ni particles influence the widht of these zones. Vickers indentation was used to determine the hardness of the materials. The observation (SEM) of crack path was made.

Acknowledgements
The results presented in this paper were obtained within the project from The Polish National Science Centre (NCN) No. 2013/11/B/ST8/0029.