18. KONFERENCA O MATERIALIH IN TEHNOLOGIJAH

15.–17. november 2010, Portorož, Slovenija

18th CONFERENCE ON MATERIALS AND TECHNOLOGY

15–17 November 2010, Portorož, Slovenia

PROGRAM IN KNJIGA POVZETKOV

PROGRAM AND BOOK OF ABSTRACTS

UREDNIK / EDITOR
MONIKA JENKO

INŠTITUT ZA KOVINSKE MATERIALE IN TEHNOLOGIJE, LJUBLJANA

18. KONFERENCA O MATERIALIH IN TEHNOLOGIJAH /
18th CONFERENCE ON MATERIALS AND TECHNOLOGY

Program in knjiga povzetkov / *Program and book of abstracts*

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Lepi pot 11, Ljubljana, Slovenija

Za založnika *Monika Jenko*

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VSEBINA – CONTENTS

Legenda – Legend:
KM Kovinski materiali – Metallic materials
AM Anorganski materiali – Inorganic materials
P Polimeri – Polymers
VT Vakuumska tehnika – Vacuum technique
NN Nanomateriali in nanotehnologije – Nanomaterials and nanotechnology
RP Raziskovalna politika – Research policy
VO Varstvo okolja – Environmental protection
MF Materiali za fuzijo – Materials for fusion

VP Vabljena predavanja – Invited papers
GP Govorni prispevki – Oral
MR Mladi raziskovalci – Young scientists

18. KONFERENCA O MATERIALIH IN TEHNOLOGIJAH, 15. – 17. NOVEMBER 2010
18TH CONFERENCE ON MATERIALS AND TECHNOLOGY, 15–17 NOVEMBER, 2010
PROGRAM – PROGRAM

	PONEDELJEK – MONDAY, 15. 11. 2010		**TOREK – TUESDAY, 16. 11. 2010**	**SREDA – WEDNESDAY, 17. 11. 2010**
08:45	***Odprtje – Openning***	08:45	Nenad Gubeljak	Robert Zemčik
09:00	Stane Pejovnik	09:00	Guy Pluvinage	Radek Kottner
09:15		09:15		Miran Mozetič
09:30	Mateja Mešl	09:30	Karlo T. Raić	B. Škorić
09:45		09:45		A. Gulec
10:00	Bojan Jenko	10:00	Varužan Kevorkijan	Leon Gosar
10:15		10:15		František Kavička
10:30	**Coffee Break**	10:30	**Coffee Break**	**Coffee Break**
10:45	Edita Jasiukaitytė	10:45	Peter Jurči	Josef Štetina
11:00	Andraž Kocjan	11:00		Aleš Dakskobler
11:15	A. Lenart – G. Trefalt	11:15	Borivoj Šuštaršič	Marjan Marinšek
11:30	**Coffee Break**	11:30	**Coffee Break**	**Coffee Break**
11:50	J. Koruza – M. Štefančič	11:45	Vojteh Leskovšek	L. Gorjan
12:10	M. Podlogar – M. Presečnik	12:00	Bojan Senčič	S. perko
12:30	O. V. Noshchenko – T. Šetinc	12:15	Mirsada Oruć	T. Kroupa
12:50		12:30	J. Capelle	Zdenek Adolf
13:00	**13:00 – 15:00 Odmor za kosilo – Lunch**		**13:00 – 15:00 Odmor za kosilo – Lunch**	**Zaključek konference – Closing the Conference**
15:00	S. Glinšek – A. Bytyqi	15:00	Jiri Bažan	
15:20	A. Vanya – A. Križaj	15:15	Igor Belič	
15:40	I. Paulin – N. Pukšič	15:30	Tadej Kokalj	
16:00	**Coffee Break**	15:45	Franci Vode	
16:20	B. Poniku – B. Žužek	16:00	Marjetka Conradi	
16:40	P. Bilek – P. Borković	16:15	Aleksandra Kocijan	
17:00	T. Mauder – U. Hanoglu	16:30	**Coffee Break**	
17:20	B. Horvat – M. Vukomanivić	16:45	Darja Jenko	
17:40	**Coffee Break**	17:00	Franc Tehovnik	
18:00	M. Krivec – V. Žunič	17:15	Štefan Hozjan	
18:20	M. Sefa – S. Avdiaj	17:30	Miha Kovačič	
18:40	A. Millaku – M. Hočevar	17:45	Matej Babič	
19:00	F. Kafexhiu – M. Malešević	18:00		
19:20				
20:00 – 22:00	**Podelitev nagrad MR – Young Scientists Awards Cocktail Party**	20:00 – 22:00	**Posterska sekcija – Poster Session KM, AM, P, VT, NN, VO COCKTAIL PARTY**	

PROGRAM 18. KONFERENCE O MATERIALIH IN TEHNOLOGIJAH
18th CONFERENCE ON MATERIALS AND TECHNOLOGY: PROGRAM

PONEDELJEK – MONDAY 15. 11. 2010		
	Predsedujoči – Chair:	
8:45	**ODPRTJE – OPENNING**	
9:00		
9:30		
10:00	Bojan Jenko Ministrstvo za visoko šolstvo, znanost in tehnologijo RAZISKAVE V EU, 7. OKVIRNI PROGRAM IN SLOVENIJA RESEARCH IN EU, FP7 AND SLOVENIA	RP-VP
10:30	**Odmor – Break**	
	Predsedujoči – Chair:	
10:45	Edita Jasiukaitytė[1], Matjaž Kunaver[1], Claudia Crestini[2] [1]National Institute of Chemistry, Hajdrihova 19, SI-1000, Ljubljana, Slovenia [2]Tor Vergata University, Via della Ricerca Scientifica, 00133 Rome, Italy STUDY ON WOOD LIQUEFACTION WITH LIGNIN AS A MODEL COMPOUND	P-GP
11:00	Andraž Kocjan, Aleš Dakskobler, Kristoffer Krnel, Tomaž Kosmač Engineering Ceramics Department, Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia INVESTIGATION OF AlN POWDER-HYDROLYSIS MECHANISMS AND KINETICS IN DILUTED AQUEOUS SUSPENSIONS	AM-GP
11:15	Alenka Lenart[1], Breda Mirtič[2], Sašo Šturm[1] [1]Department for nanostructured Materials, Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia, [2]Department of Geology, Faculty for Natural Sciences and Engineering, Aškerčeva cesta 12, SI-1000 Ljubljana, Slovenia JAPANESE TWINNED NATURAL QUARTZ CRYSTALS	AM-MR
11:25	Gregor Trefalt, Danjela Kuščer, Gaj Stavber, Marija Kosec Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia INK-JET PRINTING OF TiO_2 SUSPENSIONS	AM-MR
11:35	**Odmor – Break**	
	Predsedujoči – Chair:	
11:50	Jurij Koruza[1], Barbara Malič[1], Marija Kosec[1] [1]Institut Jožef Stefan, Jamova 39, 1000 Ljubljana, Slovenia MICROSTRUCTURE EVOLUTION DURING SINTERING OF SODIUM NIOBATE	AM-MR
12:00	Martin Štefanič, Kristoffer Krnel, Tomaž Kosmač »Jožef Stefan« Institute, Engineering Ceramics Department, Jamova 39, Ljubljana BIOMIMETIC SYNTHESIS OF OCTA-CALCIUM PHOSPHATE COATINGS ON ZIRCONIA CERAMICS	AM-MR
12:10	Matejka Podlogar[1], Slavko Bernik[1,2], Jacob J. Richardson[3] [1]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, [2]Center of Excellence NAMASTE, Jamova cesta 39, 1000 Ljubljana, Slovenia, [3]Materials Department, University of California, Santa Barbara, CA 93106, United States A LOW-TEMPERATURE SYNTHESIS OF TRANSPARENT ZnO THIN FILMS FROM AN AQUEOUS SOLUTION	AM-MR

12:20	Mojca Presečnik[1], Slavko Bernik[1,2] [1]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, [2]Center of Excellence NAMASTE, Jamova cesta 39, 1000 Ljubljana, Slovenia SYNTHESIS OF THE $Ca_3Co_4O_9$ THERMOELECTRIC COMPOUND BY MECHANO-CHEMICAL ACTIVATION	AM-MR
12:30	O. V. Noshchenko[1], D. Kuščer[1], O. Mocioiu[2], M. Zaharescu[2], M. Kosec[1] [1]Jožef Stefan Institute, Jamova cesta 39, SI-1000, Ljubljana, Slovenia, [2]"Ilie Murgulescu" Institute of Physical Chemistry, 202 Splaiul Independentei Street, 6th District, 060021 Bucharest, Romania PROCESSING OF PZT-AQUEOUS SUSPENSIONS SUITABLE FOR INK-JET PRINTING	AM-MR
12:40	Tina Šetinc Advanced Materials Department, Jožef Stefan Institute, Ljubljana, Slovenia CONTROL OF PHASE COMPOSITION IN THE HYDROTHERMAL SYNTHESIS OF $Na_{0.5}Bi_{0.5}TiO_3$	AM-MR
13:00 – 15:00 ODMOR ZA KOSILO – LUNCH		
	Predsedujoči – Chair:	
15:00	Sebastjan Glinšek, Barbara Malič, Cene Filipič, Elena Tchernychova, Marija Kosec Jožef Stefan Institute, Jamova 39 SI-1000 Ljubljana, Slovenia $KTaO_3$ CERAMICS – OPTIMIZATION OF DIELECTRIC PROPERTIES BY PROCESSING	AM-MR
15:10	Arsim Bytyqi, Monika Jenko Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, Štore Steel Company d.o.o. Železarska cesta 3, Slovenia ANALYSIS OF THE INCLUSIONS IN SPRING STEEL USING AUGER ELECTRON SPECTROSCOPY (AES)	KM-MR
15:20	Attila Vanya[1], Mária Hudáková[2], Miroslav Bošanský[3] [1]Institute of Transport Technology and Engineering Design, Faculty of Mechanical Engineering,Slovak University of Technology in Bratislava, [2]Faculty of Material Sciencies and Technology in Trnava, Slovak University of Technology, [3]Institute of Transport Technology and Engineering Design, Faculty of Mechanical Engineering,Slovak University of Technology in Bratislava HARD THIN LAYERS AS A POSIBILITY TO INCREASE LOAD CARRYING CAPACITY OF CONVEX-CONCAVE GEARING	KM-MR
15:30	Ažbe Križaj[1], Peter Fajfar[2], Nataša Lipovšek[1], Monika Jenko[1] [1]Institute of Metals and Technology, 1000 Ljubljana, Slovenia, [2]University of Ljubljana, Faculty of Natural Sciences and Engineering, Aškerceva 12, 1000 Ljubljana, Slovenia HOT-DEFORMATION BEHAVIOUR AND MICROSTRUCTURAL EVOLUTION OF NON-ORIENTED ELECTRICAL STEELS	KM-MR
15:40	Irena Paulin[1,2], Varužan Kevorkijan[3], Srečo D. Škapin[4], Črtomir Donik[2], Monika Jenko[2] [1]TALUM d.d. Kidričevo, Tovarniška cesta 10, SI-2325 Kidričevo, [2]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, [3]Independent Researcher, Betnavska cesta 6, SI-2000 Maribor, [4]Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana METHODS FOR THE PREPARATION OF PRE-CURSORS FOR MANUFACTURING ALUMINIUM FOAMS USING THE POWDER-METALLURGY PROCESS	KM-MR
16:00	**ODMOR – BREAK**	
	Predsedujoči – Chair:	
16:20	Besnik Poniku, Igor Belič, Monika Jenko Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia FORMATION OF SIMULATED AUGER SPECTRA AS A TESTING GROUND FOR BACKGROUND-REMOVAL AND NOISE-REDUCTION ALGORITHMS	KM-MR
16:30	Borut Žužek, Monika Jenko, Matjaž Torkar, Franc Tehovnik, Matej Hočevar Institute of Metals and Technology, Ljubljana, Slovenia PRELIMINARY CREEP TESTS ON P92 STEEL	KM-MR

16:40	Pavel Bílek, Jana Sobotová, Peter Jurči Czech Technical University in Prague, Faculty mechanical engineering, Karlovo náměstí 13, 121 35 Praha 2 – Nové Město EVALUATION OF STRUCTURAL CHANGES IN Cr-V LEDEBURITIC TOOL STEELS DEPENDING ON TEMPERATURE AUSTENITIZATION	KM-MR
16:50	Predrag Borković, Borivoj Šuštaršič Institut of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia FATIGUE LIFE PREDICTION OF SPRING STEELS USING THE LOCAL STRESS GRADIENT CONCEPT	KM-MR
17:00	Tomas Mauder, Cenek Sandera, Josef Stetina, Milos Seda Brno University of Technology, Faculty Mechanical Engineering, Technicka 2, Brno, Czech Republic OPTIMIZATION OF QUALITY OF CONTINUOUSLY CAST STEEL SLABS BY USING FIREFLY ALGORITHM	KM-MR
17:10	Umut Hanoglu, Siraj-ul-Islam, Božidar Šarler Laboratory for Multiphase Processes, University of Nova Gorica, Vipavska 13, SI-5000 Nova Gorica, Slovenia SOLUTION OF HOT SHAPE ROLLING OF STEEL	KM-MR
17:20	Barbara Horvat, Matic Krivec, Goran Dražić Institut Jožef Stefan, Jamova cesta 39, SI-1000 Ljubljana, Slovenija COMPARISON OF HYDROTHERMAL AND SOL-GEL SYNTHESIS OF NANOANATASE TiO_2	NN-MR
17:30	M. Vukomanović,[1,2] M. Otoničar,[1] D. Uskoković,[2] S. D. Škapin,[1] D. Suvorov[1] [1]Advanced materials department, Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia, [2]Institute of Technical Sciences of SASA, Knez Mihailova 35/IV, Belgrade, Serbia SONOCHEMICAL SYNTHESIS OF GOLD NANOPARTICLES AND THEIR COMPOSITES WITH HYDROXYAPATITE	NN-MR
17:40	**ODMOR – BREAK**	
	Predsedujoči – Chair: Stane Pejovnik, Manfred Leisch, Spomenka Kobe, Majda Žigon	
18:00	Matic Krivec, Barbara Horvat, Goran Dražić Institut Jožef Stefan, Jamova cesta 39, SI – 1000 Ljubljana, Slovenija PREPARATION AND PHOTOCATALYTIC PROPERTIES OF TiO_2 BASED MICROREACTORS	NN-MR
18:10	Vojka Žunič[1], Srečo D. Škapin[1], Erika Švara[2], Danilo Suvorov[1] [1]Jožef Stefan Institute, Advanced Materials Department, Ljubljana, Slovenia, [2]Slovenian National Building and Civil Engineering Institute, Ljubljana, Slovenia VISIBLE LIGHT ACTIVE TiO_2 NANO-POWDERS PREPARED BY SOL-GEL SYNTHESIS	NN-MR
18:20	Makfir Sefa[1], Janez Šetina[2] [1] Lotrič d.o.o., Selca, Slovenia, [2] Institute of Metals and Technology, Ljubljana, Slovenia MODELLING OF HELIUM DIFFUSION IN NITROGEN	VT-MR
18:30	Sefer Avdiaj[1], Janez Šetina[2] [1]Lotrič d.o.o., Selca 163, 4227 SELCA, Slovenia, [2]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia EXTENSION OF THE RANGE OF PRIMARY VACUUM-CALIBRATION METHODS USING NON-EVAPORABLE GETTERS	VT-MR
18:40	A. Millaku[1], D. Drobne[2], Ž. Pipan Tkalec[2], M. Torkar[1], M. Jenko[1] [1]Institute of Materials and Technology, Lepi pot 11 Ljubljana, Slovenia, [2]University of Ljubljana, Biotechnical Faculty, Večna pot 111, Slovenia THE INFLUENCE OF WO_3 NANOFIBRES ON THE MORPHOLOGY OF THE DIGESTIVE GLAND EPITHELIUM OF *PORCELIO SCABER*	AM-MR

18:50	Matej Hočevar[1], Damjana Drobne[2,3,4], Sara Novak[2], Matjaž Godec[1], Monika Jenko[1] [1]Institute of Metals and Technology, Ljubljana, Slovenia, [2]Biotechnical faculty, Department for biology, Ljubljana, Slovenia, [3]Centre of Excellence in Advanced Materials and Technologies for the Future (CO NAMASTE), Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia, [4]Centre of Excellence in Nanoscience and Nanotechnology (CO Nanocenter), Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia INVESTIGATION OF BACTERIA AND BIOFILMS ON DIFFERENT SURFACE MATERIALS USING A SCANNING ELECTRON MICROSCOPE	AM-MR
19:00	Fevzi Kafexhiu, Jelena Vojvodič Tuma Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia EFFECT OF ANNEALING TIME AND TEMPERATURE ON MECHANICAL PROPERTIES OF X20CrMoV121 AND P91 STEELS	KM-MR
19:10	Milan Malešević, Jelena Vojvodič Tuma, Borivoj Šuštaršič Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia PREDICTION OF MECHANICAL PROPERTIES OF Cr-Ni-Mo STAINLESS STEEL WITH TWO-PHASE MICROSTRUCTURE	KM-MR
21:00	**Podelitev nagrad MR – Young Scientists Awards** **Cocktail Party**	

TOREK – TUESDAY 16. 11. 2010		
	Predsedujoči – Chair:	
8:45	Vinko Močilnik*, Nenad Gubeljak+, Jožef Predan+ *ERD d.o.o. Engineering, Research & Development, Dobja vas 185, 2390 Ravne na Koroškem, Slovenia, +University of Maribor, Faculty of Mechanical Engineering, Smetanova ul. 17, 2000 Maribor, Slovenia FRACTOGRAPHIC ANALYSIS OF FATIGUE FAILURE OF PRESET TORSION SPRING BARS	KM-GP
9:00	G. Pluvinage Université Paul Verlaine de Metz, Metz France VANISHING OF METALS AND BEARABLE DE GROWTH	KM-VP
9:30	Karlo T. Raić[1], Rebeka Rudolf[2,3], Primož Ternik[4], Zoran Žunič[5], Vojkan Lazić[6], Dragoslav Stamenković[6], Ivan Anžel[2] [1] University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, Belgrade, Serbia, [2]University of Maribor, Faculty of Mechanical Engineering, Maribor, Slovenia, [3] Zlatarna Celje d.d., Kersnikova ul.19, 3000 Celje, [4] Private Researcher, Bresterniška ulica 163, 2354 Bresternica, Slovenia, [5] AVL-AST, Trg Leona Štuklja 5, 2000 Maribor, Slovenia, [6] University of Belgrade, School of Dentistry, Clinic for Prosthodontics, Belgrade, Serbia CFD ANALYSIS OF EXOTHERMIC REACTIONS IN Al-Au NANO MULTI-LAYERED FOILS	NN-VP
10:00	Varužan Kevorkijan[1], Srečo Davor Škapin[2], Irena Paulin[3], Borivoj Šuštaršič[3], Monika Jenko[3], Marjana Lažeta[4] [1]Zasebni raziskovalec, Betnavska cesta 6, 2000 Maribor, Slovenija, [2]Institut "Jožef Stefan", Odsek za raziskave sodobnih materialov, jamova 39, 1000 Ljubljana, Slovenija, [3]Institut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija, [4]Impol d.o.o., Partizanska 38, 2310 Slovenska Bistrica, Slovenija THE INFLUENCE OF FOAMING PRECURSOR'S COMPOSITION AND DENISTY ON THE FOAMING EFFICIENCY, MICROSTRUCTURE DEVELOPMENT AND MECHANICAL PROPERTIES OF ALUMINIUM FOAMS	KM-VP
10:30	**ODMOR – BREAK**	
	Predsedujoči – Chair:	
10:45	Peter Jurči [1]Czech Technical University in Prague, Faculty of Mechanical Engineering, Karlovo nám. 13, 121 35 Prague 2, Czech Republic Cr-V LEDEBURITIC COLD WORK TOOL STEELS	KM-VP
11:15	B. Šuštaršič[1], M. Jenko[1], J. Vojvodič Tuma[1], M. Godec[1], A. Kocijan[1], M. Malešević[1], B. Žužek[1], B. Marini[2], C. Toffolon Masclet[2], P. Forget[2] [1]Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia, [2]DMN/SRMA and DEN-DANS, CEA, Saclay, France MICROSTRUCTURAL FEATURES AND MECHANICAL PROPERTIES OF THERMALLY AGED DUPLEX STAINLESS STEEL	KM-GP
11:30	**ODMOR – BREAK**	
	Predsedujoči – Chair:	
11:45	Vojteh Leskovšek, Monika Jenko, Bojan Podgornik Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia SIMULTANEOUS TEMPERING AND NITRIDING OF DEEP-CRYOGENIC TREATED P/M S390MC HIGH-SPEED STEEL	KM-GP
12:00	Senčič	KM-GP
12:15	Mirsada Oruč[1], Milenko Rimac[1], Omer Beganović[1], Sulejman Muhamedagić[2] [1]University of Zenica, Metalurški institut „Kemal Kapetanović" Travnička cesta 7, Zenica, BiH, [2]University of Zenica, Fakultet za metalurgiju i materijale, Travnička cesta 1, Zenica, BiH METAL MATERIALS WITH MODIFIED CHARACTERISTICS	KM-GP

12:30	J. Capelle, J. Gilgert, G. Pluvinage LaBPS – Ecole Nationale d'Ingénieurs de Metz et Université Paul Verlaine Metz, Ile du Saulcy, 57045 Metz A FATIGUE INITIATION PARAMETER FOR GAS PIPE STEEL SUBMITTED TO HYDROGEN ABSORPTION	KM-GP
13:00 – 15:00 ODMOR ZA KOSILO – LUNCH		
	Predsedujoči – Chair:	
15:00	Jiří Bažan, Zdeněk Adolf, Ladislav Socha VŠB-TU Ostrava, 17. listopadu 15/2172,708 33 Ostrava, Czech Republic TECHNOLOGICAL POSSIBILITIES OF ALLOYING OF STEEL BY NITROGEN	KM-GP
15:15	Igor Belič Institute of metals and technology, Lepi pot 11, 1000 Ljubljana CHAOTIC MODELLING OF METALLIC MATERIALS	KM-GP
15:30	Tadej Kokalj[1,2], Lore Thijs[2], Jan Van Humbeeck[2] [1]Institute of Metals and Technology, Ljubljana, Slovenia, [2]Department of Metallurgy and Materials Engineering, KU Leuven, Belgium A PRAGMATIC WAY OF DECREASING THE RESIDUAL STRESSES IN THE SLM PROCESS	KM-GP
15:45	Franci Vode[1], Franc Tehovnik[1], Matjaž Torkar[1], Darja Steiner-Petrovič[1], Anton Jaklič[2], Franci Perko[2], Bojan Rajakovič[2], Zdravko Smolej[2] [1]Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]ACRONI d.o.o., Cesta Borisa Kidriča 44, 4270 Jesenice, Slovenia GRAPHICAL USER INTERFACE OF A CONTROL SYSTEM FOR A PUSHER-TYPE FURNACE IN ACRONI	KM-GP
16:00	Aleksandra Kocijan[1], Darja Kek Merl[2], Monika Jenko[1] [1]Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Jozef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia THE INFLUENCE OF ARTIFICIAL SALIVA ON THE CORROSION CHARACTERISTICS OF AUSTENITIC AND DUPLEX STAINLESS STEELS	KM-GP
16:15	Marjetka Conradi[1], Peter M. Schön[2], Aleksandra Kocijan[1], Julius Vancso[2], Monika Jenko[1] [1]Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]University of Twente, Drienerlolaan 5, 7522 NB Enschede, The Netherlands *In Situ* AFM LOCALIZED CORROSION INVESTIGATION OF AUSTHENTIC AND DUPLEX STAINLESS STEELS IN SIMULATED BODY SOLUTIONS	KM-GP
16:30	**ODMOR – BREAK**	
	Predsedujoči – Chair:	
16:45	Darja Jenko[1], Borivoj Šuštaršič[1], Bernard Marini[2], Stan Mandziej[3], Monika Jenko[1] [1]Institute of Metals and Technology, Lepi pot 11, POB 431, SI-1000 Ljubljana, Slovenia, [2]Commissariat à l'Energie Atomique, DMN/SRMA, 91191 Gif-sur-Yvette, Sacley, France, [3]Advanced Materials Analysis, POB 3751, 7500 DT Enschede, The Netherlands DISLOCATION OBSERVATIONS IN DUPLEX STAINLESS STEEL USING TEM	KM-GP
17:00	Franc Tehovnik[1], Boris Arzenšek[1], Franci Vode[1], Boštjan Arh[1], Daniela Skobir[1], Borut Žužek[1], Boštjan Pirnar[2] [1]IMT, Ljubljana, [2]Acroni d.o.o, Jesenice MICROSTRUCTURE IN SAF 2507 SUPERDUPLEX STAINLESS STEEL DURING HOT ROLLING	KM-GP
17:15	Š. Hozjan[1], J. Vojvodič Tuma[2] [1]Nafta Strojna d.o.o., Mlinska ulica 5, 9225 Lendava, Slovenija, [2]Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija GRADNJA REZERVOARJEV ZA METANOL V LUKI KOPER	KM-GP

17:30	Miha Kovačič[1], Božidar Šarler[2] [1]ŠTORE STEEL d.o.o., Železarska cesta 3, SI-3220 Štore, Slovenia, [2]Laboratory for Multiphase Processes, University of Nova Gorica, Vipavska 13, SI-5000, Nova Gorica, Slovenia GENETIC PROGRAMMING AND SOFT ANNEALING PRODUCTIVITY	KM-GP
17:45	Matej Babič[1], Tadej Muhič[2] [1]Emo-Orodjarna d.o.o., 3000 Celje, [2]TKC d.o.o., 1000 Ljubljana FRAKTALNA STRUKTURA ROBOTSKO LASERSKO KALJENEGA MATERIEALA	KM-GP
20:00	**POSTERSKA SEKCIJA – POSTER SESSION** **KM, AM, P, VT, NN, VO** **Cocktail Party**	

SREDA – WEDNESDAY 17. 11. 2010		
	Predsedujoči – Chair:	
8:45	V. Kleisner, R. Zemčík*, T. Kroupa Faculty of Applied Sciences, University of West Bohemia in Pilsen, Univerzitní 22, 306 14 Pilsen, Czech Republic IDENTIFICATION AND VALIDATION OF COMPOSITE MATERIAL PARAMETERS FOR LADÈVEZE DAMAGE MODEL	P-GP
9:00	Radek Kottner[1], Josef Vacík[2], Robert Zemčík[1] [1]Faculty of Applied Sciences, Department of Mechanics, University of West Bohemia, [2]Faculty of Mechanical Engineering, Department of Machine Design, University of West Bohemia, Univerzitní 8, 306 14, Plzeň, Czech Republic IMPROVEMENT OF DAMPING PROPERTIES OF CARBON FIBRE REINFORCED LAMINATED PLASTICS USING DAMPING LAYERS	P-GP
9:15	Miran Mozetič Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia CHARACTERIZATION OF EXTREMELY WEAKLY IONIZED HYDROGEN PLASMA BY A DOUBLE LANGMUIR PROBE	VT-GP
9:30	B. Skoric, D. Kakas, M. Gostimirovic, A. Miletic University of Novi Sad, Faculty of Technical Sciences, Trg D. Obradovica 6, Serbia NANOSCALE MODIFICATION OF HARD COATINGS WITH ION IMPLANTATAION	NN-GP
9:45	A. Gulec[1], O. Cevher*, A. Turk*, F. Ustel*, F. Yilmaz* İstanbul Water and Sewerage Administration-İSKİ, Subscription Department For European 1st Side, Nurtepe 34406, İstanbul/Turkey[1], *Sakarya University, Faculty of Engineering, Metallurgical and Materials Engineering, Esentepe Campus, 54187 Adapazari/turkey THE BEHAVIORS OF ACCELERATED CORROSION OF Zn, Al AND Zn/15Al COATINGS ON STEEL SURFACE	KM-GP
10:00	Leon Gosar, Darko Drev Institute for water of the Republic of Slovenia, Hajdrihova 28, Ljubljana and University of Ljubljana, Faculty of civil and geodetic engineering, Hajdrihova 28, Ljubljana CONTACT WITH CHLORINATE WATER: ADEQUATE STEEL SELECTION	KM-GP
10:15	František Kavicka, Karel Stransky, Bohumil Sekanina, Josef Stetina, Tomas Mauder Brno University of Technology, Technicka 2, 616 59 Brno, Czech Republic A BREAKOUT OF A SLAB AS EFFECT OF THE THERMOPHYSICAL PROPERTIES CHANGE OF A CONCAST STEEL	KM-GP
10:30	**ODMOR – BREAK**	
	Predsedujoči – Chair:	
10:45	Josef Štětina, František Kavička Brno University of Technology, Technicka 2, Brno, Czech Republic THE INFLUENCE OF CHEMICAL COMPOSITION OF STEELS ON THE NUMERICAL SIMULATION OF A CONTINUOUSLY CAST OF SLAB	KM-GP
11:00	A. Dakskobler, T. Kosmač Jožef Stefan Institute, Engineering Ceramics Department, Jamova 39, Ljubljana, Slovenia ORDERING OF PARTICLES IN A WEAKLY FLOCCULATED PARAFFIN-WAX SUSPENSIONS USED FOR LPIM	AM-GP
11:15	Marjan Marinšek University of Ljubljana, Faculty of Chemistry and Chemical Technology, Aškerčeva 5, 1000 Ljubljana INFLUENCE OF GRANULATION AND GRAIN SHAPE ON QUALITY OF FOUNDRY CORES	AM-GP
11:30	**ODMOR – BREAK**	
	Predsedujoči – Chair:	

11:45	L. Gorjan[1,2], A. Dakskobler[2], T. Kosmač[2] [1]Hidria AET d.o.o., Poljubinj 89a, Tolmin, Slovenia, [2]Institute Jožef Stefan, Jamova cesta 39, Ljubljana, Slovenia STRENGTH OF THERMALLY WICK-DEBINDED PARTS SHAPED BY LPIM	AM-GP
12:00	S. Perko, A. Dakskobler, T. Kosmač Jožef Stefan Institute, Engineering ceramics department, Jamova 39, SI-1000, Ljubljana, Slovenia HIGH-PERFORMANCE POROUS Y-TZP CERAMICS FOR DENTAL APPLICATIONS	AM-GP
12:15	Tomáš Kroupa, Robert Zemčík, Petr Janda Department of mechanics, University of West Bohemia, Univerzitní 8, 306 14, Pilsen, Czech Republic LINEAR TWO SCALE MODEL FOR DETERMINATION OF MECHANICAL PROPERTIES OF TEXTILE COMPOSITE MATERIAL	KM-GP
12:30	Zdeněk Adolf, Jiří Bažan, Ladislav Socha VŠB-TU Ostrava, FMMI, 17. listopadu 15/2172,708 33 Ostrava, Czech Republic CONDITIONS FOR FORMATION OF BORON OXIDE AND NITRIDE IN BORON ALLOYED STEELS	KM-GP
12:45	**Zaključek konference – Closing the Conference**	

POSTERSKA SEKCIJA – POSTER SESSION
TOREK – TUESDAY 17. 11. 2009 (20:00 – 22:00)

KM – KOVINSKI MATERIALI / METALLIC MATERIALS	
KM-1	B. Arh[1], F. Tehovnik[1], M. Torkar[1], M. Klinar[2], A. Košir[2] [1]Inštitut za kovinske materiale in tehnologije, Ljubljana, [2]ACRONI d.o.o. Jesenice, Slovenija NON-METALLIC INCLUSIONS IN STAINLESS STEELS ALLOYED WITH TITANIUM
KM-2	Boris Arzenšek[1], Franc Tehovnik[1], Borut Žužek[1], Matjaž Torkar[1], Franci Vode[1], Boštjan Pirnar[2] [1] Institute of Metals and Technology Ljubljana, [2] ACRONI d.o.o. Jesenice DEFORMATION ABILITIES OF THE DUPLEX STAINLESS STEEL LDX2101
KM-3	Roman Celin, Franc Tehovnik, Franci Vode, Franc Vodopivec, Jelena Vojvodič Tuma Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia STAINLESS STEEL IMPELLER BLADE FAILURE ANALYSIS
KM-4	Roman Celin[1], Jelena Vojvodič Tuma[1], Robert Planinc[2], Aleksandra Antolovič[2], Marin Kaštelan[2] [1]Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Krško nuclear power plant, Vrbina 12, 8270 Krško, Slovenia INTRODUCTION OF THE REACTOR-VESSEL HEAD-REPLACEMENT PROJECT
KM-5	Črtomir Donik[1], Irena Paulin[1,2], Djordje Mandrino[1], Monika Jenko[1] [1]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia, [2]TALUM d.d. Kidričevo, Tovarniška cesta 10, SI-2325 Kidričevo, Slovenia CHARACTERIZATION OF A AlSi7 CLOSED-CELL ALUMINIUM FOAM
KM-6	M. Godec[1], B. Šetina Batič[1], T. Večko Pirtovšek[2], M. Jenko[1] [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 COMPARISON OF THE TRANSFORMATION OF BULK AND SURFACE CARBIDES DURING THE VACUUM ANNEALING OF NON-EQUILIBRIUM SOLIDIFYING M42 HIGH-SPEED STEEL
KM-7	Fevzi Kafexhiu, Jelena Vojvodič Tuma Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia CORRELATION BETWEEN CREEP RATE AND YIELD STRESS AS A FUNCTION PARTICLE-TO-PARTICLE SPACING FOR X20CrMoV121 AND P91 STEELS
KM-8	Damjan Klobčar[1], Uroš Braz[2], Gregor Humar[2], Janez Tušek[1] [1]Fakulteta za strojništvo, Univerza v Ljubljani, Aškerčeva 6, 1000 Ljubljana, Slovenija, [2]Študent, Fakulteta za strojništvo, Univerza v Ljubljani, Aškerčeva 6, 1000 Ljubljana, Slovenija MICROSTRUCTURE AND MECHANICAL PROPERTIES OF FRICTION STIR WELDED AlMg4.5Mn ALLOY
KM-9	Nataša Lipovšek, Matjaž Godec, Monika Jenko Inštitut za kovinske materiale in tehnologije, Lepi pot 11, Ljubljana DOLOČANJA POVPREČNE VELIKOSTI KRISTALNIH ZRN V KOVINSKIH MATERIALIH
KM-10	Djordje Mandrino, Črtomir Donik, Aleksandra Kocijan, Monika Jenko Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia XPS DEPTH PROFILING OF ELECTROCHEMICALLY PREPARED THIN OXIDE LAYERS ON DUPLEX STAINLESS STEEL
KM-11	N. Romčević[1,2], R. Rudolf [3,4*], J. Trajić[1], M. Romčević[1], D. Stojanović[1], M. Mirić[1], Z. Lazarević[1], B. Hadžić[1], I. Anžel[3] [1]Institute of Physics, 11080 Belgrade, Serbia, [2]Kristal infiz d.o.o., 11080 Belgrade, Serbia, [3]Faculty of Mechanical Engineering, University of Maribor, 2000 Maribor, Slovenia, [4]Zlatarna Celje d.d., Kersnikova 19, 3000 Celje, Slovenia OPTICAL PROPERTIES OF PLASTICALLY DEFORMED COPPER

KM-12	Danijela A. Skobir[1], Matjaž Godec[1], Martin Balcar[2], Monika Jenko[1] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]ŽĎAS, a.s., Strojírenská 6, 591 71 Žď'ár nad Sázavou, Czech Republic INFLUENCE OF MICRO-ALLOYING ELEMENTS OF HSLA STEEL ON MICROSTRUCTURE AND MECHANICAL PROPERTIES
KM-13	Karel Stransky[1], František Kavicka[1], Bohumil Sekanina[1], Vasilij Gontarev, Tomas Mauder[1] [1]Brno University of Technology, Technicka 2, 616 59 Brno, Czech Republic, [2]University of Ljubljana, Askerceva 12, 1000 Ljubljana, Slovenia THE CRYSTALLIZATION OF CONCAST BILLETS IN ELECTROMAGNETIC FIELD
KM-14	Matjaž Torkar, Matjaž Godec Inštitut za kovinske materiale in tehnologije, Lepi pot 11, SI-1000 Ljubljana EDS ANALYSES OF THE SPOTS ON AN ALUMINIUM ALLOY CASTING
KM-15	Matjaž Torkar, Matjaž Godec, Borivoj Šuštaršič Institute of Metals and Technology, Lepi pot 11, POB 431, SI-1000 Ljubljana, Slovenia FORMATION OF Fe-ALUMINIDE ON A STEEL SUBSTRATE
KM-16	
KM-17	

AM – ANORGANSKI MATERIALI / INORGANIC MATERIALS

AM-1	Miha Kastelic, Matjaž Spreitzer, Jakob König, Danilo Suvorov Advanced materials department, Jožef Stefan Institute, Jamova 39, Ljubljana PREPARATION OF CERAMIC $AgNb_{1-X}Ta_XO_3$ TARGETS FOR PULSED LASER DEPOSITION
AM-2	K. Zupan, M. Marinšek, B. Novosel Faculty of Chemistry and Chemical Technology, University of Ljubljana, Aškerčeva 5, 1000 Ljubljana, Slovenia COMBUSTIBLE PRECURSOR BEHAVIOR IN THE LANTHANUM CHROMITE FORMATION PROCESS
AM-3	

P – POLIMERI / POLYMERS

P-1	S. Bedenk, M. Kralj Novak, Z. Susteric Savatech d.o.o., R & D Institute, Skofjeloska 6, 4000 Kranj, Slovenia DETERMINATION OF LINEAR THERMAL EXPANSION COEFFICIENT OF ELASTOMERS BY DMA
P-2	Miroslav Huskić, Majda Žigon Kemijski inštitut, PP 660, 1001 Ljubljana, Slovenija MODIFICATION OF MONTMORILLONITE USING IONIC POLYMERS

NN – NANOMATERIALI IN NANOTEHNOLOGIJE – NANOMATERIALS AND NANOTECHNOLOGY

VT-1	Marija Čolović[1], Metka Hajzeri[1], Angela Šurca Vuk[1], Adolf Jesih[2], Boris Orel[1] [1] National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia, [2] Ježef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia APPLICATION OF IONIC LIQUID-BASED REDOX ELECTROLYTE IN A HYBRID ELECTROCHROMIC DEVICE
VT-2	Metka Hajzeri[1], Marija Čolović[1], Angela Šurca Vuk[1], Matjaž Koželj[1], Boris Orel[1] [1] National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia SEMI-SOLID GEL ELECTROLYTES FOR BATTERY-TYPE OF ELECTROCHROMIC DEVICES

VT-3	Višnja Henč-Bartolić[1], Suzana Jakovljević[2], Iva Orhanović[1] [1]Faculty of Electrical Engineering and Computing, University of Zagreb, Croatia, [2]Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Croatia DAMAGE CAUSED BY NANOSECOND UV LASER ON HEATED Cu SURFACE
VT-4	Lidija Slemenik Perše, Marija Čolović, Angela Šurca Vuk, Boris Orel National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia SOL-GEL PROCESS OF MULTIFUNCTIONALIZED IMIDAZOLIUM BASED IONIC LIQUIDS BY MEANS OF RHEOLOGICAL PROPERTIES
VT-5	Franc Švegl[2], Angela Šurca Vuk[1], Metka Hajzeri[1], Lidija Slemenik Perše[1], Boris Orel[1] [1]National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia, [2]Amanova Ltd, Tehnološki park 18, SI-1000 Ljubljana, Slovenia NICKEL OXIDE THIN FILMS FOR COUNTER ELECTRODES IN ELECTROCHROMIC DEVICES
VT-6	Angela Šurca Vuk, Lidija Slemenik Perše, Metka Hajzeri, Miran Gaberšček, Robert Dominko, Boris Orel National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia $CeVO_4$ AS COUNTER ELECTRODES FOR ELECTROCHROMIC DEVICES: IR SPECTROELECTROCHEMICAL CHARACTERISATION
VT-7	Angela Šurca Vuk[1], Metka Hajzeri[1], Lidija Slemenik Perše[1], Marija Čolović[1], Bettina Herbig[2], Uwe Posset[2], Boris Orel[1] [1] National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia, [2] Fraunhofer Institut Silicatforschung ISC, Neunerplatz 2, D-97082 Wuerzburg, Germany THIN FILMS OF VANADIUM OXIDE PREPARED AT TEMPERATURES SUITABLE FOR DEPOSITION ON POLYMERIC SUBSTRATES

VT – VAKUUMSKA TEHNIKA / VACUUM TECHNIQUE	
VT-1	T. Černec, M. Brunčko, I. Anžel University of Maribor, Faculty of Mechanical Engineering, Smetanova 17, SI-2000 Maribor, Slovenia, Europe NON-DECTRUCTIVE SUPERVISION OF VACUUM CARBURIZING PROCESS
VT-2	Alenka Vesel Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia ACTIVATION OF PET POLYMER BY EXPPOSURE TO CO_2 AND O_2 PLASMA
VT-3	
VT-4	

NN – NANOMATERIALI IN NANOTEHNOLOGIJE – NANOMATERIALS AND NANOTECHNOLOGY	
NN-1	
NN-2	
NN-3	
NN-4	
NN-5	

VO – VARSTVO OKOLJA – ENVIRONMENTAL PROTECTION	
VO-1	

18. KONFERENCA O MATERIALIH IN TEHNOLOGIJAH

15.–16. november 2010, Kongresni center GH Bernardin, Portorož, Slovenija

18th CONFERENCE ON MATERIALS AND TECHNOLOGY

15–16 November 2010, Congress Centre GH Bernardin, Portorož, Slovenia

KNJIGA POVZETKOV

BOOK OF ABSTRACTS

RP-VP

RESEARCH IN EU, FP7 AND SLOVENIA

Bojan Jenko
Ministry of Higher Education, Science and Technology, Slovenia

The *7th Research Framework Programme for the period 2007–2013 – FP7* (having a budget of more than 50 billion EUR) and the *7th Framework Programme of the European Atomic Energy Community – Euratom for the period 2007–2011* (having a budget close to 3 billion EUR) are in the second half of their duration. (http://cordis.europa.eu/fp7/home_en.html). The FP7 *Collaborative research* part incorporates 10 thematic priorities, including *Nanosciences, Nanotechnologies, Materials and new Production Technologies (NMP).* The work programmes are defining a detailed work plan and details for each call regarding the thematic priority. Last year in July, for the first time, the EC published calls for projects including calls based on the EU *Recovery Plan*; from 3 PPP in 2009, the EC published on 20 July 2010 already 4 PPP calls: besides thematic in *"Energy-efficient Buildings – EeB", Factories of the Future – FoF"* and *"Green Cars"* the calls theEC opened included the *"Future Internet – FI"* call as well.
Slovenia has been successful in FP7, even more than in the former FPs; about 400 Slovenian participants have been eligible for more than 60 million EUR in the first three FP7 years, placing Slovenia (per capita) above the EU average.
The European Commission announced its *"Innovation Union"* vision in October, based on the *"Europe 2020"(COM(2010)2020 final)* document; this corresponds to the preparation and open debate on *"Research and innovation strategy of Slovenia 2011–2020" (RISS 2011–20).*

RAZISKAVE V EU, 7. OKVIRNI PROGRAM IN SLOVENIJA

Bojan Jenko
Ministrstvo za visoko šolstvo, znanost in tehnologijo

Sedmi okvirni program Evropske skupnosti za raziskave, tehnološki razvoj in predstavitvene dejavnosti za obdobje 2007–2013 – 7. OP (s proračunom več kot 50 milijard EUR) in *7. okvirni program Evropske skupnosti za atomsko energijo – Euratom za obdobje 2007–2011* (s proračunom skoraj 3 milijarde EUR) sta že v drugi polovici svoje aktivnosti. 7. OP v posebnem programu "*Sodelovanje*" združuje raziskave na 10 tematskih področjih, vključno s področji "*Nanoznanosti, nanotehnologije, materiali in nove proizvodne tehnologije*" (NMP). Delovni programi (WP) določajo podrobnosti vsake tematske prioritete in podrobnosti razpisov. Od lani Evropska komisija objavlja razpise za projekte v začetku poletja, ko je prvič objavila tudi razpise na osnovi "paketa za okrevanje gospodarstva", povezane v PPP (public-private-partnership)-razpise; od lanskih 3 PPP-razpisov so bili letos 20. julija objavljeni že 4 PPP-razpisi: poleg področij *Energetsko učinkovite zgradbe – EeB*, *Tovarne prihodnosti – FoF* in *Zeleni avtomobili – GC* je letos še *Internet prihodnosti – FI* (http://cordis.europa.eu/fp7/). Skupno je letos EK razpisala od poletja več kot 60 razpisov (vključno 12 za področje NMP) v skupni vrednosti več kot 6,4 mrd. EUR, kar je letno največ doslej. Prvi razpisi se novembra že končujejo.
Slovenija je bila tudi v 7. OP uspešna, še bolj kot pri dosedanjih OP, saj je bilo v prvih treh letih 7. OP blizu 400 slovenskih udeležencev upravičenih do več kot 60 miljonov EUR sredstev EK in je tako Slovenija v EU nadpovprečno uspešna glede na število prebivalstva.
Evropska komisija je letos oktobra objavila *Unijo inovacij* na osnovi vizije *Evropa 2020 (COM(2010)2020 konč.)*, kar se v Sloveniji sklada s pripravo in javno razpravo o *Raziskovalni in inovacijski strategiji Slovenije 2011–2020 (RISS 2011–20).*

P-GP

STUDY ON WOOD LIQUEFACTION WITH LIGNIN AS A MODEL COMPOUND

Edita Jasiukaitytė[1], Matjaž Kunaver[1], Claudia Crestini[2]
[1]National Institute of Chemistry, Hajdrihova 19, SI-1000, Ljubljana, Slovenia
[2]Tor Vergata University, Via della Ricerca Scientifica, 00133 Rome, Italy

The depolymerization of wood components in a liquefaction process enables us to convert wood into a potential feedstock for the synthesis of new, environmentally friendly polymers. This is the efficient utilization of renewable resources in a polymer synthesis and gives a new way to replace the raw materials otherwise produced from crude oil. Due to the diverse chemical composition and reactivity of wood components, the molecular structures of liquefied wood are very complicated. Therefore, the comprehensive understanding of wood liquefaction pathway is essential.

Beech milled-wood lignin was used as a model compound to study the structural changes that lignin undergoes during the beech liquefaction with ethylene glycol and acid as a catalyst. Nuclear magnetic resonance (NMR) spectroscopy, size-exclusion chromatography (SEC) and high-performance liquid chromatography (HPLC) was used in our studies.

The obtained results show the lignin initial degradation by cleavage of the characteristic bonds and formation of the monomeric lignin derivatives. The evaluation of phenolic and aliphatic hydroxyl group content with time by quantitative ^{31}P NMR, evaluation of the incorporated ethylene glycol into the lignin backbone by quantitative ^{13}C NMR as well as SEC have indicated the formation of the condensed lignin structures during the prolonged liquefaction.

AM-GP

INVESTIGATION OF AlN POWDER-HYDROLYSIS MECHANISMS AND KINETICS IN DILUTED AQUEOUS SUSPENSIONS

Andraž Kocjan, Aleš Dakskobler, Kristoffer Krnel, Tomaž Kosmač
Engineering Ceramics Department, Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia

Extensive research was conducted in order to better control the process of AlN powder hydrolysis, which has recently been exploited in the Hydrolysis Assisted Solidification (HAS) forming process and in the synthesis of nanostructured aluminate coatings.

Diluted aqueous suspensions, containing 3 wt. % AlN powder, were prepared for the monitoring of the pH and the temperature variation during the hydrolysis in the temperature range 22–90 °C. SEM, XRD, TG and TEM analyses were employed to study the temperature-dependent course of the hydrolysis and the reaction kinetics, which was described by an unreacted-core model. The hydrolysis exhibits three interdependent stages: the first stage, i.e., the induction period, and the second and the third stages of hydrolysis, where amorphous aluminum hydroxide gel, boehmite and bayerite are formed, respectively. The hydrolysis of the AlN powder is a reaction-controlled process in the temperature range 22–70 °C, for which the activation energy was calculated. At 90 °C the diffusion of OH^- ions through the product layer determines the rate of the hydrolysis. A thorough analysis of the temperature dependence of the course of the hydrolysis and the reaction kinetics gives a unique perspective on the hydrolysis.

AM-MR

JAPANESE TWINNED NATURAL QUARTZ CRYSTALS

Alenka Lenart[1], Breda Mirtič[2], Sašo Šturm[1]
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The Japanese twin is one type of planar defect found only in natural a-quartz crystals (SiO_2). It is classified as a normal type of rotational contact twin. Its composition plane is defined by the $\{11\bar{2}2\}$ family of planes. This type of twinning influences the morphology of the crystals, in this case the quartz exhibits a tabular growth. To study the formation and growth of Japanese twins optical microscopy and TEM were applied.

The twin boundary was determined on polished specimens using polarized light in an optical microscope. The optical indicatrise between both sides of the twinned crystal is rotated by a certain angle (the theoretical angle of 84.33°), which in polarized light is observed as a different extinction angle. The 60-μm to 140-μm thick, straight, twin-like plane was observed in the interior central part of the twinned crystals.

Wedge-polished TEM samples of the twinned quartz crystals were prepared in the $<\bar{1}100>$Q viewing direction. The selected-area electron diffraction patterns were acquired from both sides of the interface. It was found that the SAED patterns were rotated by 86° to each other, which is close to the theoretical rotation angle of Japanese $\{11\bar{2}2\}$ twins. In contrast, the detailed study of the interface revealed only general-type boundaries.

From these studies it can be concluded that the formation of Japanese twinned quartz can be divided in two growth phases: nucleation and coincident growth. The twin formation is believed to be initiated in the nucleation stage, which also determines the morphology of the crystal. Followed by the coincident growth of the already-nucleated twin, the growth continues in the same direction, but with a less crystallographically defined interface, which results in the formation of the general interface between both sides of the twinned quartz.

AM-MR

INK-JET PRINTING OF TiO_2 SUSPENSIONS

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Ink-jet printing is a versatile method for preparation of 2D and 3D structures of functional materials on various substrates. One of the main advantages of this method is the possibility to print practically any material from inorganic, organic, polymer to biological materials. Furthermore the design of the printed structures is made directly on the computer in contrast to the screen printing technique where every structure needs different template. Therefore inkjet printing technology found its use in a lot of different applications. It is used for organic thin film transistors, light-emitting diodes, solar cells, conductive structures, memory devices, sensors, and biological/pharmaceutical applications.

The main parameters that have to be controlled to make ink printable are the viscosity and surface tension of the ink and the size of the particles in the ink. To prevent clogging of the nozzles the particles have to be 50 to 100 times smaller than nozzle diameter.

In our experiments TiO_2 was used as a model system for the preparation of printable inks from micron-sized particles. The benefits of TiO_2 are that is this is relatively simple system and the structures prepared from this material can be used in applications such as photovoltaics or self-cleaning surfaces. First aqueous suspensions were made form TiO_2 powder. The particles were electrostatically stabilized with the adjustment of the pH of the suspension. The particles were milled in a colloidal mill to the average size of 150 nm. The viscosity of the suspensions was increased with increasing the solid load and with the addition of glycerol, which was also used as drying agent to supers drying of the suspension. The surface tension was lowered with the addition of surfactants to the suspensions. All the parameters were optimized to ensure quality drop formation in the printer, which is crucial to increase quality and reproducibility of the printed structures.

AM-MR

MICROSTRUCTURE EVOLUTION DURING SINTERING OF SODIUM NIOBATE

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Alkaline niobates, such as (K,Na)NbO_3 based solid solution, represent an important group of environmentally-friendly lead-free piezoceramics. One of the greatest difficulties related to processing of these materials is sintering. In order to better understand the sintering mechanism of the more complicated $NaNbO_3$-$KNbO_3$ system, we focused on one of the end members of this system-$NaNbO_3$.
Single phase $NaNbO_3$ was synthesized by solid state synthesis from Nb_2O_5 and mechanically-activated Na_2CO_3. The as-synthesized $NaNbO_3$ powders were compacted and sintered in air and by pressure-assisted sintering at different temperatures and different sintering times. The evolution of the microstructure and the grain growth mechanism were examined by a systematic study of different stages of sintering. A narrow sintering temperature interval, typical for alkaline niobates, was observed. The relative densities of the samples sintered in air at 1350 °C for 2 hours were around 95 %. Extremely high velocity of grain boundaries was observed, resulting in grains as large as 100 μm already after short sintering times (= 15 min). The evolution of the pore shape was followed and the pore-boundary separation conditions were indentified. By pressure assisted sintering almost theoretical density (99 %) could be obtained. In this case the average grain size after 6 hours at 1200 °C was around 1.9 μm.

AM-MR

BIOMIMETIC SYNTHESIS OF OCTA-CALCIUM PHOSPHATE COATINGS ON ZIRCONIA CERAMICS

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Zirconia ceramic implants are becoming increasingly important in the field of dental medicine because of their good mechanical properties, biocompatibility and for aesthetic reasons. However, zirconia is bioinert and so it does not form chemical bonds with bone. As a consequence, due to the implant's low fixation, premature loosening and failure can occur. Calcium phosphates (Ca-P) represent a possible solution to the problem of bioinertness, since they are bioactive. A thin Ca-P coating on the implant enables bonding between the implant and the bone, while the bulk properties of the implant remain unchanged. Among the various methods developed for the preparation of calcium phosphate coatings, the biomimetic method has several advantages over the others. It allows the synthesis of homogenous coatings with control over the coating thickness, morphology and composition, and uniform coatings can also be prepared on substrates with complex shapes. Moreover, due to the mild synthesis conditions, biologically active molecules can be incorporated within the coating.
In our research work, we have synthesized Ca-P coatings on sintered tetragonal zirconia substrates by utilizing the biomimetic method. The syntesis procedure included two steps. In the first step, the zirconia substrates were immersed into a supersaturated Ca-P solution with a physiologic pH at 37 °C. In the second step, the substrates were transfered into the Ca-P solution with a temperature of 37° C and with a composition similar to the first solution, and with a lower pH. In the first step of the synthesis, a thin Ca-P layer was formed on the surface of the substrate, which favoured the secondary nucleation and growth of Ca-P crystals in the second step of the synthesis. The composition and morphology of the coatings were examined with XRD, SEM and TEM analyses. The coatings were composed of individual octa-calcium phosphate lamellae, which were oriented perpendicular to the substrate surface. The thickness and the mass of the coatings increased with the synthesis time in the second step of the synthesis. After a heat treatment at 600 °C the adhesion between the coating and the ceramic substrate was improved.

AM-MR

A LOW-TEMPERATURE SYNTHESIS OF TRANSPARENT ZnO THIN FILMS FROM AN AQUEOUS SOLUTION

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Zinc oxide (ZnO) has generated a lot of interest in materials science due to its diverse and useful properties. ZnO is a wide-band-gap semiconductor. It has a high exiton binding energy, good optical transparency, a large piezoelectric response and it is also biocompatible. It is already used successfully as a material for different applications. Optoelectronic applications require thin films. ZnO thin films have been grown with a variety of vapor- and solutiondeposition methods. The hydrothermal synthesis of ZnO thin films is usually performed at a temperature of about 150°C. In recent years, it has been shown that thin ZnO films can be grown from an aqueous solution at the lower temperature of 90°C. It has many advantages, such as easier use in industry, speed, the low cost of the materials and equipment used and it is also environmentally benign.

Our low-temperature aqueous growth of thin, transparent ZnO films involves three steps. In the first step, a Zn-acetate ethanol solution with concentrations from 0.5 to 0.05 M was used. It was deposited at room temperature using a spin-coater on high-temperature glass slides. After the deposition the film was dried on a hot plate. In the second step, the breakup of the deposited film into ZnO islands was performed with a heat treatment. The formation of the ZnO islands was studied at temperatures from 400 to 900°C. The third step, which is the growth of the ZnO film on the substrate, requires Zn-nitrate as the source of the soluble Zn ions, a pH of 10.9 and Na-citrate. The Na-citrate reduces the growth rate in the c-direction and enables the formation of a smooth epitaxial ZnO film. The ZnO films were observed with a scanning electron microscope. The phases were identified using x-ray diffraction, and the optical properties were studied using UV-Vis-NIR spectrometer.

AM-MR

SYNTHESIS OF THE $Ca_3Co_4O_9$ THERMOELECTRIC COMPOUND BY MECHANO-CHEMICAL ACTIVATION

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High-performance, thermoelectric materials are promising for converting waste heat directly into electricity in an efficient, economical, and environment-friendly manner. They can be used, for example, to harvest a large portion of petroleum energy lost as waste heat in a typical gasoline-fuelled, internal combustion engine. High-efficiency thermoelectric conversion requires, simultaneously, a high electric conductivity and thermal resistivity and this turns out to be rather challenging.

Thermoelectric oxide ceramics are particularly suitable because they are nontoxic, chemically stable in air up to high temperatures of 800 to 1000 K and much lighter than typical thermoelectric alloys, such as, SbTe. Among the possible oxide thermoelectric materials, layered cobalt oxides, such as $Ca_3Co_4O_9$, exhibit great potential, while CoO_2 nanosheets possess a strongly correlated "charge carrier" system, which serve as highly electrically conductive layers, calcium cobalt oxide misfit layers serve as phonon-scattering regions, reducing the thermal conductivity.

Because of the sluggishness of the solid-state formation of the $Ca_3Co_4O_9$ and $Ca_3Co_2O_6$ compounds at the relatively low temperatures of their thermal stability in air, the methods of preparation and pre-reaction of the mixtures are critical for a successful synthesis. We studied the synthesis of the $Ca_3Co_4O_9$ ceramics with the help of mechano-chemical activation of the starting powder mixtures to accelerate its formation.

All samples were prepared from stoichiometric mixtures of $CaCO_3$ and Co_3O_4 for the $Ca_3Co_4O_9$ compound. For comparison, samples were prepared both by a classical ceramic procedure from un-activated powder mixtures and mixtures activated by high-energy milling for different durations, from 5 hours to 70 hours.

The morphology of the starting powder mixtures, their thermal behaviour, phase compositions and the microstructures of the sintered samples were analysed using granulometric analysis, DTA/TG analysis, x-ray diffraction analysis (XRD), scanning electron microscopy (SEM) and energy-dispersive x-ray spectroscopy (EDXS).

AM-MR

PROCESSING OF PZT-AQUEOUS SUSPENSIONS SUITABLE FOR INK-JET PRINTING

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Ink-jet printing is useful and reliable technique for processing complex structures. We have studied the preparation of $Pb(Zr_{0.53}Ti_{0.47})O_3$ (denoted PZT) aqueous-based suspension that can be used for piezoelectric ink-jet printing. The requirements for the suspension include proper viscosity and surface tension, particle size 100 times smaller than cartridges' nozzle size and high stability. In this contribution we address the reducing of the particle size and the influence of anionic surfactant on the stability of PZT aqueous suspension.

The PZT powder was prepared by solid-state synthesis from constituent oxides at 950 `C. The obtained powder had perovskite structure and consisted of micrometer-sized particles. PZT particles were stabilised in water using electrosteric stabilisation. The pH of the suspensions was adjusted by ammonia or formic acid. Ammonium polyacrylate (PAA-NH_4) with M_r č 2000 was used as a surfactant. The amount of PAA-NH_4 adsorbed on PZT particles as a function of pH was studied by titration of the supernatant. We have observed that the amount of adsorbed PAA-NH_4 on PZT increases with the increasing amount of PAA-NH_4. Higher degree of adsorption was observed at pH 3 than at pH 8.5 and 10.

The suspensions with 5 vol. % PZT and 5 wt. % PAA-NH_4 (expressed on amount of PZT) were prepared at pH 3, 8.5 and 10. They were milled in a colloidal mill for 4 h. During the course of milling we measure particle size and zeta potential of PZT. After the milling the suspensions were centrifuged and powder was analysed by XRD and FT-IR. We have observed that the particles size decreases with increasing milling time. After 4 hours of milling the PZT suspension with pH 10 exhibits high stability and contains particles smaller than 200 nm. This suspension was used for ink-jet printing.

AM-MR

CONTROL OF PHASE COMPOSITION IN THE HYDROTHERMAL SYNTHESIS OF $Na_{0.5}Bi_{0.5}TiO_3$

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Sodium bismuth titanate, $Na_{0.5}Bi_{0.5}TiO_3$ (NBT), attracted much attention over the years mainly due to its interesting piezoelectric and ferroelectric properties. Ceramic powders for electronic applications have traditionally been prepared by solid-state reaction. However, conventional techniques inherently do not provide high control over the final products morphology. In this regard, hydrothermal method was found to be a promising way to prepare non-agglomerated nanosized crystalline powders under moderate temperature conditions.

NBT powders were synthesized by hydrothermal treatment of TiO_2 (anatase) and $Bi(NO_3)_3 \cdot 5H_2O$ as titanium and bismuth precursor in a highly concentrated NaOH solution. Various alkaline conditions, concentrations of precursors, the reaction temperature and treatment time were studied. The as-prepared powders were characterized by X-ray diffraction analysis (XRD) and transmission electron microscopy (TEM).

Experimental results revealed that parallel reactions are proceeding in the reaction system, resulting in the formation of NBT and sodium titanate phases in the initial stage of reaction. Secondary phases arised also at lower alkali concentrations and mild temperature conditions. Both parameters significantly influence the solubility of precursors and the stability of NBT and secondary phases under hydrothermal conditions.

In our contribution we will reveal the acquired correlations between the reaction parameters applied and the formation of NBT and secondary phases. In addition, we will demonstrate how the ratio between the individual precursor species can be used as a powerful tool for control of the final phase composition.

AM-MR

$KTaO_3$ CERAMICS – OPTIMIZATION OF DIELECTRIC PROPERTIES BY PROCESSING

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$KTaO_3$ is one of the prototype incipient ferroelectrics applicable in microwave components operating at cryogenic temperatures, because it has high dielectric permittivity ε' value and low dielectric losses $tan\delta$. Besides, it is also an end member of lead-free (K,Na,Li)(Ta,Nb)O_3 ceramics, which exhibit high piezoelectric coefficients. It is a well known material in the single-crystal form, however, reports on processing and properties of the ceramics are still rare due to demanding processing [1].

In our study $KTaO_3$ powder was prepared by heating the mechanochemically activated K_2CO_3-Ta_2O_5 powder mixture at 800 °C for 4 h. Another heating at 800 °C was performed to improve both chemical and structural homogeneity of the powder. Phase-pure $KTaO_3$ ceramics with relative densities above 95 % were obtained by hot-pressing the single- and the double-calcined powder compacts at 1250 °C.

Calcination step has a strong influence on dielectric properties. The dielectric permittivity, measured at 5 K and 1 kHz, of the ceramic prepared from the single-calcined powder is 2450. Almost two-times increase of the permittivity value, i.e. 4090, was observed in the ceramics prepared from the double-calcined powder. Low-temperature dielectric losses of the latter ceramics are 0.005. Several dielectric relaxation regions were determined in the losses-spectra of both ceramics; their origin will also be discussed.

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KM-MR

ANALYSIS OF THE INCLUSIONS IN SPRING STEEL USING AUGER ELECTRON SPECTROSCOPY (AES)

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In terms of a capability for high lateral and depth resolution, Auger electron spectroscopy (AES) is one of the outstanding analytical methods for nanotechnology. In order to characterise the inclusions in steel in terms of size, shape, and chemical composition all the types of inclusions in a spring steel (51CrV4) surface were analyzed using Auger electron spectroscopy. From the AES measurements it was confirmed that the inclusions consist of manganese sulphide (MnS) and aluminium oxide Al_2O_3 or mixture of these. More specifically, the potentials of the different techniques were addressed with regard to the detection limits for trace analysis and a quantisation of the measured data.

Key words: AES, SEM, inclusions, spring steel

KM-MR

HARD THIN LAYERS AS A POSIBILITY TO INCREASE LOAD CARRYING CAPACITY OF CONVEX-CONCAVE GEARING

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The increase of load carrying capacity and the durability (service life) of gearings represents problems that are currently determined with questions relating to requirements for the use of new materials and technologies, increasing their performance and also the burden of the environment.
The presented contribution deals with the introduction of the modified convex-concave gearing, selection a its geometrical parameters from the aspect of increasing the carrying capacity in contact area and other benefits compared with the standard and commonly used envolute gearings. It analysis the possibility of thin film application on the surface of convex-concave gearing as a substitute for heat treatment with the aim to increase the contact carrying capacity, durability and also to improve its tribological features.

KM-MR

HOT-DEFORMATION BEHAVIOUR AND MICROSTRUCTURAL EVOLUTION OF NON-ORIENTED ELECTRICAL STEELS

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Electrical steels are used in the production of electrical engines and transformers. The main characteristics that are of interest when dealing with electrical steels are the energy losses, which are a consequence of the energy needed for the change of the direction of magnetization. They depend on many influences. One of the factors that has been reported in the literature is the influence of the hot-rolling process on the final magnetic properties, like during hot rolling the microstructure and texture form. In our research the hot-deformation behaviour of non-oriented electrical steel with different contents of Si, Al and P produced in Acroni was investigated using a Gleeble 1500D thermo-mehanical simulator. The high-temperature compression tests were performed at a strain rate of 0.01–5 s^{-1} and a temperature of 850–1150 °C. The maximal strain for all the tests was 0.9. For the analysis of the microstructural evolution we used optical microscopy. The flow curves exhibit a typical characteristic of dynamic recrystallisation. However, an irregular change of the flow-curves shape was observed for two types of steel in the temperature range where the phase transformation from γ-Fe to α-Fe occurred.

KM-MR

METHODS FOR THE PREPARATION OF PRE-CURSORS FOR MANUFACTURING ALUMINIUM FOAMS USING THE POWDER-METALLURGY PROCESS

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The production of aluminium foams by the powder-metallurgy (PM) process depends on the preparation of pre-cursors. In general, pre-cursors consist of a compacted metallic powder that is sintered at a pre-determined temperature. Due to the high temperature of the sintering, the foaming agent decomposes into a solid component that is built into the matrix material, and a gas component that causes foaming of the matrix material.
In our research we have focused on three different pre-cursor preparation techniques: compacting metallic powders, extruding metallic powders, and sandwich-rolling thin aluminium sheet. However, in the first two techniques the aluminium powder or aluminium-alloy powder is mixed with powder of the foaming agent, TiH_2 in our case. The third technique is based on hot sandwich-rolling thin aluminium sheets with the foaming agent in-between. When rolling the sheets with the foaming agent in-between, the obtained unified sheet represents a compacted material suitable for a further foaming process. TiH_2 was also used as foaming agent in this technique.
However, all these techniques have advantages and disadvantages, which were examined with light and electron microscopy, and the process of foaming was also checked. The aluminium foams prepared by those techniques were then analyzed. The density of the porous material, the size and the distribution of the pores was determined. Furthermore, SEM/EDS analyses of the distribution of single elements in the cellular walls were also made. The results of the characterization of the individual pre-cursors and the obtained foams were compared.

PRIPRAVA PREKURZORJEV ZA IZDELAVO ALUMINIJEVIH PEN S PRAŠNO METALURGIJO

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Izdelava aluminijevih pen po postopku prašne metalurgije (PM) je odvisna od priprave prekurzorjev, od t. i. predmateriala, ki je v našem primeru stisnjen kovinski prah. Prekurzorje se nato na določeni temperaturi sintra. Zaradi povišane temperature razpade penilno sredstvo, pri čemer se razvije plin, ki povzroči, da se material peni.
V naši raziskavi smo se osredinili na tri različne tehnike priprave prekurzorjev: stiskanje aluminijevih prahov, iztiskovanje aluminijevih prahov in valjanje tanke pločevine. Pri prvih dveh tehnikah gre za mešanje prahu aluminija ali aluminijeve zlitine in penilnega sredstva, ki je bil v našem primeru TiH_2. Pri pripravi prekurzorjev z valjanjem tanke pločevine pa gre za metodo, pri kateri se med dve plasti tanke pločevine aluminija ali aluminijeve zlitine doda penilno sredstvo in se vse skupaj z valjanjem pri nekoliko povišani temperaturi stisne v enovito pločevino. Tudi pri tej metodi je bil uporabljen TiH_2 kot penilno sredstvo.
Vsak od teh načinov priprave ima svoje prednosti in pomanjkljivosti, ki smo jih raziskali s svetlobno in elektronsko mikroskopijo ter s potekom penjenja posameznih aluminijevih pen. Pri tako sintetiziranih aluminijevih penah smo določili gostoto, velikost in porazdelitev por ter izvedli SEM/EDS-analizo porazdelitve elementov v stenah celičnega materiala. Rezultate karakterizacije posameznih prekurzorjev in pen smo nato primerjali med seboj.

KM-MR

FORMATION OF SIMULATED AUGER SPECTRA AS A TESTING GROUND FOR BACKGROUND-REMOVAL AND NOISE-REDUCTION ALGORITHMS

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Each Auger spectra (AES) contains the spectra, which is superimposed on the stochastic spectra background. To both these elements the noise is added. An automatic analysis of the AES can only be made when both the background and the noise are eliminated. This process of elimination also influences the spectra itself. Several measured AES were analyzed, where the shape of the spectra, the background and the noise were analyzed and compared. The methodology for the assessment of the background- and noise-removal algorithms is proposed. When simulating the spectra the levels of background and noise are known prior to processing, since they are added by the user/software. By comparing the data of the pre- and post-processed spectra, the level of influence the algorithm has on the outgoing data is known. By having this knowledge at hand it will be possible to account for it when working with real Auger spectra. Uncertainty about the level of software influence on the data is one of the weaknesses of the present spectra-processing methods. The influence of the used AES analysis algorithm therefore becomes statistically known. As the result of our research, three different elements of AES were established, i.e., the primary background, the peak base and the peaks. We have created a database containing the peak base and the peaks for different pure (standard) elements. The AES simulation software was developed. It uses the database of standard elements to randomly generate the AES and adds the primary background and the noise. The generated AES are stored in separate files, which represent the testing ground for different AES analysis software that will be developed in our future research work.
Keywords: Auger spectra, simulation, background removal, noise reduction, algorithm, automation

SIMULACIJA AUGERJEVIH SPEKTROV KOT PREIZKUSNO OKOLJE ZA ŠTUDIJO ALHORITMOV ZA ODSTRANJEVANJE OZADJA IN ŠUMA

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Vsak spekter, ki ga izmerimo z Augerjevim spektrometrom (AES), je sestavljen iz spektra samega in stohastičnega ozadja. Obema elementoma je dodan tudi šum. Avtomatska analiza Augerjeveih spektrov je možna in smiselna šele, ko odstranimo ozadje in šum. Proces odstranjevanja ozadja in šuma neizogibno povzroči popačenje osnovnega spektra.

Analizirali smo celo vrsto spektrov, pri čemer smo bili posebej pozorni na obliko sestavnih elementov. Zgradili in predstavili smo okolje za ovrednotenje algoritmov, namenjenih odstranjevanju ozadja in šuma. Simulacijske metode smo izbrali zato, ker pri simuliranem spektru vsebino vedno natančno poznamo, vse elemente namreč generira sistem sam. S primerjavo simuliranih in z algoritmom analiziranih spektrov natančno ugotovimo popačenja, ki jih v analizo uvaja sam algoritem. Z natančnim poznanjem delovanja algoritmov bomo kasneje lahko bolje ocenili napake, ki jih bodo algoritmi vnašali v analizo izmerjenih spektrov. Vpliv posameznega algoritma bo torej statistično poznan in ovrednoten.

Ugotovili smo, da oblikovno Augerjev spekter sestavljajo trije ločeni elementi, in sicer: osnovno ozadje, podlaga vrhov in spektralni vrhovi. Pripravili smo podatkovno bazo, ki za znane standardne (osnovne) elemente vsebuje podatke o spektralnih vrhovih in njihovi podlagi. Razvito programsko okolje za simulacijo spektrov uporablja podatke, zbrane v podatkovni bazi, jih naključno kombinira ter jim doda naključno izbrano osnovno ozadje ter šum. Generirani spektri so shranjeni v posebnih datotekah, ki so pripravljene tako, da ponujajo možnost kasnejšega shranjevanja podatkov, ki jih bodo ustvarili preizkušeni algoritmi za analizo spektrov.
Ključne besede: Augerjeva spektroskopija, simulacija, odstranjevanje ozadja, zmanjševanje šuma, algoritmi, avtomatizacija

KM-MR

PRELIMINARY CREEP TESTS ON P92 STEEL

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With the aim to determine the creep resistance of P92 steel, preliminary creep tests were carried out. However, only short-term creep tests were conducted, lasting 100 hours at 170 MPa for different temperatures. Constant-stress and constant-load tests were carried out. The creep curves show the creep behaviour of the material at different parameters. A metallographic examination was also performed and a basic distinction in comparison with previous types of steel such as X20 and P91 was concluded.

PREDHODNI PREIZKUSI LEZENJA PRI JEKLU P92

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Za ugotavljanje odpornosti proti lezenju pri jeklu P92 so bili izvedeni predhodni preizkusi lezenja. Zaradi dolgotrajnosti teh preskusov so bili izvedeni le kratkotrajni 100-urni preizkusi lezenja pri obremenitvi 170 MPa ter pri različnih temperaturah. Opravljeni so bili preizkusi pri konstantni napetosti ter pri konstantni sili. Krivulje lezenja prikazujejo vedenje materiala pri različnih parametrih. Narejena je bila tudi metalografska analiza preiskovanega materiala, podane so bile tudi bistvene razlike v primerjavi s predhodnimi vrstami jekel, kot sta X20 ter P91.

KM-MR

EVALUATION OF STRUCTURAL CHANGES IN Cr-V LEDEBURITIC TOOL STEELS DEPENDING ON TEMPERATURE AUSTENITIZATION

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The samples made from Vanadis 6 PM Cr-V ledeburitic steel were austenitized at temperatures from the range 1000 – 1200°C and then oil-quenched. Structural changes were investigated by scanning electron microscope and evaluated using NIS Elements software. Obtained results indicated that the M_7C_3 – carbides underwent intensive dissolution in the austenite and they were not detected above the temperature of 1100°C. On the other side, MC – carbides remained almost completely unaffected and symptoms of dissolution were found only at the temperature of 1200°C. The saturation of the austenite by carbon, chromium and partly also vanadium results to an increased hardness of the as-quenched material, with the maximum at the austenitizing temperature of 1025°C.

KM-MR

FATIGUE LIFE PREDICTION OF SPRING STEELS USING THE LOCAL STRESS GRADIENT CONCEPT

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The prediction of the fatigue life of components by calculation is a common step within the design process of machine. This prediction consists of: stresses, loads and strength behavior of the material component. Stresses in the component are frequently calculated by means of the finite element method (FEM), while loads are mostly described by means of load spectra. The information about the strength behavior of the material is the third group of input data for the calculation of the fatigue life, which are based on test results and are described by S/N curves. Fatigue tests on notched specimens under compression-tension loading were carried in order to obtain the S/N curves of investigated spring steel. Two groups of specimens were prepared: longitudinal and perpendicular relative to the rolling direction, both with two different tempering temperature. According to obtained fatigue results it is obviously that segregation orientation has an important influence on the fatigue behaviour of the spring steels as well as heat treatment condition.
Key words: fatigue life, compression-tension loading, notched specimen.

KM-MR

SOLUTION OF HOT SHAPE ROLLING OF STEEL

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The modeling of hot shape rolling of steel is represented by using a meshless method. The physical model consists of coupled thermal and mechanical models. Both models are solved through a strong formulation. The material is assumed to behave ideally plastic. The model decomposes the 3D geometry of the steel billet into a traveling 2D cross section which lets us analyze the large shape reductions by a sequence of small steps. A uniform velocity over each of the cross-sections is assumed. The boundary and operating conditions, specific for the new Store-Steel rolling mill are presented. The meshless method, based on collocation with radial basis functions is used to solve the thermo-mechanical problem. The node distribution is elliptically adapted at each deformation step to the new form of the billet. The solution is calculated in terms of temperatures and displacements at each node. Preliminary numerical examples for the new rolling mill in Štore Steel are shown.

NN-MR

COMPARISON OF HYDROTHERMAL AND SOL-GEL SYNTHESIS OF NANOANATASE TiO_2

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Titania in anatase modification is the most photocatalytic among all undoped, pure crystal modifications in powder form. It is used as a selfcleaning coating for exterior surfaces, it is used to clean waste water and air, against fog on interior surfaces i.e. on mirrors, for sterilisation of interior surfaces for example in hospitals etc.
Our goal is to compare degree of crystallinity and their photocatalytic effect after the hydrothermal synthesis and after the sol-gel synthesis. Sol-gel synthesis was performed changing the concentration of the reactant, solutes and additives. With constant stirring at room temperature sol-gel suspension was let to evaporate. Remaining powder product, was then used in hydrothermal synthesis. As alternative non-evaporated sol-gel suspensions were used.
We tried to show that for photocatalytic effect of the product is very important that primary material for hydrothermal synthesis has to be well prepared i.e. crystals already started to form. We also tried to show that the sol-gel powder product is always semi-crystalline, on the other hand hydrothermal product prepared at enough harsh conditions for long enough time is always in nano-crystalline form.
When determining the structure, chemical composition and morphology of particles, TEM, HRTEM and EDXS were used.

PRIMERJAVA HIDROTERMALNE TER SOL-GEL SINTEZE NANO-ANATAZA TiO_2

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Titanov dioksid v anatazni modifikaciji velja za najbolj fotokatalitičnega izmed vseh nedopiranih, čistih kristalnih modifikacij v praškasti obliki. Uporablja se ga za samočistilne premaze zunanjih površin, čiščenje odpadnih vod ter zraka, proti rošenju na notranjih površinah kot so npr. ogledala, za sterilizacijo notranjih površin npr. v bolnicah.
Naš cilj je bil primerjati stopnjo kristaliziranosti ter njihovo fotokatalitičnost pri dveh tipih sinteze tj. hidrotermalni ter sol-gel sintezi. Pri sol-gel sintezi smo spreminjali koncentracijo reaktanta, topila ter dodatke. Prekurzor pri hidrotermalni sintezi sem pri sobni temperaturi in konstantnem mešanju v prvem primeru pripravila z odparevanjem produktov sol-gela do suhega, v drugem primeru pa sem kot prekurzor uporabila suspenzijo.
Poskušali smo pokazati, da je za fotokatalitičnost produkta zelo pomembno, da je vhodni material v hidrotermalno sintezo čim bolje pripravljen tj. da so se kristali že začeli formirati. Prav tako smo želeli pokazati, da je pri sol-gel sintezi produkt vedno delno kristaliziran, medtem ko po hidrotermalni sintezi ob dovolj ostrih pogojih ter dovolj dolgem času dobimo nano-kristale.
Pri določanju strukture, kemijske sestave ter morfologije delcev smo si pomagali s TEM, HRTEM ter EDXS.

NN-MR

SONOCHEMICAL SYNTHESIS OF GOLD NANOPARTICLES AND THEIR COMPOSITES WITH HYDROXYAPATITE

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Noble metals have very interesting variations of electrical and optical properties achieved by reduction of particles size. A lowering of the particles' dimensions to nano-sizes and their functionalization results in appearance of properties such as surface plasmon resonance, fluorescence, nontypical electrochemistry and enhanced biological activity. These properties have significant role in practical applications of these materials in catalysis, microelectronics and optics. Moreover, they allow wide range of possible applications of these materials in the field of biomedicine. Some of the most studied directions of their biomedical applications are related to both diagnostics (for biosignals and biosensors) and therapeutics (for antibacterial and anticancer agents).

In this work we developed homogeneous sonochemical precipitation method for the synthesis of gold nanoparticles (AuNp) and their composites with hydroxyapatiate (HAp/AuNp). For that purpose two different agents of homogeneous precipitation containing amine and thiol groups were applied. Amine and thilol groups of precipitation agents have stabilization role in formation of gold nanoparticles since they posses ability to be chemisorbed onto their surface. Influence of different ways of stabilization on morphological properties of gold particles was investigated. Additionally, presence of hydroxyl groups onto the surface of HAp particles allows formation of HAp/Au composite. Within this composite HAp influenced size and shape of gold particles and prevented their agglomeration.

NN-MR

PREPARATION AND PHOTOCATALYTIC PROPERTIES OF TiO_2 BASED MICROREACTORS

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Microreactors are miniaturized reaction devices (ID smaller than 1 mm), which are built from different materials such as glass, silicone, ceramics and polymers. They are frequently used in chemistry, biotechnology and chemical engineering. Microreactors are often used in case of catalyzed reactions, in which the catalysts (anorganic, organic) are immobilized on inner surface of microcreactors. This approach offers several advantages over conventional reaction systems: reactions are faster, more efficient and productive.

Titanium oxide (TiO_2) is an inorganic material, which can be found in three crystal modifications: anatase, rutil and brukit. TiO_2 is a semiconductor and is widely used because of its photocatalytic properties. Exposing the photocatalyst to an energy source (UV light) cause activation of electrons, which interact with water and produce hydroxyl radicals. These are efficient oxidants for several organic chemicals, even microorganisms and they offer many applicative possibilities in construction of cleaning devices.

In the present work commercialy available polymeric FEP (fluorinated ethylene propylene) microtubes with internal diameter of 750 μm were used for immobilization of thin film of TiO_2 on their inner surface. Anatase crystals were produced by a sol-gel method on reflux conditions at low temperature. A water suspension of these crystals and water suspension of Degussa P25 powder were activated with UV light and inserted in seperate microtube. A blue dye resozurine was used for determination of photocatalytic activity, which transforms into resorufine and changes its colour (pink).

PRIPRAVA IN FOTOKATALITIČNE LASTNOSTI MIKROREAKTORJEV NA OSNOVI TiO_2

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Mikroreaktorji so miniaturne naprave, katerih ogrodje je najpogosteje zgrajeno iz stekla, silikona, keramike in polimerov, dimenzije le-teh pa so manjše od 1 mm. Mikroreaktorji predstavljajo pomembno orodje v kemiji, biotehnologiji in kemijskem inženirstvu. Najpogosteje se uporabljajo za namene kataliziranih reakcij, kjer so katalizatorji (anorganski, organski) imobilizirani na notranje stene mikroreaktorjev, reakcije pa so zaradi mnogih prednosti takšnega postopka mnogo bolj učinkovite, hitrejše in bolj produktivne.

Titanov dioksid (TiO_2) je anorganski fotokatalizator, ki se v naravi nahaja v kristalnih modifikacijah anataza, rutila in brukita. Zaradi polprevodniških lastnosti materiala se ob dovolj veliki energiji (UV žarki) vzbudijo elektroni, kateri reagirajo z vodo ter ustvarijo hidroksilne radikale. Ti so osnova za oksidacijo organskega onesnaženja, poleg tega pa ubijejo večino mikroorganizmov in predstavljajo dobro orodje za konstrukcijo čistilnih naprav.

V svojem delu sem uporabil komercialno dostopne polimerne cevke FEP (fluoriziran etilen propilen), premera 750 μm ter na njihovi notranji površini nanesel tanek film TiO_2. S sol-gel postopkom, ki se je izvajal pod refluksom in na relativno nizki temperaturi, sem sintetiziral kristale anataza ter jih v obliki vodne suspenzije vnesel v mikrokanale. Za primerjavo sem na notranjo površino drugega kanala nanesel še tanek film TiO_2, pripravljen iz prahu Degussa, P25. Suspenzije kristalov sem pred nanosom obseval z UV svetlobo. Fotokatalizo sem preveril z barvilom resozurin, ki reducira v prisotnosti prostih elektronov v resorufin ter spremeni barvo (iz modre v roza).

NN-MR

VISIBLE LIGHT ACTIVE TiO_2 NANO-POWDERS PREPARED BY SOL-GEL SYNTHESIS

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Titanuim dioxide (TiO_2) can perform a photocatalytic reaction. Among the three natural crystal polymorphs (anatase, brookite, rutile) only anatase and rutile are of interest for photocatalytic applications. In particular, anatase is considered as the most active phase due to its higher Fermi level, higher degree of surface hydroxylation and lower capacity to adsorb oxygen.[1] However, it was reported that a biphasic titania, consisting of anatase and rutile, exhibits even higher photoreactivity due to the appearance of the synergy effect that enhances the charge carriers separation.[2] In general, a photocatalytic activity is influenced by the crystal phase, degree of crystallinity and particle size. Degree of crystallinity is of great importance because it directly influences charge carriers live time. High crystalline materials posses less bulk defects which represent recombination centres for photogenerated electrons and holes. On the contrary, high crystalline materials usually consist of large particles, exhibit low specific surface area and therefore offer a decreased number of surface active sites on which the photocatalytic reaction can proceed.[3,4] From this point of view high photocatalytic active titania should exhibit high crystallinity, small particle size and high specific surface area.

In this contribution we describe sol-gel method for synthesis of visible light active biphasic TiO_2. The visible light activity of the prepared powders was influenced by polymorphic phase composition and particle size. The samples were characterized by XRD method, FE-SEM microscopy and the specific surface area was measured by BET method. Particle size was calculated using the Scherrer equation and the anatase-rutile fractions were evaluated by Rietveld refinement. The photocatalytic activity was evaluated as the velocity of the acetone formation from isopropanol. So prepared powders were visible light active, highly crystalline biphasic TiO_2, with particle size up 36 nm for anatase and up to 45 nm for rutile.

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VT-MR

MODELLING OF HELIUM DIFFUSION IN NITROGEN

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We have studied the phenomenon of gas inter diffusion. The aim of the contribution was to investigate the relationship between the gas pressure and the diffusivity, and to check if the gravity has some effect on the diffusivity of a "lighter gas".
The measurement setup consisted of a long tube that was connected to a helium leak detector through a small leak that was made by a variable leak valve. On the other side, the tube was connected to a gas reservoir that could be filled with pure nitrogen or a nitrogen-helium mixture at different pressures. The leak detector measures the gas flow of He through a leak valve and this flow is proportional to the He partial pressure in the mixture at the entrance of the leak valve. The diffusivity of He in N_2 can be determined from the time dependence of the He partial pressure after a sudden change of the boundary condition at the other side of the tube.
In the first part of the experiment a long tube was held in a horizontal position. Initially, all the gas is removed from the tube and the gas reservoir, then the tube is filled with pure N_2 at a pressure *P*, whereas the reservoir is filled with a gas mixture of 90 % N_2 and 10% He at the same pressure *P*. When the valve between the reservoir and the tube is opened (at time $t = 0$) the He from the mixture starts to diffuse into the pure nitrogen in the tube. The signal measured by the leak detector starts to increase until the concentration is equalized throughout the whole system and equilibrium gas flow through the leak valve is obtained. Following that the valve between the reservoir and the tube is closed, and the gas mixture in the reservoir is replaced by pure N_2, keeping the He gas mixture inside the tube unchanged. When the valve is re-opened, the He starts to diffuse out of the tube.
In the second part of the experiment the tube was held in the vertical position to verify the influence of gravity on the diffusivity in the upward and downward directions.
The physical process of diffusion of He in N_2 can be described by the diffusion equation, which has been modelled numerically with the finite difference method (FDM). The time constant of the change of He signal depends on the diffusion constant. From the model the diffusion constant can be easily determined.
The results show that the diffusivity of helium in nitrogen is the same in the horizontal and vertical directions and is not influenced by gravity. The diffusion constant of helium in nitrogen is inversely proportional to the total pressure. The measured values are in good agreement with the literature data.

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VT-MR

EXTENSION OF THE RANGE OF PRIMARY VACUUM-CALIBRATION METHODS USING NON-EVAPORABLE GETTERS

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The vacuum environment at pressures below 10^{-8} Pa (ultra-high vacuum - UHV) is currently used, not only in research, but also in industry on a more or less routine basis. Some demanding technologies even require pressures below 10^{-10} Pa (extreme high vacuum - XHV) and there is a gradual but clear increase in the demand for vacuum-gauge calibration gauges in this range. Ultra-high vacuum chambers are usually made of stainless steel. The main problem in the generation of very low pressures is the outgassing of the walls of the vacuum chamber. In a dynamically pumped vacuum system the equilibrium pressure in the system is proportional to the outgassing rate and inversely proportional to the available pumping speed. In continuous expansion calibration systems the pumping speed is deliberately limited to a few tens of liters per second to retain as close as possible a Maxwellian distribution of the gas molecules. In static expansion systems the outgassing rate determines the rate of the pressure rise in the expansion volumes.

We have investigated how to extend the lower limit of static expansion systems by the use of a non-evaporable getter pumps (NEGP) for reducing the influence of outgassing.

NEGP has two remarkable characteristics: one is the large pumping speed for active gases, especially for H_2 at ambient temperature; and the second is a virtually zero pumping speed for inert gases. So the use of NEGP together with a reduction of the hydrogen outgassing may help to maintain the background in critical components of primary vacuum calibration systems at the XHV level, without changing the gas quantity in the calibration chamber when an inert gas is used as the calibration gas. This makes the standard pressure accurately calculated by the ideal gas law. To determine the pressure after expansion, the expansion ratio (volume ratio) has to be known, and the initial pressure and temperatures of the two vessels have to be measured. The volume ratio of two chambers of the experimental static expansion system were measured using argon and helium and the results were compared to the measurements without the use of NEG.

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AM-MR

THE INFLUENCE OF WO_3 NANOFIBRES ON THE MORPHOLOGY OF THE DIGESTIVE GLAND EPITHELIUM OF *PORCELIO SCABER*

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During the past decade the production of nanofibres has increased enormously and the use of these fibres in different fields of industry and human life is more common. However, there is a lack of data relating to the toxicity and health risks of nanofibres on living organisms and the environment. The eco-toxicity data on the effects of nanofibres are much needed for an appropriate environmental risk assessment. The aim of this work was to find the morphological changes associated with the digestive gland epithelium of *Porcelio scaber* when tungsten oxide nanofibres are ingested. As a test organism we used the woodlice *Porcellio scaber.* These animals were collected in the vicinity of Ljubljana from an unpolluted area. After a period of acclimatization in the laboratory the test organisms were fed with the treated food of tungsten nanofibres over a period of two weeks. The digestive gland tubes were prepared for scanning electron microscopy, which proved to be a very useful technique for investigating the morphological changes in the surface of the digestive gland epithelium. We found some different characteristics in the morphology of the digestive gland epithelium in some areas that were different from the usual appearance. In some areas we found some interaction between the epithelium cells and the tungsten nanofibres. From these results we can conclude that there are some negative influences on the morphology of the digestive gland epithelium when tungsten oxide nanofibres are ingested.

Keywords: morphology of epithelium, tungsten nanofibres, influence, *porcelio scaber*

AM-MR

INVESTIGATION OF BACTERIA AND BIOFILMS ON DIFFERENT SURFACE MATERIALS USING A SCANNING ELECTRON MICROSCOPE

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We used a scanning electron microscope (SEM) to study the adhesion of bacteria and complex biofilms on different surfaces (stainless steel, rubber and digestive gland epithelium). For this purpose, different sample-preparation techniques are required. They need to ensure the satisfactory preservation of the biological material and at the same time they have to make the samples conductive. In the work presented here we tested different fixatives and we varied the duration of a post fixation with OsO_4 in order to make the samples conductive. We successfully developed a preparation protocol for the SEM observation of a complex biofilm composed of different microorganisms. We also developed a simplified preparation method for bacteria, where the attachment of the bacteria to different surfaces is studied. We discuss the sample-preparation protocols for investigating the adhesion of bacteria to different surfaces (nanostructured surfaces, etc.). The aim of this was to study the properties of surfaces that may be responsible for the bacterial attachment.

KM-MR

EFFECT OF ANNEALING TIME AND TEMPERATURE ON MECHANICAL PROPERTIES OF X20CrMoV121 AND P91 STEELS

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Effect of growth and redistribution of carbide precipitates on room temperature tensile properties and hardness of two ferritic-martensitic creep-resistant steels, X20CrMoV121 and P91, annealed for 17520 h at 923 K (650°C) and 8760 h at 1023 K (750°C) was investigated. On samples annealed for different time periods, yield stress, tensile strength, elongation and hardness were determined at room temperature.

It was found that the effect of annealing at 750°C on microstructural changes, room temperature tensile properties and hardness was greater for both steel compared to the annealing at 650°C. Changes of yield stress, tensile strength and hardness of both steels at a given annealing temperature were found to be very similar; therefore a general mathematical expression with specific coefficients for each property could be used. These results will be later used to find the correlation between particle-to-particle spacing, yield stress and creep rate, which could be useful in the process of determining the lifetime issues of thermal power plant components.

Key words: annealing, mechanical properties, X20CrMoV121 and P91 steels.

KM-MR

PREDICTION OF MECHANICAL PROPERTIES OF Cr-Ni-Mo STAINLESS STEEL WITH TWO-PHASE MICROSTRUCTURE

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We analyzed results obtained by mechanical tests performed on Cr-Ni-Mo stainless steel, trying to find relation between these results. Primary subject of this analyze were Impact toughness results. Charpy-V tests were performed on three types of alloys with three different chemical compositions and delta ferrite contents. Alloys were designated as A (2%), B (11%) and C (with 27 wt% of delta ferrite). All results were then described with one suitable function. After that a program for prediction of mechanical properties (impact toughness) was made. Program application was written in Visual Basic 6 environment. With this program is possible to predict a change of impact toughness of Cr-Ni-Mo stainless steel depending on time, working temperature and delta ferrite content of this material, for working temperatures from 290 to 350°C, delta ferrite content from 2 to 27 wt%. To avoid unnecessary mistakes and to focus on time period which have a practical use, time is also limited to 0 to 40 years. We believe that with this same principle used here is also possible to predict mechanical properties of any other material with any other chemical composition. But, this method is pure empirical and this achievement will require much more diverse experimental data.
Keywords: Cr-Ni-Mo stainless steel, impact toughness, mechanical properties, Charpy-V test, chemical composition, delta ferrite content, empirical method, program application, Visual Basic 6.

KM-

FRACTOGRAPHIC ANALYSIS OF FATIGUE FAILURE OF PRESET TORSION SPRING BARS

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Preset torsion spring bars were subjected to fatigue twist loading. Specimens with fatigue cracks were fractographically analyzed in post-test investigation. It was found that two typical failures can occur. The first one occurred after fatigue crack initiation under the surface of a specimen. The distance, of the fatigue initiation corresponds to the distance of the shear stress peak after super positioning of the residual stress and testing torsion stress. Initial fatigue formation has an elliptical shape, and it lies under on angle of 45°, in respect to the spring's centre line. It confirms the theoretical fact that an initial crack starts within the plane of principal stress. The fatigue crack then spreads inside the material in the spring's transversal direction and then passes on to the spring's surface. The final failure spreads in the transversal direction of the central line of the spring bar.

Prednapete paličaste torzijske vzmeti so bile izpostavljene utrujenostnemu vzvojnemu preizkušanju. Analiza preloma je opravljena po utrujenostni porušitvi preizkušancev. Raziskava je pokazala, da nastopata dva značilna lomna obnašanja. V prvem primeru inicialna utrujenostna razpoka nastane pod površino vzmeti. Razdalja od površine do točke iniciacije utrujenostnega loma se ujema z maksimalnimi strižnimi napetostmi, ki so izračunane na osnovi superpozicije zaostalih napetosti in vzvojne obremenitve. Začetna utrujenostna razpoka pod površino ima eliptično obliko in je za 45° zamaknjena glede na simetralo paličaste vzmeti. To potrjuje teoretično ugotovitev da začetna utrujenostna razpoka nastane v ravnini glavnih napetosti. Utrujenostna razpoka se širi pod površino v prečni smeri glede na os, dokler ne pride na površno. Končna porušitev nastopa v prečni smeri glede na os vzmeti. V drugem primeru se utrujenostna razpoka inicira na površini v kolikor je prisotna napaka ali vključek. Takrat se utrujenostna razpoka širi s površine proti notranjosti do kritične velikosti. Končni lom poteka spiralno po površini pod pogoji ravninsko napetostnega stanja, medtem ko se v notranjosti zlomi pod pogoji ravninsko deformacijskega stanja.

KM-VP

VANISHING OF METALS AND BEARABLE DE GROWTH

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The management of metal waste represents today a real financial issue because of increasing of economical and environmental costs. The metal waste recycling allows in particular the protection of the natural resources. However recycling is not however effective at 100% and one big part of raw materials is lost each year. Time for exhaustion of metal ores is not for millennia, nor even for centuries, but only for a few tens years. In this context, our technological civilization is not at all durable under its current form and must evolve as fast as possible.
Based on actual production and known ore world reserves, prediction of metals vanishing can be made.

Table 1: End of elements

Date	End of Element	Date	End of Element
2012	End of terbium	2040	End of uranium
2018	End of hafnium	2048	End of nickel
2021	End of silver	2050	End of oïl
2022	End of antimony	2064	End of platine
2023	End of palladium	2072	End of natural gas
2025	End of l'or	2087	End of iron
2028	End of tin	2120	End of cobalt
2030	End of lead	2139	End of aluminium
2038	End of tantale	2158	End of coal
2039	End of copper		

NN-VP

CFD ANALYSIS OF EXOTHERMIC REACTIONS IN Al-Au NANO MULTI-LAYERED FOILS

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The aim of the work was to explain the development of novel reactive nano-multilayered material that enables rapid bonding of similar and dissimilar materials by using the CFD analysis. For this purpose the Au-Al system was used. The potential use for the reactive Al-Au nano-foils is as a controllable, localised heat source for joining applications. To optimize the performance of the Al-Au foils it is necessary to have a clear understanding of the physical processes which dictate the reaction temperature, the rate of heat generation and the velocity at which the reaction propagates along a foil. Several existing models describe the propagation velocity of the exothermic reactions. In self-propagating high-temperature synthesis (SHS) the compact is heated locally using an external heat source. The local heating initiates the reaction locally, releasing heat that drives the reaction forward. The reaction moves across the compact in a self-propagating manner, driven by its own heat. Having thin nano-layers of reactants (here Al and Au) that are in intimate contact with each other makes the SHS reaction propagate faster in most reactive foils than in a powder compact with the same components.

This work will present the possibility of numerical modelling using the Computational Fluid Dynamics (CFD). The governing equations were solved using a Finite Volume Methodology (FVM). The computational domain was discretized using a uniform Cartesian grid of appropriate mesh size along the x and y directions with the corresponding number of grid points. Field variables were discretized at cell centres and spatial, as well as time derivatives, were approximated using the second-order accurate numerical scheme. The time-evolution of temperature and concentration fields, as well as the atomic diffusion coefficient, will be presented for the appropriate Al-Au nano-foil geometry and boundary conditions.

Key words: nano-foils, Au, Al, CFD analysis

KM-GP

THE INFLUENCE OF FOAMING PRECURSOR'S COMPOSITION AND DENISTY ON THE FOAMING EFFICIENCY, MICROSTRUCTURE DEVELOPMENT AND MECHANICAL PROPERTIES OF ALUMINIUM FOAMS

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In this work, the influence of the composition as well as the density and the porosity of the foaming precursors on the foaming efficiency, the microstructure development and the mechanical properties of aluminium foams are presented and discussed. Foams were prepared, starting from precursors made either by the powder metallurgy (PM) or by the melt route. Following the PM route, precursors were made by mixing Al powder and 3-10 vol. % of dolomite or calcium carbonate particles of various particle size (from 20 to 120 μm) and cold isostatically pressing of the obtained mixture at 700 MPa. In the case of the melting route, precursors were made by introducing dolomite or calcium carbonate particles directly into the molten aluminium at 700 °C. After melt stirring, the precursors were prepared by casting the semi-solid slurry into a cylindrical water-cooled mould.
Finally, aluminium foams were made in all cases by inserting precursors into a cylindrical stainless-steel mould and heating the arrangement at 750 °C for 10 min. After that, the mould was removed from the furnace and the foaming process was stopped by its cooling in air to room temperature.
The microstructure of the obtained foams was investigated by optical and scanning electron microscopy (SEM-EDS), while XRD was applied for a detailed identification of the phases presented.
The quality of the precursors was evaluating by determining their mechanical properties (uniaxial room-temperature compression stress-strain curve, compressive strength and energy absorption after a 30% strain) and the foaming efficiency (the relative density of the foam obtained). The concentration of the foaming agent and the density of the precursors were observed to have a detrimental influence on the foaming efficiency as well as on the foam microstructure and mechanical properties. The foaming of precursors with open porosity was inefficient.

VPLIV SESTAVE IN GOSTOTE PREKURZORJEV ZA PENJENJE NA UČINKOVITOST PENJENJA TER RAZVOJ MIKROSTRUKTURE IN MEHANSKIH LASTNOSTI ALUMINIJSKIH PEN

V delu poročamo o vplivu sestave ter gostote oz. poroznosti prekurzorja za penjenje na učinkovitost penjenja ter razvoj mikrostrukture in mehanskih lastnosti aluminijevih pen. Pene smo izdelovali s pomočjo prekurzorjev na osnovi Al, s homogeno porazdeljenimi delci dolomita ali kalcijevega karbonata. Prekurzorje smo pripravljali s postopkom prašne metalurgije (PM) in z litjem taline ki je cenejše, zagotavlja pa manj homogeno porazdelitev sredstva za penjenje. S PM postopkom smo prekurzorje za penjenje izdelovali iz zmesi Al prahu in 3-10 vol. % dolomita ali kalcijevega karbonata različne povprečne velikosti (od 20 do 120 μm) , ki smo jo izostatsko stisnili pri 700 MPa. Z litjem smo prekurzorje pripravljali tako, da smo delce penilca uvajali v Al talino, segreto do največ 700 °C, premešali in nastalo suspenzijo ulili v cilindričen, vodno hlajen jeklen model. Pene smo iz obeh vrst preurzorjev izdelovali tako, da smo prekurzor vstavili v zaprt jeklen model za penjenje, segrevali pri 750 °C, 10 min. ter nato ohlajali na zraku do sobne temperature.
Mikrostrukturo nastalih pen smo preučevali z optično in elektronsko (SEM/EDS) mikroskopijo in sicer tako, da smo ugotavljali morfologijo in povprečno velikost por; sestavo prisotnih faz pa z metodo rentgenske (XRD) difrakcije. Gostoto prekurzorjev in pen smo določali na osnovi mase in izračunane prostornine strojno obdelanih vzorcev, učinkovitost penjenja (relativno gostoto dobljene pene) pa na osnovi primerjave dejansko dosežene gostote pene in gostote aluminija. Primerjalno smo gostoto pen določali tudi z Arhimedovo metodo.
Kakovost izdelanih pen smo ocenjevali na osnovi njihovih mehanskih lastnosti (krivulje napetost-deformacija pri sobni temperaturi, tlačne trdnosti in sposobnosti absorpcije energije pri 30% deformaciji). Ugotovili smo, da na učinkovitost penjenja ter razvoj mikrostrukture in mehanskih lastnosti vplivata predvsem kemijska sestava in gostota prekurzorja za penjenje, pri čemer je prekurzorje z odprto poroznostjo bilo nemogoče peniti.

KM-VP

Cr-V LEDEBURITIC COLD WORK TOOL STEELS

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Cold work tool steels based on the Cr-V alloying belong to the most important tool materials for large series manufacturing. To enable high production stability, the tools must withstand various types of degradation processes. On the first side, it concerns the plastic deformation and wear. Therefore, the materials should have high hardness, tensile and/or compressive strength and wear resistance. On the other hand, the materials have to resist the brittle fracture, e.g. they must exhibit sufficiently high toughness and fracture toughness. The paper deals with small overview on the heat treatment procedures and surface engineering techniques, suitable for the Cr-V tool steels. The effect of each of the on the main mechanical properties is also demonstrated and discussed. As a typical example, PM made Cr-V ledeburitic steel Vanadis 6 is given.
Keywords: P/M cold work steel Vanadis 6, heat-treatment, surface engineering, microstructure, hardness, three point bending strength, fracture toughness

KM-GP

MICROSTRUCTURAL FEATURES AND MECHANICAL PROPERTIES OF THERMALLY AGED DUPLEX STAINLESS STEEL

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The samples of cast duplex stainless steel type 258 were aged for 10,000 h and 30,000 h at 300 °C and 350 °C. ICP-AES bulk chemical analyses of the samples, microstructure investigations with LM and SEM, micro-chemical analyses with SEM/EDS, as well as a phase analysis with four different methods were then performed. Tensile test specimens were also made from the aged samples and standard tensile tests at room temperature were performed. The SEM fractography of the fractured surfaces was also made. Microhardness measurements of the ferrite and austenite phases were determined on polished metallographic samples. The results of the microstructural and mechanical testing and the fractographic examinations will be reported and discussed in the presented contribution.
Keywords: duplex stainless steel, isothermal annealing, mechanical properties, microhardness, fractography

MIKROSTRUKTURNE ZNAČILNOSTI IN MEHANSKE LASTNOSTI IZOTERMNO ŽARJENEGA DUPLEKSNEGA NERJAVNEGA JEKLA

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Preizkušance, izdelane iz vzorcev litih dupleksnih feritnih jekel tipa 258, smo umetno starali (izotermno žarili) 10 000 h in 30 000 h pri temperaturah 300 °C in 350 °C. Nato smo izvedli njihovo volumensko kemijsko analizo na ICP-AES, mikrostrukturno analizo na optičnem in vrstičnem elektronskem mikroskopu (SEM) ter mikrokemijsko fazno analizo z rentgenskim disperzijskim spektrometrom (SEM/EDS). Fazna analiza je bila izvedena na štiri različne načine, vključno z novim SEM/EBSD-spektrometrom. Iz staranih vzorcev smo izdelali tudi standardne natezne preizkušance in izvedli standardni natezni preizkus ter fraktografijo prelomov na SEM. Z merjenjem mikrotrdote smo ugotovili spremembo mikrotrdote ferita in avstenita zaradi staranja. V prispevku poročamo o rezultatih mikrostrukturnih, mehanskih in fraktografskih preiskav.
Ključne besede: dupleksno nerjavno jeklo, izotermno žarjenje, mehanske lastnosti, mikrotrdota, fraktografija prelomov

KM-GP

SIMULTANEOUS TEMPERING AND NITRIDING OF DEEP-CRYOGENIC TREATED P/M S390MC HIGH-SPEED STEEL

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A deep cryogenic treatment is claimed to be an efficient technique to improve the properties of tool and high-speed steels. A lot of benefits related to this treatment are reported in the scientific literature and probably even more on the internet. The process has a wide range of applications and some of the benefits of the cryogenic treatment include a longer part life, less failure due to cracking, improved thermal properties, a reduced coefficient of friction, improved flatness, and easier machining. Sometimes the influence of a sub-zero treatment could be directly ascribed to a specific metallurgical transformation. It is the case that the transformation of retained austenite into martensite, causes a general increase in hardness and higher wear resistance (but lower toughness). In other cases, however, the increase in wear resistance is not supported by a higher hardness and a lot of theories were proposed to justify the observed results. To the authors' best knowledge the most reliable is the so-called "low-temperature conditioning of martensite" occurring in steels during prolonged soaking in liquid nitrogen, and affecting the precipitation of secondary carbides on tempering. However, poor experimental evidence was reported in the literature for this phenomenon. The aim of the paper is to present and discuss some of the results collected in previous years. Specific attention is paid to the influence of a sub-zero treatment placed just after quenching and solubilization in the conventional vacuum heat treatment or nitriding cycle of the P/M S390MC high-speed steel, respectively. Special emphasis was put on abrasive wear resistance and resistance to galling under dry sliding conditions. The abrasive wear resistance was tested under reciprocating sliding conditions using an alumina ball, while the galling resistance against austenitic stainless steel was determined in a load-scanning test rig. The tribological tests were evaluated in terms of the high-speed-steel wear volume, the coefficient of friction under reciprocating sliding, the friction variation with load, and the critical load for galling initiation and stainless-steel transfer layer formation. From the obtained results it can be concluded that the application of a deep-cryogenic treatment results in significantly higher wear resistance of high-speed steels, but no significant improvements in toughness were noticed.
Key words: high-speed steel, deep-cryogenic treatment, toughness, fracture toughness, wear resistance, nitriding

Senčič

KM-GP

METAL MATERIALS WITH MODIFIED CHARACTERISTICS

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New industrial branches have permanent need for new materials in order to improve performances of their constructions. Development of new materials is complicated and costly process. Due to that in many cases the existing materials with modified characteristics are used. By usage of certain technological processes of producing liquid metals such as deformation, thermal treatment and surface treatments the mechanical and exploitation characteristics of existing materials can be improved. In this paper is given an overview of several researches conducted at the Institute in Zenica. Those researches had a goal to improve characteristics of some materials that are in use in air and car industry. Within semi industrial facilities and laboratories of the Institute some researches are conducted upon stainless steels and Maraging steels as well as upon super alloys based on nickel and iron.

Key words: new materials, constructions, new technologies, stainless steels, Maraging steels, super alloys

KM-GP

A FATIGUE INITIATION PARAMETER FOR GAS PIPE STEEL SUBMITTED TO HYDROGEN ABSORPTION

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Fatigue initiation resistance has been determined on API 5L X52 gas pipe steel. Tests have been performed on Roman Tile (RT) specimen and fatigue initiation was detected by acoustic emission. A comparison between specimens electrolytically charged with hydrogen and specimens without hydrogen absorption were made and it has been noted that fatigue initiation time is reduced of about 3 times when hydrogen embrittlement occurs. It has been proposed to use the concept of Notch Stress Intensity Factor as parameter to describe the fatigue initiation process. Due to the fact that hydrogen is localised in area with high hydrostatic pressure, definitions of local effective stress and distance have been modified when hydrogen is absorbed. This modification can be explained by existence of a ductile-brittle transition with hydrogen concentration. The fatigue initiation resistance curve allows that to determine a threshold for large number of cycles of fatigue non initiation. This parameter introduced in a Failure Assessment Diagram (FAD) provides supplementary information about defect nocivity in gas pipes: a non critical defect can be detected as sleeping or not sleeping defect i.e. as non propagating defect.
Key words: Fatigue initiation resistance, API 5L X52 steel, Notch Stress Intensity Factor

KM-GP

TECHNOLOGICAL POSSIBILITIES OF ALLOYING OF STEEL BY NITROGEN

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The paper presents theoretical pre-requisites of nitrogenation of steel melts. It mentions also various methods and technological possibilities of use of gaseous nitrogen, as well as nitrogen containing alloying additives. Numerous used technologies are enumerated and development trends are outlined both for use of alloying additives and gaseous nitrogen.
The work was solved within the frame of the project EUREKA ENSTEEL E!4092 and projects MPO FR-TI1/222 and FR-TI1/477 under financial support of MŠMT ČR (Ministry of Education, Youth and Sports) and MPO ČR (Ministry of Industry and Trade of Czech Republic).

KM-GP

CHAOTIC MODELLING OF METALLIC MATERIALS

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The modelling of the properties of materials is a very complex process. The more concise the modelling is, the larger the amount of data space and computational time is needed. A key property of chaotic systems and fractals is their ability to present the contents of modelling relating to any scale of observation. The presented work provides the fundamental issues regarding the possibilities of chaotic and fractal modelling. A literature overview on the topic is provided. The overall objective is to achieve such conditions that the final substructure and phenomena are as near to that of real materials. It has been proven that materials do have obvious fractal characteristics; the problem is how to practically define the fractal properties that will resemble the modelled structure. Fractals are patterns of chaotic behaviour, meaning that shapes and trends in nature, which can be thought of as hypersensitive to initial conditions, can be described efficiently. Our main objective is to establish the fractal structure of the metallic materials, which will later enable us to study the microstructure-macrostructure properties of the materials.
Keywords: chaos, fractals; grain modelling, metallic materials.

KAOTIČNO MODELIRANJE KOVINSKIH MATERIALOV

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Modeliranje lastnosti materialov je izjemno kompleksen proces. Od stopnje natančnosti, s katero želimo predstaviti/modelirati material, je odvisno, koliko spominskega prostora potrebujemo in kako hitro je delovanje modela. Osnovna prednost modeliranja s kaotičnimi sistemi in fraktali je sposobnost predstavitve modela ne glede na finost predstavitve – skaliranje. Predstavljeno delo ponuja osnovne zakonitosti, ki veljajo za kaotično in fraktalno modeliranje. Podan je pregled literature. Skupni cilj dela je poiskati tak model materialov, ki bo kolikor mogoče povzemal pomembne lastnosti realnih materialov. V literaturi je bilo pokazano, da imajo naravni materiali jasno izražene fraktalne lastnosti, in sicer na različnih nivojih. Velik praktičen problem kaotičnega modeliranja je, kako najti primerne parametre, ki bodo zadovoljivo opisali modeliran material. Znano je namreč, da so fraktali hiperobčutljivi za začetne pogoje. Od nastavitve začetnih pogojev je odvisno, kakšne oblike in lastnosti bo imel opisan model.
Glavni cilj je postaviti fraktalno strukturo kovinskih materialov, ki bo kasneje omogočala študij mikrostrukturnih in makrostrukturnih lastnosti materialov.
Ključne besede: kaos, fraktali, modeliranje zrn, kovinski materiali

KM-GP

A PRAGMATIC WAY OF DECREASING THE RESIDUAL STRESSES IN THE SLM PROCESS

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Selective Laser Melting (SLM) is an additive manufacturing technology with a presence in medical, aerospace and high-technology engineering and the electronics sectors. The process uses a high-powered laser to fuse fine metal powders together layer-by-layer direct from CAD data to create functional metal parts. The material in this process is exposed to high temperatures, high temperature gradients and high cooling rates as well as to a cyclic re-heating and re-melting process. All of these are suitable for the development of residual stresses (RSs). These RSs are a consequence of the plastic deformation due to thermal loading and remain in the workpiece even after the manufacturing process is finished. The RSs in SLM can be very high and are one of the most critical issues in the SLM process. By selecting a suitable scanning strategy the RSs could be decreased, but to avoid extended experimentation, a fast numerical simulator would be of great value. To avoid a long-lasting numerical computation based on a coupled thermo-mechanical model, we intend to correlate the residual stresses with the thermal model only. Our aim is to find the characteristic functions derived from the temperature history of the workpiece that best correspond to the residual stresses. These characteristics can be gradients, temperatures, times, etc., and many others as well as their linear combinations. Based on the most suitable characteristic the scanning strategy can optimized. With this pragmatic and approximate method we intend to significantly improve the scanning strategy for SLM in order to decrease the RSs.

KM-GP

GRAPHICAL USER INTERFACE OF A CONTROL SYSTEM FOR A PUSHER-TYPE FURNACE IN ACRONI

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In the hot-rolling plant of ACRONI d.o.o., a Furnace Control System (FCS), which controls the individual slab reheating according to the predefined Reference Reheating Curve, is in the final phase of testing. A Graphical User Interface (GUI) for communications between the FCS and the furnace operator was developed. Since the FCS uses an existing mathematical model for the calculation of the slab temperature, the GUI of the FCS is upgraded from the GUI of the mathematical model. The GUI is developed using the open-source Xforms library on a Linux-based Operating System (OS). The main window is dived into three sub-areas, where two sub-areas have additional Tabs. Four groups of drop-down menus are positioned on the top main window, altogether opening eleven sub-windows or forms. Most of these sub-windows can be opened via drop-down menus or via buttons, which are suitably positioned throughout the GUI. Shortcuts are added for closing the sub-windows. Access to the sub-windows is protected by password, where required, e.g., a change of the RRC.
A data exchange between the GUI and FCS is performed via the Database Tables, the Files and the Shared Memory. The GUI is used for inserting the required data such as: inserting delays – duration and occurrence instant, selection of the agglomeration function in the zones, determination of the discharging temperature difference limit, etc. The GUI is also used to maintain the different database tables, such as the Reference Reheating Curve (RRC) table. A RRC editor is also built-in, where different useful modifications can be made for manually adjusting the selected RRC. Informative warnings and the errors of the FCS are also displayed for a user-friendly detection of the FCS malfunction.

KM-GP

THE INFLUENCE OF ARTIFICIAL SALIVA ON THE CORROSION CHARACTERISTICS OF AUSTENITIC AND DUPLEX STAINLESS STEELS

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Currently, duplex stainless steels (DSS) are replacing austenitic steels because of their good compromise between the mechanical properties, the corrosion resistance and the economic advantages. They are composed of virtually equal amounts of austenitic and delta-ferritic phases. As a result, duplex stainless steels display properties that are characteristic of both austenitic and ferritic stainless steels. Duplex stainless steels are, in most cases, tougher than ferritic stainless steels, and the strength of duplex stainless steels can, in some cases, be double that for austenitic stainless steels. While duplex stainless steels are considered to be resistant to stress-corrosion cracking, they are not as resistant to this form of attack as ferritic stainless steels. However, the corrosion resistance of the least-resistant duplex stainless steel is greater than that of the most commonly used grades of stainless steel, i.e., 304 and 316. The main applications are in the chemical and oil industries in the form of as-cast material. One of their main advantages with respect to medical applications is the decrease in the nickel hypersensitivity effect for patients undergoing orthodontic treatments. These austenitic-ferritic wires can be a substitute for the common commercial wires of austenitic stainless steels, with the advantage of a reduced nickel content. It has been reported, for example, that up to 21 % of the population may exhibit allergic reactions to nickel, and case studies have indicated hypersensitivity reactions to nickel, stimulated by exposure to orthodontic brackets [1].
The aim of the present study was to evaluate the corrosion behaviour of AISI 316L stainless steel and 2205 duplex stainless steel suitable for orthodontic clinical applications in artificial saliva, with and without the addition of fluoride ions. The study was conducted using the electrochemical techniques of cyclic voltammetry, potentiodynamic measurements and electrochemical impedance spectroscopy (EIS). The compositions and depth profiles of the oxide films formed on the surface of both stainless steels at the open-circuit potential were studied by X-ray photoelectron spectroscopy (XPS).

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KM-GP

In Situ AFM LOCALIZED CORROSION INVESTIGATION OF AUSTHENTIC AND DUPLEX STAINLESS STEELS IN SIMULATED BODY SOLUTIONS

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We report on *in-situ,* electrochemical, atomic force microscopy (EC-AFM) studies of the localized corrosion of duplex 2205 stainless steel (DSS 2205) and AISI 316L stainless steel in two model solutions – artificial saliva and simulated physiological solution-Hank´s solution – with an increased concentration of chloride ions. The AFM topography analysis illustrates the high corrosive resistance of the DSS 2205 for the chosen range of potentials in both solutions. In contrast, pitting corrosion was observed on the surface of the AISI 316L, the pits being more evident, larger and deeper, when the sample was electrochemically treated in the physiological solution. On both surfaces, however, we observe the growth of corrosion products related to anodic oxidation in the passivation process, such as Cr(III) to Cr(VI) and Ni(II) to Ni(IV). As a result, depending on the sample's metallurgical structure, different high-state oxides cover the surface close to the breakdown potential. We distinguish between the square-like type of oxides on the surface of DSS 2205, whereas AISI 316L is characterized with an elliptic-like oxide deposition.

NN-GP

DISLOCATION OBSERVATIONS IN DUPLEX STAINLESS STEEL USING TEM

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Samples of duplex stainless steel (DSS; 258 type) were isothermally annealed (aged) at temperatures of 300 °C and 350 °C for 10 000 h and 30 000 h. Thin foils of specimens were prepared using argon ion slicing or electrochemical thinning with finishing by the jet-electropolishing method. Spinodal decomposition is expected to occur during the thermal ageing of this type of material. The characteristic is the formation of a nano-cellular microstructure of ferrite domains with regions enriched with Cr and other alloying elements. This causes a significant change in the mechanical properties (the hardness and tensile strength increase, but the ductility and toughness decrease). The change in the mechanical properties must be related to the changes of the material's internal structure (stacking faults, morphology and density of dislocations). Therefore, non-aged and aged samples were studied using transmission electron microscopy (TEM) at a 200-kV electron accelerating voltage.
It has been established that there are a lot of dislocations after ageing at 300 °C and that they appeared in different configurations, with a lot of them being substantially mobile (numerous side-trails and traces of dislocations escape to the foil surface). The dislocation configurations changed and many of the dislocations became immobilized (or at least slowed down in their movements) after ageing at 350 °C when the transformation of the matrix additionally occurred. The research makes it possible to understand the characteristics of spinodal decomposition, the influence of the ferrite presence in duplex stainless steel and thus help us to increase the life-time of the components of thermal power plants made of DSS. Further investigations (TEM/EDS) will make it possible to explain the real rearrangement of the alloying elements and the formation of new phases during spinodal decomposition.
Key words: duplex stainless steel, dislocations, TEM, power plant

KM-GP

MICROSTRUCTURE IN SAF 2507 SUPERDUPLEX STAINLESS STEEL DURING HOT ROLLING

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Depending on the chemical composition and the applied thermomechanical processing, the microstructure of superduplex stainless steels (SDSS) mostly consists of different amounts of ferrite and austenite and, likely, together with deleterious intermetallic phases. As a result, the optimisation of the mechanical properties and the corrosion resistance of the SDSS depend on a precise control of the microstructural evolution during the hot deformation and the subsequent aging process. On the other hand, the appropriate treatment is necessary to avoid the formation of undesirable intermetallic phases, i.e., σ and χ. It is supposed that among the intermetallic precipitates, the σ phase is the most detrimental one, as it causes a considerable drop in the toughness as well as the corrosion resistance. The purpose of the present work was, therefore, to determine the effect of aging at high temperatures and during hot rolling in the range from 1250 to 900 °C on the microstructural evolution of SDSS grade SAF 2507.

MIKROSTRUKTURA SUPERDUPLEKSNEGA NERJAVNEGA JEKLA SAF 2507 MED VROČIM VALJANJEM

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Mikrostruktura dupleksnih nerjavnih jekel je sestavljena iz različne količine ferita in avstenita in tudi neželenih intermetalnih faz, odvisno od kemične sestave zlitin in tehnoloških termomehanskih procesov. Optimizacija mehanskih lastnosti in korozijske odpornosti SDSS je odvisna od natančne kontrole mikrostrukture zlitine med vročim preoblikovanjem in kasnejšim procesom žarjenja, ki je primeren postopek za preprečitev tvorbe intermetalnih faz, kot so σ, χ in itd. Prisotnost najpomembnejše intermetalne faze v zlitini močno zmanjšuje žilavost in tudi korozijsko odpornost. V raziskavi je prikazan vpliv žarjenja pri visokih temperaturah in med vročim valjanjem v temperaturnem območju med 1250 °C in 900 °C na mikrostrukturo jekla SAF 2507.

KM-GP

GRADNJA REZERVOARJEV ZA METANOL V LUKI KOPER

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Na pomolu I. v Luki Koper smo zgradili rezervoarski prostor kapacitete 31 000 m^3. Zasnova rezervoarjev in vseh spremljajočih tehnoloških sistemov ter nadzorno-krmilnih enot je prilagojena pretovarjanju in skladiščenju metanola, etanola, avionskega goriva Jet A1 in dieselskega goriva. Rezervoarji in lovilni bazeni rezervoarjev so izdelani iz materiala S235J2+N in so postavljeni na temeljno betonsko ploščo, ki je podprta z jeklenimi piloti iz materiala S 275 J2, premera 813 mm in zabitih do globine 34m. Rezervoarji so pokriti z aluminijastimi kupolastimi strehami iz materiala EN AW 3003-H-16. Konstrukcija aluminijaste kupolaste je v kombinaciji z drsnimi podporami in notranjim napetostnim obročem pritrjena na plašč rezervoarja. Zasnovana je kot 3-dimenzionalna palična kupola in izdelana iz materiala EN AW 6061-T6.

Izhlapevanje skladiščenega medija je omejeno z notranjo visečo membrano pontonskega tipa, ki je obešena na streho rezervoarja.

Sistem protikorozijske zaščite zunanjosti rezervoarjev je izveden v kombinaciji sistemov: epoksi-poliamidnim in poliuretanskim-akrilnim premaznim sistemom. Dodatno so še vsi nadzemni in podzemni kovinski elementi protikorozijsko zaščiteni s sistemom katodne zaščite za zaščito kompleksnih kovinskih struktur.

Ključne besede: rezervoar, aluminijasta streha, naftni derivati, gradnja, katodna zaščita. protikorozijska zaščita

KM-GP

GENETIC PROGRAMMING AND SOFT ANNEALING PRODUCTIVITY

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The optimal thermo-mechanical processing in steel industry is difficult because of the multi-constituent and multiphase character of the commercial steels, variety of the possible processing paths, and plant specific equipment characteristics. This paper shows successful implementation of the genetic programming approach for increasing the furnace conveyor speed and consequently productivity of the heat treatment furnace in the soft annealing process. The data (222 samples covering 24 different steel grades) on a furnace conveyor speed, chemical composition of steel (weight percent of C, Cr, Mo, Ni and V) and Brinell hardness before and after the soft annealing were collected during daily production. On the basis of the monitored data a mathematical model for the hardness after the soft annealing was developed by genetic programming. According to the modeled influences on the hardness, the higher furnace conveyor speed was attempted in practice. The experimental results of the hardness after the soft annealing with the increased conveyor speed and the predictions of the mathematical model were compared within the agreement of 3.24 %. The genetic model was also compared and verified with linear regression model. The productivity of the soft annealing process increased (from the furnace conveyor speed 3.2 m/h to 7 m/h) as a consequence of the used computational intelligence approach.
Keywords: Steel, soft annealing, furnace productivity, hardness, genetic programming, modeling

KM-GP

FRAKTALNA STRUKTURA ROBOTSKO LASERSKO KALJENEGA MATERIEALA

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This paper deals with a fractal structure of the robot laser hardening material. It describes the results of previous work and research experience in robotic laser quenching of metal. The second part deals with fractal structure of the robot laser hardening material.
Key words: hardening, robot, laser, fractal

Prispevek obravnava fraktalno struktura robotskega laserskega kaljenja materiala. Opisuje rezultate dosedanjega dela, raziskav in pridobljenih izkušenj na robotskem laserskem kaljenju kovin. Drugi del pa obravnava fraktalno strukturo robotskega laserskega kaljenja materiala.
Ključne besede: kaljenje, robot, laser, fraktal

P-GP

IDENTIFICATION AND VALIDATION OF COMPOSITE MATERIAL PARAMETERS FOR LADÈVEZE DAMAGE MODEL

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This work deals with the identification and validation of a composite material model which is implemented in PAM-CRASH software – namely the Ladèveze damage model. The Ladèveze damage model is implemented in PAM-CRASH in a multi-layered thin shell element. This damage model is implemented only in the explicit code of PAM-CRASH. It includes the following modes of failure of a composite material: debonding, micro-cracking, delamination, and fiber rupture. The model includes inelastic material deformations which are caused by the matrix dominated load. The matrix has a plastic behaviour as will be shown on the results from experimental measurements. This is very important in cyclic loading. The plasticity of the reinforcement (in this case carbon fibers) can be neglected. This material model is used for crash simulation which will be performed later. In this study, unidirectional composite strips are analysed. The material parameters for the numerical material model are obtained from these results. By experimental measurements we have managed to tune the composite material model to include the damage and the plasticity of a tensile load (simple tension test on $[0]_8$ laminates, simple tension test with load/unload cycles on $[\pm 45]_{2S}$ laminates and simple tension test with load/unload cycles on $[+45]_8$ laminates). The future goal is to tune this material model for compressive load and also more complex structure, for example an impact on a composite plate (laminate plate). The damage model is suitable for fabric composites too. The verification of the model for fabric composite materials will be the next step.

P-GP

IMPROVEMENT OF DAMPING PROPERTIES OF CARBON FIBRE REINFORCED LAMINATED PLASTICS USING DAMPING LAYERS

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The increase of operation speeds of machine tools leads to demand for light designs of the machine tools parts with low moment of inertia, high stiffness and good damping characteristics. Such demands on material could be satisfied by a hybrid composite consisting of carbon fibre reinforced plastic and damping layers. The damping layers made from rubber or from ACM87 cork and rubber composite material were used in the investigated hybrid structure. Suitable hybrid structure in terms of damping and stiffness was investigated using experiments and numerical simulations, where the frequency response or the transient response were analysed. The analysed samples were cantilever beams. The optoNCDT laser measurement device or Brüel&Kjaer 4507 accelerometer were used for the measurement of the responses. The three-dimensional numerical simulations were performed in finite element system MSC.Marc. Significant increase in damping was observed for samples in which the damping layers were placed near the neutral axis, where the shear stress is at a maximum.

VT-GP

CHARACTERIZATION OF EXTREMELY WEAKLY IONIZED HYDROGEN PLASMA BY A DOUBLE LANGMUIR PROBE

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Basic parameters of hydrogen plasma created in a large discharge chamber were determined using a double Langmuir probe. Plasma was created in a Pyrex cylinder with the diameter of 25 cm and the height of 80 cm by an antenna connected to a RF generator operating at the frequency of 27.12 MHz and the power of about 200 W. The antenna was a copper coil of 4 turns. The discharge chamber was pumped with an oil diffusion pump with the nominal pumping speed of 600 L s^{-1} backed by a two stage rotary pump with the pumping speed of 16 m^3 h^{-1}. The ultimate pressure of about $2 \cdot 10^{-3}$ Pa was obtained in the vacuum system after pumping for few hours. A double Langmuir probe was galvanic separated from the mains and placed into the centre of the discharge chamber. The probe was made from 2 tungsten rods with a diameter of 1.2 mm and separated for 2 cm. The length of un-insulated part of the rods was 17.5 mm. Plasma parameters were measured at different pressures between 0.4 and 7.2 Pa. The electron temperature reached the maximum of about kT_e = 3.5 eV at the pressure of 1 Pa. The plasma density was slowly decreasing with increasing pressure and was of the order of 10^{15} m^{-3}, and the Debye length was rather constant at about $2 \cdot 10^{-4}$ m. The results were explained by characteristics of an electrode less RF discharge in the E mode.

NN-GP

NANOSCALE MODIFICATION OF HARD COATINGS WITH ION IMPLANTATAION

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The mechanical properties of new hard coatings based on a multilayer structure have been investigated at the nanometre scale. A multilayer structure consist of nitrided layer on steel substrate and hard coating deposited by Physical Vapor Deposition and Ion Beam Assisted Deposition. In the present investigation the subsequent ion implantation was provided with $N2^+$ ions.The microstructure of obtained nitrided layer showed differences with regard to the presence or absence of a white layer, its thickness and its ε/γ' phase ratio (XRD) and nitriding depth. This paper describes the use of the nanoindentation technique for determination of hardness and elastic modulus.The results are analyzed in terms of load-displacement curves, hardness, Young's modulus, unloading stiffness and elastic recovery. The analysis of the indents was performed by Atomic Force Microscope. The analyzed AE signal was obtained by a scratching test designed for adherence evaluation. Coating is often in tensile stress with greater microhardness. The stress determination follows the conventional $\sin^2\psi$ method, using a X-ray diffractometer. The evolution of the microstructure from porous and columnar grains to densel packed grains is accompanied by changes in mechanical and physical properties. A variety of analytic techniques were used for characterization, such as scratch test, calo test, SEM, AFM, XRD and EDAX. Therefore, by properly selecting the processing parameters, well-adherent TiN films with high hardness can be obtained on engineering steel substrates, and show a potential for engineering applications.The experimental results indicated that the mechanical hardness is elevated by penetration of nitrogen, whereas the Young's modulus is significantly elevated.

KM-GP

THE BEHAVIORS OF ACCELERATED CORROSION OF Zn, Al AND Zn/15Al COATINGS ON STEEL SURFACE

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Zn, Al and Zn/Al 85/15 coatings could be produced in optimum conditions by twin wire arc spraying technique. The coatings are used in a variety of industrial applications in order to corrosion protection. In this study it is investigated that the salt spray corrosion of Zn, Al and Zn/15Al coatings on steel surface. The surfaces of steel coupons are coated with Zn, Al and Zn/15Al using by twin wire arc spray deposition system. The corrosion test was performed in salt solution for over 2000 hours. The corrosion of samples is measured in terms of ratio of area of coatings. Salt spray test results showed that Al and Zn/15Al coatings have better corrosion resistance than Zn coatings.
Keywords: Salt spray, corrosion, coating, Zn, Al, Zn/15Al.

KM-GP

CONTACT WITH CHLORINATE WATER: ADEQUATE STEEL SELECTION

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In water supply systems and public swimming pools highly chlorinated water can appears with very aggressive corrosion. When choosing the appropriate type of steel extreme corrosive condition that can occur are often forgotten. Under these conditions, corrosion protection layers (zinc layer, polymer color) can be quickly removed, also stainless steel corrosion may occour. High risk for corrosion of galvanized steel pipes can be caused also by improper implementation of disinfection. With aggressive disinfectants layer of zink is quickly dissolved which lead to corrosion of steel pipe. Therefore, we must select the type of stainless steel, which provides a much higher corrosion resistance than afforded by a usually stainless steel. It is very important that already at the design stage selection of materials is determined and how desinfection will be implemented. In the selection of steel elements in contact with swimming pool water, in most cases extreme aggressive oscillations don't occur in normal operating condition because the content of chlorine and other elements that affect the corrosion is mostly more or less the same. However, even in these cases from time to time agresive shocks may be present at the time of cleaning treatment. Therefore, with selection of appropriate stainless steel corrosion risk can be prevented. When deciding of the materials selection we need to consider a complete technological proces and not just single segment. The contribution of paper is mainly focused on experiences regarding appropriate materials selection in the field of sanitary engineering.

KM-GP

A BREAKOUT OF A SLAB AS EFFECT OF THE THERMOPHYSICAL PROPERTIES CHANGE OF A CONCAST STEEL

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The solidification and cooling of a continuously cast slab and the simultaneous heating of the mold is a very complicated problem of three-dimensional (3D) transient heat and mass transfer. The solving of such a problem is impossible without numerical models of the temperature field of the concasting itself while it is being processed through the concasting machine. Experimental research and measurements have to take place simultaneously with numerical computation, not only to be confronted with the numerical model but also to make it more accurate throughout the process. An important area of the caster is the so-called secondary cooling zone, which is subdivided into thirteen sections, where the first section uses water jets from all sides of the concasting and the remaining twelve sections engage air-water cooling jets positioned only on the upper and lower sides of the concasting.
In the secondary-cooling zone, where the slab is beginning to straighten out the breakout of the steel can occur in points of increased local chemical and temperature heterogeneity of the steel, from increased tension as a result of the bending of the slab and also from a high local concentration of non-metal, slag inclusions. Especially dangerous are the changes in the chemical composition of the steel during the actual concasting. In the case of two melts one immediately after the other, this could lead to immediate interruption in the concasting and a breakout. The material, physical, chemical and technological parameters, which both melts differed in were determined. If the dimensionless analysis is applied for assessing and reducing the number of these parameters, then it is possible to express the level of risk of breakout as a function of five dimensionless criteria.

KM-GP

THE INFLUENCE OF CHEMICAL COMPOSITION OF STEELS ON THE NUMERICAL SIMULATION OF A CONTINUOUSLY CAST OF SLAB

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The chemical composition of steels has significant influence on the actual concasting process, and on the accuracy of its numerical simulation and optimization. The chemical composition of steel affects the thermophysical properties (heat conductivity, specific heat capacity and density in the solid and liquid states) often requires more time than the actual numerical calculation of the temperature fields of a continuously cast steel slab. Therefore, an analysis study of these thermophysical properties was conducted. The order of importance within the actual process and the accuracy of simulation were also determined. The order of significance of the chemical composition on thermophysical properties was determined with respect to the metallurgical length. The analysis was performed by means of a so-called calculation experiment, i.e. by means of the original numerical continuously cast model developed by the authors of this paper. It is convenient to conduct such an analysis in order to facilitate the simulation of each individual case of continuously cast, thus enhancing the process of optimization.

AM-GP

ORDERING OF PARTICLES IN A WEAKLY FLOCCULATED PARAFFIN-WAX SUSPENSIONS USED FOR LPIM

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Low-pressure injection moulding (LPIM) is used for forming of near-net shaped ceramic green parts with complex geometries. Its success relies primarily on the rheological properties of the ceramic-powder paraffin-wax suspensions. These slurries are weakly flocculated because the used surfactants. These surfactants are short organic molecules composed of aliphatic chain ending with a polar group, which effectively reduce the van der Waals attraction but are insufficient to provide complete stabilization.

In the present study we focus on the shear-conditions dependant behaviour of the ceramic-powder paraffin-wax suspensions and its effect on the particles packing. In a weakly flocculated suspensions, the overall interaction potential in the suspension is attractive and continuous network is formed above a certain volume fraction of solids. To induce flow of suspension a certain shear stress is needed to overcome the interparticle forces – yield stress. We assume that by applying appropriate shear conditions, the flow can be induced in such a way that just sliding of particles over each other occur, due to the short range repulsive potential. This should result in locally more dense packing of particles compared to the nominal packing in the suspension. As a final result of such ordering, almost theoretical packing of particles in the suspension can be achieved.

In order to experimentally confirm these assumptions, highly loaded paraffin-wax suspensions of micron-sized SiO_2 spheres were prepared. The effect of shear conditions on the rheological properties and particle packing will be addressed.

AM-GP

INFLUENCE OF GRANULATION AND GRAIN SHAPE ON QUALITY OF FOUNDRY CORES

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Several quartz moulding sands were used for the preparation of foundry models. All moulding sands were similar with respect to their sieving parameters, yet still different according to some morphological characteristics. Foundry models were analysed regarding to their mechanical properties. It was shown that flexural strength of the prepared foundry models varied substantially despite of the fact that basic morphological characteristics obtained by sieving analysis of the moulding sands were very similar. The observed dissimilarities were explained with regard to some differences of micro-morphological characteristics of the sands. Quantitative morphological analysis of the sands was done on pictures taken by optical and electron microscopes using Zeiss KS 300 software. Crucial morphological parameters were defined by treating the moulding sands in laboratory scale rotated vessel type homogenization equipment and subsequent flexural strength measurements.

AM-GP

STRENGTH OF THERMALLY WICK-DEBINDED PARTS SHAPED BY LPIM

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Strength of thermally wick-debinded of Al_2O_3 ceramic parts, prepared by a low-pressure injection-molding (LPIM) has been investigated. Strength of samples depends on a paraffin wax binder content and on a chemical nature of the binder, which changes drastically if the wick-debinding takes place in air at temperatures higher than 190°C. Above this temperature paraffin wax undergoes a chemical transformation, which is the result of complex exothermal reactions – it is partially transformed into a volatile products and partially into a non-volatile, solid substance, which resides in the molded part and bonds powder particles firmly together. If the process is properly conducted partially debinded parts, with bending strengths up to 14 MPa, with less than 2 % of the binder content, can be obtained. Such parts can be handled without the danger of damaging them, which is crucial in the wick-debinding process, where debinded parts must be removed from the wick embedment, cleaned and then loaded in the sintering furnace. Strength of partially debinded parts increases with the time of the debinding process at temperatures higher than 190°C, whereas the binder content reaches certain value and then remains constant. The residual binder is finally removed in the sintering cycle, where a very rapid heating can be applide without the risk of introducing flaws, because parts contain only little amount of residual binder.

AM-GP

HIGH-PERFORMANCE POROUS Y-TZP CERAMICS FOR DENTAL APPLICATIONS

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Y-TZP ceramics are becoming increasingly popular in the field of biomaterials, especially in dentistry. They are used as fixed partial dentures, implants and implant abutments. When fully sintered, these materials exhibit excellent flexural strength and fracture toughness. One of the problems with dental zirconia is related to its high elastic modulus compared to that of dentine. However, the problem can be solved by introducing moderate porosity into the sintered body, although inevitably this reduces the flexural strength of the material. In order to increase the strength while maintaining a high porosity, several approaches are being pursued, including mixing the starting powders with different particle size distributions.

In our work the so-called core-shell concept was adopted for the preparation of the starting materials.[1,2] This concept exploits homo-aggregation, which results in a uniform distribution of nanosized particles attached to the surface of the submicron-sized particles in the slurry. After the slip casting, the green pellets were biscuit-sintered at various temperatures in the ambient air in order to obtain moderately porous zirconia samples.

The results revealed that in the temperature range from 1000 °C to 1400 °C the nanostructured ceramic exhibits a lower densification rate in comparison with the dry-pressed, sub-micron-sized Y-TZP powders and the phenomenon was explained with an in-situ-heating TEM study. Furthermore, the flexural strength of the biscuit-sintered, nanostructured material rapidly increases with the fractional density, starting from 80 MPa at 55 % of TD and reaching a plateau of 670 MPa at 70% of TD. The highest increase, from 200 MPa to 450 MPa, was observed for a minimal increase in densification from 58% TD to 60% TD.

This remarkable increase in strength is related to the larger area of the interparticle contacts. [3] The addition of the nanoparticles enhances the formation of the necks between the nanosized and/or the submicron-sized particles. At a TD of 70 % the flexural strength almost doubles with respect to the conventionally used, dry-pressed, submicron-sized Y-TZP powder. [4] An occurrence of a plateau at 70 % of the TD is explained by the SEM sintering model, which shows an extensive pore growth with increasing end temperature.

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KM-GP

LINEAR TWO SCALE MODEL FOR DETERMINATION OF MECHANICAL PROPERTIES OF TEXTILE COMPOSITE MATERIAL

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The engineering mechanical constants necessary for the description of the mechanical macro-scale models of textile composite materials are calculated using finite element analysis. Two sub-scale models of representative volumes are used. Micro-scale model represents periodically repeated volume consisting of fibers and matrix within each inerweaved bundle. Meso-scale model represents one unit cell of four interweaved bundles which is repeated within the whole composite with properties obtained from micro-scale model and matrix. The finite element models are built in commercial packages Siemens NX 7.5 and MSC.Marc 2008r1. Three typical epoxy matrix textile composites with carbon, aramid and glass fibers are investigated. The results from the multi-scale models are the homogenized Young's and shear moduli and Poisson's ratios.

KM-GP

CONDITIONS FOR FORMATION OF BORON OXIDE AND NITRIDE IN BORON ALLOYED STEELS

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The paper presents a thermo-dynamic analysis of probability of formation of boron oxide and nitride in steels alloyed by boron and nitrogen. It strives to determine at what temperatures in the course of cooling and solidification of steel oxide B_2O_3, or nitride BN are formed. Thermo-dynamic criterion of nucleation of new phase (B_2O_3 or BN) is higher value of product of real concentrations of boron and oxygen, or of boron and nitrogen than the value that would correspond to the equilibrium for the given temperature. It followed from calculations that theoretical temperature of start of nucleation of the oxide B_2O_3 is higher temperature of star of nucleation of the nitride BN. It means therefore that in the course of solidification and cooling of steel boron oxide will be formed before formation of boron nitride.

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KM-

NON-METALLIC INCLUSIONS IN STAINLESS STEELS ALLOYED WITH TITANIUM

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The most important characteristic of austenitic stainless steel is its good corrosion resistance. To prevent the formation of intergranular corrosion at elevated temperatures, certain types of steels are alloyed with titanium. The alloyed titanium in the steel binds carbon and nitrogen in the carbonitride. They do not dissolve at elevated temperatures and reduce the strain ability to both hot and cold rolling. Therefore, the objective before alloying the steel with titanium is to achieve a total nitrogen and carbon in the steel melt below 300 μg/g. Stabilization of the structure with titanium at low contents of nitrogen and carbon prevents the occurrence of intergranular corrosion and maintains a good strain capacity. This paper shows the analyzed non-metallic inclusions, resulting in the production of the austenitic stainless steels AISI316 Ti and AISI321.

NEKOVINSKI VKLJUČKI V Cr-Ni-JEKLIH, LEGIRANIH S TITANOM

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Najpomembnejša lastnost Cr-Ni-zlitin oz. avstenitnih nerjavnih jekel je dobra korozijska obstojnost. Da bi preprečili nastanek interkristalne korozije pri povišanih temperaturah, so nekatere vrste teh jekel legirane s titanom. Legiran titan pa v jeklu veže ogljik in dušik v karbonitride. Ti se tudi pri povišanih temperaturah ne raztopijo in zmanjšujejo deformacijsko sposobnost tako med vročim kot tudi hladnim valjanjem. Zato je cilj pred legiranjem jekla s titanom doseči skupno vsebnost dušika in ogljika v talini jekla manj kot 300 μg/g. Stabilizacija strukture s titanom pri nizkih vsebnostih dušika in ogljika zagotavlja preprečitev nastanka interkristalne korozije ter dobro deformacijsko sposobnost. V prispevku so prikazani analizirani nekovinski vključki, nastali pri izdelavi avstenitnih nerjavnih jekel AISI 316Ti in AISI 321.

KM-

DEFORMATION ABILITIES OF THE DUPLEX STAINLESS STEEL LDX2101

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In this work the deformation abilities of the duplex stainless steel LDX2101 were determined at high temperatures by hot rolling in the temperature range between 950 °C and 1250 °C. The rolling was performed on flat and wedged specimens. The deformation degree on flat specimens was 3 x 18 % (ε_s = 44 %) and for the wedged specimens up to ε_s = 65 %. In the research, metallographic investigations of the steel were performed; the volume of the ferrite/austenite in the steel in dependence of the rolling temperature and the deformation degree, the impact toughness and the hardness of the steel after rolling and heat treatment and the influence of the s-phase on the deformation abilities of the steel. From the results, the optimal rolling temperatures were determined and a comparison with other stainless steels was performed.

PREOBLIKOVALNE SPOSOBNOSTI DUPLEKSNEGA NERJAVNEGA JEKLA LDX2101

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V raziskavi smo ugotovljali preoblikovalne sposobnosti dupleksnega nerjavnega jekla LDX2101 v vročem stanju. Ugotavljali smo jih z vročim valjanjem jekla v temperaturnem območju med 950 °C in 1250 °C pri valjanju ploščatih in klinastih preizkušancev in metalografskimi preiskavami valjanega jekla. Stopnje deformacije pri ploščatem valjanju jekla so bile 3 × 18 % (s skupno deformacijo ε_s = 44 %), pri klinastih preskušancih pa do ε_s = 65 %. V raziskavi smo ugotavljali tudi spreminjanje deleža ferit/avstenit v mikrostrukturi jekla v odvisnosti od temperature valjanja in stopnje deformacije, žilavost in trdoto jekla po valjanju in topilnem žarjenju ter vpliv izločanja σ-faze na preoblikovalnost jekla .
Iz rezultatov preiskav smo določili optimalne temperature vročega valjanja jekla in naredili primerjavo preoblikovalnih sposobnosti jekla z drugimi nerjavnimi jekli.

KM-

STAINLESS STEEL IMPELLER BLADE FAILURE ANALYSIS

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Several, large-diameter type 316L stainless-steel impeller blades in a circulating water pump failed after approximately 13 months of operation. The impeller was a single casting that had been modified with a fillet-weld build-up at the blade root. A visual examination indicated that the fracture originated near to the blade-to-hub attachment in the area near the weld build up. Specimens from two failed blades were cut out and subjected to an analysis. In this presentation the examination procedures and results of the specimen analysis are presented.

ANALIZA POŠKODBE LOPATICE ROTORJA IZ NERJAVNEGA JEKLA

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Na lopaticah rotorja črpalke, ki je bil izdelan iz nerjavnega jekla 316L, so se po približno 13 mesecih obratovanje pojavile razpoke. Rotor črpalke s pestom in lopaticami je bil ulit v enem kosu.
Pred poškodbo je bila izvedena modifikacija z nanosom več varkov na koren lopatice. Z vizualno preiskavo je bilo odkrito začetno mesto rasti razpoke v bližini nanosa varkov zraven pesta rotorja. V prispevku bodo predstavljeni postopki preiskave lopatic in rezultati opravljenih preiskav.

KM-

INTRODUCTION OF THE REACTOR-VESSEL HEAD-REPLACEMENT PROJECT

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The reactor-vessel upper heads in pressurized water reactor (PWR) plants have a variety of penetrations that are used for assorted purposes, including the control rod drive mechanism (CRDM), the instrument nozzles, the head vent nozzles and the thermocouple nozzles. Typical CRDM nozzles are installed into a hole in the vessel head and then welded to the inside surface of the head with a partial penetration Alloy 182 J-groove weld. As a result of years of operation at high temperatures and stress levels, CRDM nozzles in several plants have experienced primary water stress corrosion cracking (PWSCC) of the Alloy 600 nozzle base material and the associated Alloy 182 weld material. Although the reactor vessel head at the Krško nuclear power plant did not experience any primary water stress corrosion cracking, a decision has been made to replace the existing reactor vessel head to reduce the cost of the J-groove weld inspections. The scope of the project is the removal of the existing reactor vessel head (RVH) and the manufacturing and installation of a new RVH with improved design features.
Key words: project, replacement, reactor vessel head, nuclear power plant

PREDSTAVITEV PROJEKTA ZAMENJAVE REAKTORSKE GLAVE

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Reaktorske glave v tlačnovodnih jedrskih elektrarnah imajo več vrst priključkov, kot so priključki kontrolnih palic reaktorja, priključki za merilnike, odzračevanje in merjenje temperature s termočleni. Priključek je izdelan tako, da se v izvrtino na reaktorski glavi vstavi cev. Vstavljeno cev se potem z notranje strani zavari s tako imenovanim J-zvarom. Dodajni material pri varjenju je zlitina z oznako A182. Priključki raktorske glave in J-zvari so med dolgoletnim obratovanjem izpostavljeni visokim temperaturam, obremenitvam in hladilu, potrebnem za hlajenje sredice reaktorja. Zaradi tega so na priključkih nekaterih elektrarn nastale razpoke kot posledica napetostne korozije J-zvarov in osnovnega materiala. Na reaktorski glavi Nuklearne elektrarne Krško ni bilo odkritega napetostnega korozijskega pokanja, vendar je bila zaradi zmanjšanja stroškov pregleda J-zvarov sprejeta odločitev o zamenjavi reaktorske glave. Projekt zamenjave je obsegal odstranitev sedanje reaktorske glave ter izdelavo in montažo nove glave z izboljšanimi konstrukcijskimi rešitvami.
Ključne besede: projekt, zamenjava, reaktorska glava, jedrska elektrarna

KM-

CHARACTERIZATION OF A AlSi7 CLOSED-CELL ALUMINIUM FOAM

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Advanced metallic materials with a large porosity (up to 90 %) and many appealing combinations of physico-mechanical properties, such as a high stiffness in conjunction with a very low specific weight, a high impact energy absorption, flame and heat resistance, sound absorption, low electrical conductivity and low thermal conductivity are metal foams. Aluminium and aluminium-alloy-based metal foams are usually used for aerospace and aeronautics industry, armoured vehicles, the car industry and related areas.

In the presented study the aluminium alloy AlSi7 was used as a closed-cell foam. The aluminium foams with a closed-cell structure are produced with a foaming agent (in our case TiH_2), which is a gas-releasing substance. The closed-cell structure has high impact energy absorption, which is a very important mechanical property for the army and the car industry. An investigations of the aluminium foams' alloy AlSi7 showed us interesting results of the pore size distribution and a decrease of the material density and the spatial distribution of the chemical elements. Scanning electron microscopy with energy-dispersion spectroscopy (SEM/EDS) and surface-sensitive Auger electron spectroscopy (AES) were used for the characterization for a detailed surface analysis.

Key words: AlSi7 alloy, close cell aluminium foam, AES, SEM/EDSS

KM-

COMPARISON OF THE TRANSFORMATION OF BULK AND SURFACE CARBIDES DURING THE VACUUM ANNEALING OF NON-EQUILIBRIUM SOLIDIFYING M42 HIGH-SPEED STEEL

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Our motivation was to research the cast microstructure of the super-high-speed steel AISI M42 and follow the changes in the eutectic carbides during the annealing at the temperature of plastic deformation at 1100 °C for different times. In conventional high-speed steels the eutectics M_2C or M_6C form, depending on the chemical composition and the solidification conditions. During plastic forming the eutectic carbides transform to a stable form. The transformations of large M_2C carbides and the neighbouring microstructure were monitored after annealing at a certain temperature for different times. Due to the rather large eutectic carbides the same area of interest was monitored and ex-situ annealed. The carbides' transformation in the bulk was compared to the transformation that occurred on the surface. The results show that the carbides' transformation in the bulk is drastically different to that on the surface. Therefore, it is difficult to study the transformation of the in-situ carbides. It was found that some carbides start growing at the lower temperature and their growth is faster than at other locations in the bulk material.

In the bulk it was observed that large monocrystalline M_2C carbides transform into a larger number of small grains of M_6C carbides with different crystal orientations. This phenomenon has a beneficial effect during forging. So, going through the carbide transformation the final microstructure has smaller M_6C carbides, like if the starting material already has stable M_6C carbides.

KM-

CORRELATION BETWEEN CREEP RATE AND YIELD STRESS AS A FUNCTION PARTICLE-TO-PARTICLE SPACING FOR X20CrMoV121 AND P91 STEELS

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Correlation between creep rate and yield stress as a function of particle-to-particle spacing on mechanical properties of two ferritic-martensitic creep-resistant steels, X20CrMoV121 and P91, annealed for 17520 h at 650°C and 8760 h at 750°C was evaluated. On samples annealed for different time periods, room temperature yield stress together with other mechanical properties was determined. From the same samples, metallographic specimens were cut and SEM imaging at the appropriate magnification was performed, so that an observation of microstructural changes, mainly the particle-to-particle spacing due to annealing was performed.

It was found that the initial particle-to-particle spacing for the steel P91 is slightly larger compared to the steel X20CrMoV121. Due to annealing, creep rate $\dot{\varepsilon}$ and particle-to-particle spacing increases as yield stress σ_y decreases; therefore a good correlation between these three properties of steels exists and can be really useful in process of determining the lifetime issues of thermal power plant components.

Key words: particle-to-particle spacing, yield stress, creep rate, X20CrMoV121 and P91 steels.

KM-

MICROSTRUCTURE AND MECHANICAL PROPERTIES OF FRICTION STIR WELDED AlMg4.5Mn ALLOY

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A comprehensive research of Friction Stir Welding of 4 mm thick aluminium alloy (AlMg4.5Mn) for forming was done. A vast variety of process parameters was tested according to the plan of experiments at constant 2° tilt angle. Specialy designed tensile test specimens were cut in the direction of welding and perpendicular to welding. The microstructure was prepared for observation on a light microscope under the polarised light source. A Vickers micro-hardens was measured. The results show the influence of FSW process parameters on the formation of microstructure and mechanical properties.

KM-

DOLOČANJA POVPREČNE VELIKOSTI KRISTALNIH ZRN V KOVINSKIH MATERIALIH

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Kovinski materiali pri strjevanju navadno tvorijo polikristalno strukturo, kjer so poleg drugih napak tudi dvodimenzionalne kristalne napake, t. i. kristalne meje. Lastnosti kovinskih materialov so v splošnem odvisne od značilnosti mikrostrukture, in ena od teh lastnosti je tudi velikost kristalnih zrn. Načeloma velja pravilo, da manjša kristalna zrna pomenijo boljše mehanske lastnosti materiala. Obstajajo razni standardi (ISO 643, ASTM E 112, DIN 50601 idr.), ki natančno opredeljujejo meritev velikosti zrn. V splošnem poznamo tri metode določanja velikosti kristalnih zrn, in sicer: primerjalno metodo, planimetrično in presečno. Velikost zrn po planimetrični metodi podajamo v obliki števila zrn na kvadratni milimeter, po presečni v obliki presečne dolžine v milimetrih in po primerjalni v obliki vrednosti G. Ravno tako za planimetrično in presečno podajamo vrednost G. Prikazani so načini odkrivanja predhodnih avstenitnih zrn in tudi način določanja velikosti zrn v večfaznih sistemih in pri deformiranih zrnih.

Ključne besede: kristalna zrna, ISO 643, ASTM E 112

KM-

XPS DEPTH PROFILING OF ELECTROCHEMICALLY PREPARED THIN OXIDE LAYERS ON DUPLEX STAINLESS STEEL

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The surface oxidation of the duplex stainless steel 2205 (DSS 2205) was studied by X-ray Photoelectron Spectroscopy (XPS). The experiments were performed on the alloy after controlled oxidation in a chloride solution at a controlled potential. The evolution of the passive layers formed on the DSS 2205 in a chloride solution was studied using cyclic voltammetry. XPS depth profiles of the passive layers formed at selected potentials were measured and compared. All the passive layers were found to be of nanometre thickness, with the composition varying by depth, composed predominantly of Fe/Cr oxides, with chromium enrichment and molybdenum enrichment or depletion. Details, such as the location of the maximum of the chromium enrichment area inside the passive layer were found to depend on the parameters of the electrochemical oxidation.
Key words: XPS, duplex stainless steel, potentiostatic oxidation, passive layer

KM-

OPTICAL PROPERTIES OF PLASTICALLY DEFORMED COPPER

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Pure copper (99.99), prepared in a sample of square cross-section (10×10 mm^2) and length about 50 mm, was extremely plastically deformed with the repeated application of Equal Channel Angular Pressing (ECAP). ECAP was applied as an effective technique for producing bulk nano-scaled structures. The optical properties of the sample were investigated using AFM, Raman spectroscopy and spectroscopic ellipsometry in the UV-VIS range. The parameters of the sample, such as copper oxide and the surface roughness overlayer, were calculated using a two-film model together with Bruggeman effective medium approximation. Two types of lines are registered in the Raman spectra: narrow (with a width of ~7 cm^{-1}) and wide (~40 cm^{-1}) The existence of two types of lines indicates that, in the specimen, nano-sized crystal structures of both Cu and CuO exist, related with three-dimensional amorphous boundary spaces, which indicates that the plastic deformation of the sample did not lead to total amorphisation of the specimen.

Key words: copper, Channel Angular Pressing, AFM microscopy, Raman spectroscopy

KM-

INFLUENCE OF MICRO-ALLOYING ELEMENTS OF HSLA STEEL ON MICROSTRUCTURE AND MECHANICAL PROPERTIES

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Micro-alloyed high-strength low-alloy (HSLA) steels are technologically important structural materials. These steels contain small amounts of alloying elements, such as titanium, niobium, vanadium or zirconium, which enhance the strength through the formation of stable carbides, nitrides or carbonitrides.

In this work hot-forged HSLA steels based on the chemical composition 34CrNiMo6 were investigated in order to determine the type of precipitates forming and their effect on the mechanical properties. Individual steels were micro-alloyed with one of the following elements or combination of elements: niobium, titanium or zirconium and vanadium.

The compositional changes in the microstructure and the various kinds of precipitates observed in microalloyed steels have been examined using energy-dispersive spectroscopy (EDS) and electron back-scattered diffraction (EBSD) analysis techniques.

Optical and scanning electron microscopy studies revealed that the addition of micro-alloying elements did not considerably change the main microstructural features due to the fact that all the microstructures consisted of tempered martensite and finely dispersed carbide precipitates along martensite laths. In all the microstructures relatively large precipitates of micro-alloyed elements were observed. This could be a possible reason as to why no significant improvement in the mechanical properties was observed.

KM-

THE CRYSTALLIZATION OF CONCAST BILLETS IN ELECTROMAGNETIC FIELD

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Electromagnetic stirring (EMS) applied on the steel caster (concasting machine) is basically a magneto-hydraulic process together with crystallisation processes and solidification of billet steel. The temperature of the billet gradually decreases as it passes through the caster down to a temperature lying far below the solidus temperature. From the viewpoint of physics and chemistry, the course of the process is co-determined by a number of relevant material, physical and thermokinetic characteristics of the concast steel and also electrical and magnetic quantities. EMS suppresses the growth of columnar crystals of billets and reduces the tendency to cracking during casting and at low temperatures. A caster was used for the testing of two induction stirrers – one on the actual mould and the other beneath the mould – to determine the effect of EMS on the formation of the structure of non-alloy steel. As part of these tests, certain parts of the billets had been cast without the use of stirrers and other parts underwent alternate switching on and off of the stirrers for as many as nine combinations of modes. Samples were taken from the sections of these billets, fine-ground and etched in order to make the dendritic structure visible. The mode with the highest efficiency was when both stirrers ran simultaneously. The growth of the columnar crystals, which pointed inward, was limited to ¼-to-? of the length of the case when there was no stirring. Experimental research was also confronted with results acquired from the application of the models of the temperature field and chemical heterogeneity and the physical-similarity theory. Statistical monitoring of the quality of concast billets has proven that stirring significantly reduces the occurrence of defects – in this case cracks.

KM-

EDS ANALYSES OF THE SPOTS ON AN ALUMINIUM ALLOY CASTING

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We received a clutch cover made of the Al alloy AlSi9Cu3 (Fe) for review and analysis. The cover had some areas subjected to grinding. On both areas some gray stains were present. According to the manufacturer's information, after machining the castings are first cleaned in a washing machine, then the castings go to the control of leaks, and after that the castings are inspected again and packed in plastic boxes. The boxes are then loaded onto pallets and transported to a warehouse. The spots appeared during the storage period, because otherwise they would have been seen during the final inspection before packaging. The EDS analyses were performed on the spot and away of the spot. The results of the analyses of the surfaces at different locations showed that in addition to the elements that are present in the alloy, impurities such as Na, K and Cl were also observed. These are typical elements that come from the fluids used for lubrication during machining. On the rough, unmachined surfaces, outside the spots the analysis revealed the presence P. This means that the process of washing and drying the castings was not carried out optimally. The moisture expanded from the porous sites during the storage time, caused the corrosion processes and the formation of spots. As the elimination of the porosity in the castings is a complex and long-term measure, we propose first to optimize the processes (time, temperature, intensity) of washing, rinsing and drying to reduce the concentration of residuals and the moisture. If moisture is not present, then the corrosion processes are also eliminated.

EDS-ANALIZA MADEŽEV NA ULITKU IZ ALUMINIJEVE ZLITINE

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V pregled in analizo smo dobili pokrov sklopke iz Al-zlitine AlSi9Cu3(Fe). Pokrov je imel s struženjem obdelane in neobdelane površine, na obeh površinah so bili sivi madeži. Po navedbi proizvajalca se ulitke po strojni obdelavi očisti v pralnem stroju, potem jih pošljejo na kontrolo tesnosti, nato se jih še enkrat pregledajo in zapakirajo v plastične zaboje, ki jih nato naložijo na palete in odpeljejo v skladišče. Madeži so nastali med skladiščenjem, sicer bi jih že opazili pri končni kontroli pred pakiranjem. Izvršene so bile EDS-analize na značilnih mestih. Prikazani so rezultati analize površine na različnih mestih. Preiskave so pokazale, da se v spektrih energij poleg elementov, ki so v litini, pojavijo še nečistoče, kot so Na, K in Cl. To so značilni elementi, ki izvirajo iz sredstva za mazanje pri strojni obdelavi. Na neobdelani površini pa je analiza odkrila zunaj madežev tudi P. To pomeni, da postopek pranja in sušenja ni bil izveden optimalno. Vlaga, ki se je med skladiščenjem širila iz poroznih mest v ulitku, je sprožila korozijske procese in nastanek madežev. Ker je rešitev poroznosti z livarskimi ukrepi kompleksna in dolgotrajna, smo predlagali, da se najprej skuša optimizirati (čas, temperatura, intenziteta) postopke pranja, splakovanja in sušenja, da se zmanjša koncentracija ostankov in da se vlaga odstrani s primernim sušenjem tudi iz drobnih por. Če ni vlage, potem tudi ni težav s korozijskimi procesi.

KM-

FORMATION OF Fe-ALUMINIDE ON A STEEL SUBSTRATE

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Spark alloying enables the transfer of metallic material from an electrode to a substrate. However, due to the pulsed spark the heat transfer to the substrate is limited. Despite the fact that the diffusion bonding of the material from the electrode with the material of the substrate is possible, it is assisted by the exothermic reaction between the components that form the aluminide. We present the results of light microscopy and an EDS analysis of the in-situ formed non-stoichiometric Fe-aluminides. The benefit of the aluminide on the surface of the metallic substrate is the formation of the Al_2O_3 protective layer that increases the resistance to oxidation and in the case of the Fe-aluminide also the resistance to sulphidation. These are important properties for applications in the field of thermal power plants.

TVORBA Fe-ALUMINIDA NA POVRŠINI JEKLA

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Legiranje v obloku omogoča prenos kovinskega materiala iz elektrode na podlago. Zaradi pulzirajočega obloka je prenos toplote na podlago omejen. Kljub temu lahko nastane difuzijska vezava med materialom iz elektrode in tistim iz podlage, k temu pa še prispeva eksotermna reakcija med materialoma, ki tvorita aluminid. Predstavljeni so rezultati svetlobne mikroskopije in EDS-analize "in situ" nastalega nestehiometričnega Fe-aluminida. Koristnost aluminida na površini podlage iz konstrukcijskega jekla je možnost nastanka Al2O3 varovalne plasti, ki poveča odpornost površine proti oksidaciji in v primeru Fe-aluminida tudi poveča odpornost proti sulfidaciji. To je pomembna lastnost za uporabo tako zaščitenega jekla v termoelektrarnah.

AM-

PREPARATION OF CERAMIC $AgNb_{1-X}Ta_XO_3$ TARGETS FOR PULSED LASER DEPOSITION

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$AgNb_{1-x}Ta_xO_3$ ceramics with perovskite crystal structure are used in electronic applications. The high permittivity constant ($\varepsilon_r > 400$) and the low dielectric losses ($\tan \delta = 2 \cdot 10^{-4}$) enable use in the radio-frequency as well as in the microwave frequency range. With a miniaturization of electronic components and use of materials in a thin film form, there is a demand for preparation of a suitable precursor, like targets for thin film production using pulsed laser deposition (PLD). For this purpose, preparation of disk-shaped ceramic compacts, with the desired composition, homogeneous and single phase as well as crack-free structure is crucial. The electrical properties of the system are tailored by changing the ratio between niobium and tantalum.

Ceramics with the desired composition ($x = 0.35$, 0.5 and 0.65) were synthesized using solid-state reaction method from starting oxide powders: Nb_2O_5, Ta_2O_5 and Ag_2O. To eliminate silver oxide reduction, Nb_2O_5–Ta_2O_5 solid solutions were prepared and only then silver oxide was added, while the reaction was performed under an oxygen atmosphere. The synthesis was monitored using X-ray powder diffraction and a scanning electron microscope.

AM-

COMBUSTIBLE PRECURSOR BEHAVIOR IN THE LANTHANUM CHROMITE FORMATION PROCESS

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Combustion-derived lanthanum chromite (LC) powders were prepared by combustion synthesis from the citrate-nitrate precursor gels. Transformation process of reactive citrate-nitrate gel to cubic perovskite modification of (LC) was investigated. The influence of the fuel/oxidant molar ratio in the precursor gel on the combustion propagation and thermal characteristics of the combustion system was studied by simultaneous thermal analysis (TG, DTG and DTA) evolved gas analysis (MS) and gas chromatography (GC). The main (MS) responses detected were attributed to H_2, H_2O and CO_2 generation. It was found that the citrate-nitrate reaction proceeds through several separate consecutive steps and the precursor thermal decomposition characteristics depended strongly on the citrate/nitrate ratio prior to the combustion. First two steps of the thermal decomposition at approximately 150 °C and 250 °C are strongly related to the citrate-nitrate reaction, while at around 400 °C citric acid residuals combustion occurs. Last step of the thermal decomposition is caused by transformation of $LaCrO_4$ to $LaCrO_3$. Intermediate precursors and final powder ashes were analyzed also by X-ray diffraction.
Keywords: Combustion synthesis; lanthanum chromite; citrate- nitrate, thermal characteristics

TERMIČNE LASTNOSTI REAKCIJSKEGA GELA ZA PRIPRAVO LANTANOVEGA KROMITA

Prahove lantanovega kromita (LC) smo pripravili s samovzdrževalno reakcijo iz citratno nitratnih gelov. Proučevali smo pretvorbo reakativnega citratno-nitratnega gela v perovskitno modifikacijo lantanovega kromita. Vpliv razmerja gorivo/oksidatnt v izhodnem prekurzorju na hitrost gorenja in termične karakteristike smo zasledovali s simultano termično analizo (TG, DTG in DTA), EGA analizo ter plinsko kromatografijo (GC). Pomembnejše odzive na masnem spektrometru smo pripisali nastanku H_2, H_2O in CO_2. Termični razpad gela je močno odvisen od citratno-nitratenega razmerja v gelu pred sežigom, pri njegovem gorenju pa potekajo reakcije v več zaporednih med seboj ločenih stopnjah. Prvi dve stopnji termičnega razpada pri okoli 150 °C in 250 °C sta povezani z reakcijo med citronsko kislino in nitratom. Stopnja nad 400 °C kaže na razkroj ostanka citronske kisline, zadnja stopnja termičnega razpada pa je povezana s pretvorbo $LaCrO_4$ v $LaCrO_3$. Vmesne in končne produkte gorenja smo karakterizirali z rentgensko praškovno analizo.
Ključne besede: Zgorevalna sinteza, lantanov kromit, citrat-nitrat, termične lastnosti

P-

DETERMINATION OF LINEAR THERMAL EXPANSION COEFFICIENT OF ELASTOMERS BY DMA

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Solid state matter almost invariably expands with increasing temperature, a one-dimensional measure of that being the linear thermal expansion coefficient. Such comportment, however, of macromolecular systems with long, linear and flexible molecules, appearing as random coils in amorphous state, is of peculiar kind. These systems, namely, the typical among them being elastomers, are characterized by low temperature glass transition and, not rarely, by transition from amorphous to crystalline state. With respect to thermal expansion, elastomers in glassy state behave as other solid materials: they enlarge with augmenting temperature. Upon transition from glassy to amorphous state (at glass transition temperature), however, owing to random coil-shaped morphology, elastomeric bodies of constant length exhibit increase in elastic force with temperature rise, which is equivalent to contraction at constant force with a negative linear thermal expansion coefficient. This phenomenon is of entropic nature and can effectively be exploited for measuring expansion coefficients of elastomers (and other cognate polymers) as a function of temperature by a distinctive method of dynamic mechanical analysis (DMA). The coefficient temperature pattern depends on the elastomer type and additives, especially the active fillers, such as carbon black or silica, and represents a material property vitally important for elastomer processing and subsequent rubber products.
The work presents the essentials relating elastomer morphology with thermal expansion, the DMA measurement method and the results obtained on common elastomers and their compounds with active fillers.

P-

MODIFICATION OF MONTMORILLONITE USING IONIC POLYMERS

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The most common method of mineral montmorillonite (MMT) modification is a cation exchange with organic ammonium salts, which differ in a number, length and structure of long chains. The role of the modification of MMT is to increase the interlayer spacing, to reduce interactions between the MMT platelets, and improve the interaction between the clay and the polymer matrix.
Polycations have also been used as clay modifiers. Polycation-modified clays have been used for pollutants removal from waste and drinking water and as catalysts. To our knowledge polycation-modified clay minerals have not been used as fillers for preparation of commercial synthetic polymer/MMT nanocomposites. This is most probably due to hydrophilicity of the polycations, which makes intercalation or exfoliation of hydrophobic polymers unlikely.
In this work we present a modification of MMT with ionic polymers. Polyesters based on N-alkyl diethanolamine were synthesized and transformed to ionic polyesters by protonization using HCl or by quaternization with benzylchloride. Depending on a N-alkyl chain length, (8, 12 and 16 carbon atoms) some polyesters were amorphous liquids at room temperature, some formed liquid crystalline phase or smectic crystals. Thermal properties were determined by DSC and crystal structure by X-Ray diffraction
MMT was modified in water or water/ethanol solution. The influence of various processing parameters such as cation ratio, degree of ionic groups in polyesters etc. on modification were determined. Basal spacing increases with increasing N-alkyl chain length, but modified MMT always contain extractable and not bonded polyester.

NN-

APPLICATION OF IONIC LIQUID-BASED REDOX ELECTROLYTE IN A HYBRID ELECTROCHROMIC DEVICE

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The micro-Raman spectroscopic technique was used to follow the evolution of Raman spectra in a semisolid redox electrolyte encapsulated in a hybrid electrochromic (EC) cell[1]. This cell was composed of sputtered WO_3 electrochromically active film, redox (I_3^-/I^-) electrolyte and catalytical layer of Pt on electronically conductive FTO glass[1,2]. The electrolyte was made of bis end-capped silylated ionic liquid 1,14-bis(3-(3-(trimethoxysilyl)propyl))imidazolium-1-il)-3,6,9 trioxaundecan diiodide, the trialkoxysilane groups of which are capable of condensation reactions that led to the formation of condensed ionic liquids with high redox conductivity (up to 10^{-2} S/cm) if alkyl-functionalised imidazolium-based ionic liquid is added. The semi-solid gel electrolyte was analysed with ^{29}Si NMR and IR measurements, and the interactions between the polyiodide-imidazolium cations were also assessed. The in-situ micro-Raman measurements revealed the reuction of triiodide and pentaiodide species to iodides during cathodic part of the cyclovoltammetric measurement, while the intensity of their band recovered in the anodic part of the scan. Stability of the hybrid devices was excellent, enabling up to 15000 colouring/bleaching cycles.

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7) under grant agreement n° 200431 (INNOSHADE).

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NN-

SEMI-SOLID GEL ELECTROLYTES FOR BATTERY-TYPE OF ELECTROCHROMIC DEVICES

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An organic-inorganic hybrid bis N-triethoxysilyl propylcarbamatoil PEO 400[1] (PEOCS) was synthesised in order to investigate its performance as a semi-solid electrolyte in electrochromic (EC) devices. The silylated precursor allows low-temperature processing through processes of hydrolysis (solvolysis) and condensation, leading to formation of branched polysilsesquioxane structure. The conductivity of the formed sol-gel network was about 10^{-8} S/cm, but markedly increased (up to 10^{-3} S/cm) after addition of various co-solvents (γ-butyrolactone, N-methyl-2-pyrrolidone) or alkyl-functionalised ionic liquid 3-methyl-1-(2,5,8,11,14,17,20,23,26,29,32-undecaoxapentatriacontan-35il)-1H imidazolium mesylate. The network was able to accommodate a large amount of co-solvents, in the case of mesylate ionic liquid the molar ratios used were PEOCS:IL = 1:5 and 1:10. ^{29}Si NMR and IR spectroscopic measurements were used to determine the structure of the prepared electrolytes. In addition, lithium bistrifluoromethanesulfonimide was admixed to enable the intercalation and deintercalation of Li^+ ions into the structure of electrochromically active WO_3 film in EC devices. As counter electrodes, NiO_x and NiO_x/polyaniline films were used and these EC devices were cycled up to 1000 cycles.

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7) under grant agreement N° 200431 (INNOSHADE).

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NN-

DAMAGE CAUSED BY NANOSECOND UV LASER ON HEATED Cu SURFACE

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The use of pulsed UV lasers in material processing thin-films, surface cleaning, surface etching etc. is of great interest.

Experimental investigations of two different damages caused by UV laser are described in this contribution.

The UV nitrogen laser (λ = 337.1 nm) emitting pulses of 6 ns duration with a maximal energy density of 1.1 J/cm^2 was used. The spectroscopically pure target surfaces were almost perpendicular to the beam axis. Thickness of the target was 0.3 mm. During irradiation, the target was in air at atmospheric pressure. Plasmas and damages on Cu surface were developed. Two different damages were observed: a) when the target was at room temperature and b) when the identical target was previously heated at the higher temperature (370 °C ±10 °C) and irradiated by laser beam later.

a) At room temperature the modified frozen surface, i.e. a crater when the irradiation was maximal, was observed by means of SEM (Vega). After a few tens laser irradiations a crater ring and a vortex formation of a self-organized a closed loop of a vortex filament was seen. The energy dispersive spectrum (EDS) showed 7.8 % oxygen and the rest was copper.
b) If the target was warm (~ 370 °C) before the laser irradiation, the crater was shallow and capillary-gravity waves appeared in the vicinity of the crater. An influence of oxygen was higher for 13%.

We conclude that the observed change on the Cu surfaces was caused by high Cu-thermal conduction (4.01W/cmK).

NN-

NICKEL OXIDE THIN FILMS FOR COUNTER ELECTRODES IN ELECTROCHROMIC DEVICES

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Nickel oxide is important functional material for various applications like rechargeable batteries, supercapacitors, chemical sensors, gas sensors, solar cells, oxygen evolution catalysis and electrochromic devices. For the latter, it is of special interest because of low cost, high coloration efficiency and large dynamic range[1]. In this work we present a new chemical approach based on soft chemistry, which enables low temperature preparation (220 °C) of nickel oxide thin films and also composite nickel oxide-PANI (polyaniline) thin films, showing high electrochromic effect in nonaqueous Li^+-based electrolytes. These films do not need any pre-treatment before the lamination of electrochromic (EC) devices, like for example, sputtered films. In-situ UV-visible spectroelectrochemical measurements of synthesised films showed sufficiently high charge capacities (> ±10 mC/cm^2) and colouring/bleaching changes ($\Delta T \sim 20–30$ %, gray to transparent) enabling the preparation of electrochromic devices consisting of anodic composite nickel oxide counter electrode, cathodic WO_3 electrochromic layer and semi-solid gel electrolyte.

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NN-

$CeVO_4$ AS COUNTER ELECTRODES FOR ELECTROCHROMIC DEVICES: IR SPECTROELECTROCHEMICAL CHARACTERISATION

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In this work $CeVO_4$ films[1] with a wakefieldite crystalline structure were prepared using a peroxo route and characterised for their structural, electrochemical and optical properties. The films revealed excellent optically passive response ($\Delta T < 5$ %) and the charge densities from –12 to –20 mC/cm^2, depending on preparation conditions. An important subject was the assessment of the intercalation/deintercalation processes in these films, which was done using IR absorbance (TO modes) and reflection-absorption (LO modes) spectroelectrochemical techniques[2]. Both techniques were used for *ex-situ* measurements, in which the film on either silicon wafers (absorbance) or electronically conductive FTO glass (reflection-absorption) was transformed from the electrochemical cell to a sample compartment of IR spectrometer. In contrast, *in-situ* reflection-absorption measurements were made in a specially constructed *in-situ* cell[2]. Absorbance IR measurements showed the appearance of two ν_3 TO modes, sharp E_u band at 768 cm^{-1} (LO counterpart at 912 cm^{-1}) and shoulder A_{2u} band at 840 cm^{-1}. The deformational mode ν_4 ($E_u + A_{2u}$) appeared as a weak band at 444 cm^{-1}. Electrochemical impedance spectroscopy was applied for the investigation of electrolyte|counter electrode film interface properties.

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NN-

THIN FILMS OF VANADIUM OXIDE PREPARED AT TEMPERATURES SUITABLE FOR DEPOSITION ON POLYMERIC SUBSTRATES

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V_2O_5 is a typical intercalation compound and is in the form of thin films a very interesting material for electrochemical devices like smart windows or lithium batteries. A lot of effort was devoted to investigations of crystalline orthorhombic V_2O_5 that can be prepared using sol-gel processes at temperatures above 300 °C[1]. In this work, we concentrated on the preparation of films at low temperatures, appropriate for deposition on electronically conductive polymeric substrates. It was found that such films exhibit excellent adhesion properties to polymeric substrates, and were also characterised by a remarkably smooth surface as shown by SEM analysis. In-situ UV-visible spectroelectrochemical measurements in 1 M $LiClO_4$/propylene carbonate electrolyte revealed two reduction and oxidation current waves in safe potential range (1.5V to –0.4V vs. Ag/AgCl), corresponding to transformation of V^{5+} to V^{4+} and the appearance of additional one in the so called unsafe potential range (1.5V to –1.5V) as a consequence of transformation to the lower oxidation state of 3+. The efficiency of V_2O_5 films was tested in liquid electrochromic cells with poly(3,4-ethylene-dioxythiophene) (PEDOT)[2] electrochromically active layers and the optical modulation also evaluated in CIE Lab colour space.

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VT-

NON-DECTRUCTIVE SUPERVISION OF VACUUM CARBURIZING PROCESS

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Vacuum carburizing is a modern, very efficient and environmentally friendly process for case hardening of steels. Nowadays the technology has replaced atmosphere carburizing in many cases due to better repeatability and uniformity of heat treated samples. The process is performed in a conditions which are far from thermodynamic equilibrium and consists of cycles of active (saturation) and passive (diffusion) stages. The active stage starts with dissolution of the carbon atoms from the atmosphere into the surface layer of the part and is terminated with the intense carbide formation in the saturated austenite. Lowering the partial pressure of carbon in the atmosphere activate the passive stage – diffusion of the excessive carbon atoms into deeper layers of the material. Desire case depth and corresponding target concentration profile of carbon can be supervised by controlling the duration of these two stages. At the same time, the microstructure in the carburized layer, which strongly determines the utility of the part, is a function of carbon profile, steel alloy additions, conditions of cooling while hardening and parameters of tempering.

The present paper deals with in-situ and non-destructive characterization of the vacuum carburizing process. For this purpose, the unique laboratory device was set up, that enables measuring the carbon diffusion during vacuum carburizing process by electrical resistance measurements. We determined the kinetics of the process and the microstructural changes during carburizing of plain carbon steel in a low-pressure acetylene atmosphere. Additional metallographic examinations could prove that this in-situ method is well suited to determine the thickness of the carburized zone.

VT-

ACTIVATION OF PET POLYMER BY EXPPOSURE TO CO_2 AND O_2 PLASMA

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PET is nowadays widely used in different applications from microelectronics to medicine due to its excellent chemical, optical and electrical properties. The surface properties however, are not adequate so they must be modified prior to particular applications. A modern method for surface modifications is treatment by low pressure plasma. Plasma is created in different gasses in order to functionalize the surface with specific functional groups. Hydrophilization is often obtained using plasma created in oxygen, carbon dioxide, water vapour and mixture of these gases with a nobel gas. In many cases CO_2 is superior since carboxyl groups are bound on the surface of a polymer after plasma treatment. In other cases however, plasma created in pure O_2 performs better.

A comparison of O_2 and CO_2 plasma treatment for functionalization of PET is presented. Plasma was created in a glass discharge chamber at the pressure of 75 Pa by electrodeless RF discharge. The RF generator operated at a frequency of 27.12 MHz and a power of about 200 W. The samples were cut to small pieces and exposed to plasma for different periods. Immediately after the treatment the samples were characterized by high resolution XPS. Comparison of both survey and HRES C1s peaks revealed that the amount of the specific functional groups formed on the surface during plasma treatment was the same for CO_2 and O_2 plasma. Within the limits of experimental error the concentration of hydroxyl groups was about 34% and carboxyl groups was about 29%. The results were explained by rapid dissociation of both molecules to neutral oxygen atoms that are pretty stable in glass discharge tubes and readily react with the surface of polymer materials. Any effect of CO radicals is neglected since oxygen atoms are chemically more reactive so possible differences in surface functionalization might have been observed only at extremely low treatment times and/or orders of magnitude lower pressure.

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