# 22. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH

**20.–22. oktober 2014, Portorož, Slovenija**

# 22nd INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY

**20–22 October 2014, Portorož, Slovenia**

# PROGRAM IN KNJIGA POVZETKOV

# PROGRAM AND BOOK OF ABSTRACTS

INŠTITUT ZA KOVINSKE MATERIALE
IN TEHNOLOGIJE, LJUBLJANA

**22. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH /**
*22nd INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY*

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

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## VSEBINA – CONTENTS



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

**YR** Mladi raziskovalci – Young scientists

# 22. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH, 20. – 22. OKTOBER 2014
# 22nd INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY, 20–22 OCTOBER, 2014

## Monday 20.10.2014

| | EUROPA "B" | |
|---|---|---|
| 9:00 | Opening ceremony – Director IMT | |
| 9:30 | PLENARY LECTURE Philippe Marcus | |
| 10:10 | PLENARY LECTURE Rafael A. Mesquita | |
| 10:50 | Invited lecture Robert Dominko | |
| **11:15** | **COFFEE BREAK** | |
| | **EUROPA "D"** | **EUROPA "B"** |
| 11:40 | Antonopoulou – Novák | Rashkovskiy – Bilek |
| 12:00 | Hreščak – Bulejko | Vančura – Fiserova |
| 12:20 | Kupec – W. Gorczyca | Samodurova – Vorel |
| 12:40 | Gantar – Margellou | Kafexhiu – Kocaman |
| **13:00** | **LUNCH BREAK** | |
| 14:30 | Arkhipova – Jaksik | Žihalová – Sobuz |
| 14:50 | Kurtjak – Pukšič | Sirin – S. Islam |
| 15:10 | Majerič – Nahar | Burja – Plachcinska |
| 15:30 | Oprčkal – Özmen | Kominek – Kvapil |
| 15:50 | Lazar – Reif | Patek – Guzej |
| **16:10** | **COFFEE BREAK / Podgornik*** | |
| | **EUROPA "D"** | **EUROPA "B"** |
| 16:40 | Szabados – Hossain | Krištof – Luks |
| 17:00 | M. Islam – Blazek | Verlak – Pilecek |
| 17:20 | Králíková – Kejík | Mavrič – Mramor |
| 17:40 | Ferencz – Touhid | Pirvu – Liu |
| 18:00 | Botan | Niegelhell – Reishofer– Ban |
| **19:30 21:00** | **POSTER SESSION – COCTAIL PARTY** | |

* Presentation of scientific results – guidelines for PhD students on how to make a good presentation

## Tuesday 21.10.2014

| | EUROPA "B" | |
|---|---|---|
| 9:00 | PLENARY LECTURE Jan van Humbeeck | |
| | **EUROPA "B"** | **EUROPA "D"** |
| 9:50 | Invited lecture Monika Jenko | Invited lecture Junpeng Zhao |
| 10:15 | Invited lecture Peter Panjan | Invited lecture Ema Žagar |
| **10:40** | **COFFEE BREAK** | |
| 11:00 | Gubeljak | Pahovnik |
| 11:15 | Kurka | S. Kovačič |
| 11:30 | Vuherer | Vargun |
| 11:45 | Šuštaršič | Spirk |
| **12:00** | **LUNCH BREAK** | |
| | **EUROPA "A"** | |
| 13:00 | PLENARY LECTURE Peter Dahlmann | |
| 13:45 | PLENARY LECTURE Andrea Amaldi | |
| **14:30** | **COFFEE BREAK** | |
| | **EUROPA "B"** | **EUROPA "D"** |
| 15:00 | Invited lecture Matjaž Finšgar | Invited lecture Joris Baets |
| 15:25 | Ostachowski | Conradi |
| 15:40 | Novotorsev | Ubeyli |
| 15:55 | Velasques | Pazdera |
| 16:10 | Yilmaz Atay | Katsarou |
| 16:25 | Skramlik | Suslova |
| 16:40 | Dospial | Chocholaty |
| 16:55 | Giraldo | Rusnáková |
| **17:30 21:00** | **VISIT OF SANTOMAS WINECELLAR** | |

## Wednesday 22.10.2014

| | EUROPA "B" | |
|---|---|---|
| 9:00 | PLENARY LECTURE Jan Falkus | |
| | **EUROPA "D"** | **EUROPA "B"** |
| 9:50 | Invited lecture Božidar Šarler | Invited lecture Zijad Džemić |
| 10:15 | Kayikci | Kopyl |
| 10:30 | Bruna | Savilov |
| 10:45 | Pohanka | Flašker |
| 11:00 | Guštin | Egorov |
| 11:15 | Korga | Ziberi |
| **11:30** | **COFFEE BREAK** | |
| 12:00 | Hrabovský | Vojisavljevič |
| 12:15 | Ozgowicz | Kunaver |
| 12:30 | Lee | Yatskiv |
| 12:45 | Žužek | Yuliarto |
| 13:00 | Jenko D. | Grigaitiene |
| 13:15 | Slivnik | Ersšte |
| 13:30 | Grajcer | Terčelj |
| 13:45 | Steinacher | Kolarik |
| 14:00 | Lagoda | M. Kovačič |
| 14:15 | | Fajfar |
| | **CLOSING CEREMONY** | |
| **14:30** | **LIGHT LUNCH** | |

# PROGRAM 22. MEDNARODNE KONFERENCE O MATERIALIH IN TEHNOLOGIJAH
# 22nd INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY: PROGRAM

| **PONEDELJEK – MONDAY 20. 10. 2014 – EUROPA »B«** | |
|---|---|
| | **Predsedujoči – Chair:** Matjaž Godec |
| **9:00** | **ODPRTJE – OPENING CEREMONY – director IMT Matjaž Godec** |
| 9:30 | **PLENARY LECTURE**<br>THE PHYSICAL CHEMISTRY OF METAL SURFACES INVOLVED IN CORROSION PROCESSES<br>Philippe Marcus<br>Institut de Recherche de Chimie Paris/ Physical Chemistry of Surfaces, CNRS – Chimie ParisTech, Ecole Nationale Supérieure de Chimie de Paris, France |
| 10:10 | **PLENARY LECTURE**<br>PHYSICAL METALLURGY AS THE BASIS FOR DEVELOPMENTS IN TOOL STEELS<br>Rafael Agnelli Mesquita<br>Professor at Uninove, Brazil, Independent Consultant |
| 10:50 | **INVITED LECTURE**<br>FACTORS INFLUENCING LITHIUM SULPHUR BATTERY CYCLE LIFE<br>Robert Dominko<br>National Institute of Chemistry, Ljubljana, Slovenia |
| **11:15** | **Coffee Break** |
| | **EUROPA »D«** |
| | **Predsedujoči – Chair: Miran Čeh** |
| 11:40 | BIOGENIC MICRO-SILICA: A MULTIFUNCTIONAL RAW MATERIAL IN ENVIRONMENTALLY FRIENDLY APPLICATIONS<br>Michael Stamatakis[1], Sofia Antonopoulou[1], Marianthi Anastasatou[1], Stavroula Kavouri[1], George Stamatakis[2], Nafsika Papavlasopoulou[1]<br>[1]UoA, Faculty of Geology & Geoenvironment, [2]UoA, Faculty of Chemistry, Athens, Greece |
| 11:50 | CERAMICS MASONRY UNITS INTENDED FOR THE MASONRY RESISTANT TO HIGH HUMIDITY<br>Jiří Zach, Vítězslav Novák, Jitka Hroudová<br>Brno University of Technology, Faculty of Civil Engineering, Brno, Czech Republic |
| 12:00 | THE ROLE OF THE NIOBIUM PENTOXIDE PRECURSOR IN THE HOMOGENEITY AND DENSIFICATION OF THE POTASSIUM SODIUM NIOBATE LEAD-FREE CERAMICS<br>Jitka Hreščak[1,2], Tadej Rojac[1], Barbara Malič[1,2], Andreja Benčan[1,2]<br>[1]Jožef Stefan Institute, Ljubljana, [2]International Postgraduate School, Ljubljana |
| 12:10 | FILTRATION MEMBRANES BASED ON SECONDARY MATERIALS: PREPARATION, CHARACTERIZATION, PROPERTIES<br>Pavel Bulejko, Pavel Kejik, Ondrej Kristof, Katerina Sikorová, Tomas Sverak<br>Brno University of Technology, Faculty of Mechanical Engineering, Brno, Czech Republic |
| 12:20 | RELAXOR-LIKE DIELECTRIC PROPERTIES IN SOLUTION DERIVED LEAD-free $K_{0.5}Na_{0.5}NbO_3$ – $SrTiO_3$ THIN FILMS<br>Alja Kupec, Andreja Eršte, Vid Bobnar, Barbara Malič<br>Jožef Stefan Institute, Ljubljana, Slovenia |

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| 12:30 | STUDY OF NONLINEAR OPTICAL PROPERTIES OF SILVER NANOPARTICLES EMBEDED IN GLASS<br>A. Wolak-Gorczyca[1], W. Zawadzki[1], M. Grabiec[1], F. Sobczuk[1], O. Véron[2], J.P-Blodeau[2], K. Dzierżęga[1]<br>[1]Marian Smoluchowski Institute of Physics, Jagiellonian University, Cracow, Poland,<br>[2]CEMHTI,CNRS/University of Orléans, Avenue de la Recherche Scientifique, France |
| 12:40 | NANOPARTICULATE BIOACTIVE GLASS-REINFORCED GELLAN-GUM HYDROGELS FOR BONE TISSUE ENGINEERING<br>Ana Gantar, Rok Kocen and Saša Novak<br>Jožef Stefan Institute, Department for nanostructured materials, Ljubljana, Slovenia, Jožef Stefan International Postgraduate School, Ljubljana, Slovenia |
| 12:50 | BIODIESEL PRODUCTION USING MINERAL MAGNESIUM OXIDE AS CATALYST. THE ROLE OF PVA AT THE SYNTHESIS OF MgO<br>Antigoni Margellou, Aikaterini Koutsouki, Georgios Manos, Dimitrios Petrakis, Michael Kontominas and Philippos Pomonis<br>Department of Chemistry, University of Ioannina, Ioannina, Greece |
| **13:00**<br>**14:30** | **LUNCH break** |
| | **Predsedujoči – Chair: Miran Čeh** |
| 14:30 | SYNTHESIS AND STUDY OF N-DOPED CARBON NANOFLAKES FROM HYDROCARBONS PYROLYSIS<br>Arkhipova E.A., Savilov S.V., Ivanov A.S.<br>Department of Chemistry, M.V. Lomonosov Moscow State University, Moscow, Russia |
| 14:40 | ANALYSIS OF THE INFLUENCE OF $TiO_2$-NANOPARTICLES IN A POLYAMIDE6-MATRIX ON THE PROPERTIES OF MELT-SPUN FILAMENTS<br>Karolina Jaksik, Gunnar Seide, Thomas Gries<br>Institut für Textiltechnik der RWTH Aachen University, Aachen, Germany |
| 14:50 | GALLIUM NANOPARTICLES ON HYDROXYAPATITE<br>Mario Kurtjak, Marija Vukomanović, Danilo Suvorov<br>Jožef Stefan Institute, Advanced Materials Department – K9, Ljubljana |
| 15:00 | INCIPIENT PLASTICITY OF (1,1,19) VICINAL SURFACES OF COPPER AND NICKEL<br>Nuša Pukšič, Monika Jenko, Matjaž Godec<br>Institute of Metals and Technology, Ljubljana, Slovenia |
| 15:10 | Au NANOPARTICLE SYNTHESIS VIA ULTRASONIC SPRAY PYROLYSIS WITH A SEPARATE EVAPORATION ZONE NN YR<br>Peter Majerič[1], Primož Ternik[2], Jelena Bogović[3], Bernd Friedrich[3], Rebeka Rudolf[1,4]<br>[1] University of Maribor, Faculty of Mechanical Engineering, Slovenia, [2] Private Researcher, Bresternica, Slovenia, [3] IME Process Metallurgy and Metal Recycling, RWTH University Aachen, Germany, [4] Zlatarna Celje d.d., Celje, Slovenia |
| 15:20 | *MOMORDICA CHARANTIA* MEDIATED GREEN BIOSYNTHESIS OF SILVER NANOPARTICLES<br>M. K. Nahar[1], Z. Zakaria[2] & U. Hashim[1]<br>[1]Institute of Nano Electronic Engineering (INEE). University Malaysia Perlis, [2]School of Bioprocess Engineering. University Malaysia Perlis |
| 15:30 | THE ADVANCED SOLIDIFICATION/STABILIZATION METHOD FOR REMEDIATION OF HEAVY METAL CONTAMINATED SOILS<br>Primož Oprčkal[1], Radmila Milačič[2], Janez Ščančar[2], Andrijana Sever-Škapin[1], Ana Mladenovič[1]<br>[1]Slovenian National Building and Civil Engineering Institute, Ljubljana, Slovenia, [2]Jožef Stefan Institute, Ljubljana, Slovenia |

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| 15:40 | THE PREDICTION OF ELASTIC MODULUS OF CHICKEN FEATHER REINFORCED PLA AND THE COMPARISON WITH EXPERIMENTAL RESULTS<br>Uğur Özmen, Buket Okutan Baba, Celal Bayar University, Engineering Faculty, Mechanical Engineering Department, Manisa, TURKEY |
| 15:50 | PREPARATION OF ELECTRO-CONDUCTIVE Y-TZP/TiN COMPOSITE WITH REDUCED TiN CONTENT<br>Ana Lazar, Kristoffer Krnel<br>Jožef Stefan Institute, Ljubljana |
| 16:00 | STUDY OF THERMAL AND MOISTURE TRANSPORT IN THE STRUCTURE OF INSULATING MATERIALS BASED ON NATURAL FIBERS<br>Jiří Zach, Martina Reif, Jitka Hroudová<br>Brno University of Technology, Faculty of Civil Engineering, Brno, Czech Republic |
| **16:10** | **Coffee break / Podgornik**<br>Presentation of scientific results - guidelines for PhD students on how to make a good presentation |
| | **Predsedujoči – Chair: Miran Čeh** |
| 16:40 | AN IMPROVED MECHANO-HYDROTHERMAL METHOD TO SYNTHETIZE CaAl-LAYERED DOUBLE HYDROXIDES<br>M. Szabados[1], I. R. Mészáros[2], Zs. Ferencz[1], P. Sipos[3], and I. Pálinkó[1]<br>[1]Department of Organic Chemistry, University of Szeged, Szeged, Hungary, [2]Material and Solution Structure Research Group, University of Szeged, Szeged, Hungary, [3]Department of Inorganic and Analytical Chemistry, University of Szeged, Szeged, Hungary |
| 16:50 | ANALYSIS OF THE EFFECTS OF ANTENNA SUBSTRATE MATERIALS ON SAR IN THE HUMAN HEAD<br>M. I. Hossain, M. R. I. Faruque, M. T. Islam<br>Universiti Kebangsaan Malaysia, UKM, bangi, Selangor, Malaysia |
| 17:00 | A PRINTED MICROSTRIP LINE-FED PATCH ANTENNA ON HIGH DIELECTRIC MATERIAL FOR C-BAND APPLICATIONS<br>[1]Md. Moinul Islam, [2]Mohammad Tariqul Islam, [1]Mohammad Rashed Iqbal Faruque<br>[1]Space Science Centre (ANGKASA), Universiti Kebangsaan Malaysia, UKM, Bangi, Selangor, Malaysia, [2]Department of Electrical, Electronic and Systems Engineering, Universiti Kebangsaan Malaysia, UKM, Bangi, Selangor, Malaysia |
| 17:10 | THE POSSIBILITIES OF ASCERTAINING CEMENT COMPOSITE STRUCTURE USING METHODS FOR DETERMINING THE AIR CONTENT AND COMPUTED TOMOGRAPHY<br>Bronislava Moravcová, Petr Pőssl, Petr Misák, Michal Blažek<br>Brno University of Technology, Faculty of civil Engineering, Brno |
| 17:20 | VALIDATION OF METHODS FOR DETERMINING PERMEABILITY OF CEMENT COMPOSITE STRUCTURE BY MEANS OF COMPUTED TOMOGRAPHY<br>Tereza Komárková, Monika Králíková, Pavel Kovács, Dalibor Kocáb, Tomáš Stavař<br>Brno University of Technology, Faculty of civil Engineering, Veveří 331/95, 602 00 Brno |
| 17:30 | COIR-BASED FILLERS GRINDING AND BULK PROPERTIES<br>Pavel Kejík, Tomáš Svěrák, Kateřina Sikorová, Ondřej Krištof, Pavel Kejík<br>FME BUT, Brno, Czech republic |
| 17:40 | MECHANOCHEMISTRY IN THE SYNTHESIS OF Ca-Al LAYERED DOUBLE HYDROXIDES<br>Zs. Ferencz[1], Á. Kukovecz[3,4], Z. Kónya[3,5] P. Sipos[2], and I. Pálinkó[1]<br>1Department of Organic Chemistry, University of Szeged, Szeged, Hungary, 2Department of Inorganic and Analytical Chemistry, University of Szeged, Szeged, Hungary, 3Department of Applied and Environmental Chemistry, University of Szeged, Szeged, Hungary, 4MTA-SZTE "Lendület" Porous Nanocomposites Research Group, Szeged, Hungary, 5MTA-SZTE Reaction Kinetics and Surface Chemistry Research Group, Szeged, Hungary |

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| 17:50 | COMPOSITE MATERIAL PRINTED ANTENNA FOR MULTI-STANDARD MOBILE WIRELESS APPLICATION<br>Touhidul Alam[1], Mohammad Rashed Iqbal Faruque[1], Mohammad Tariqul Islam[2]<br>[1]Space Science Center(ANGKASA), Universiti Kebangsan Malaysia, 43600UKM, Bangi, Selangor, Malaysia, [2]Department of Electrical, Electronic and Systems Engineering, Universiti Kebangsan Malaysia, 43600UKM, Bangi, Selangor, Malaysia |
| 18:00 | INFLUENCE OF ARAMID FIBERS ON MECHANICAL PROPERTIES OF TWO POLYMERIC BLENDS<br>Mihail Botan, Constantin Georgescu, Catalin Pirvu, Lorena Deleanu<br>"Dunarea de Jos" University of Galati, Department of Mechanical Engineering, Galati, Romania |
| | |
| **19:30**<br>**21:00** | **Poster section - Coctail party** |

| **PONEDELJEK – MONDAY 20. 10. 2014 – EUROPA »B«** | |
|---|---|
| **11:15** | **Coffee Break** |
| | **Predsedujoči – Chair: Bojan Podgornik** |
| 11:40 | KINETICS OF SMALL IMPURITIES GRAIN BOUNDARIES SEGREGATIONS FORMATION IN COLD-ROLLED DEEP DRAWING 08C-Al AND IF-STEELS DURING POST-DEFORMATION ANNEALING<br>Yu. Rashkovskiy, A.I. Kovalev, D.L. Wainstein, I.G.Rodionova, Yu.S. Bykova, D.N. Zakharova<br>I.P. Bardin Central Research Institute of Ferrous Metallurgy, Moscow, Russia |
| 11:50 | INTERACTION OF $Cr_2N$ AND $Cr_2N$/Ag THIN FILMS WITH CuZn-BRASS COUNTERPART DURING BALL-ON-DISK TESTING<br>Pavel Bílek, Peter Jurči, Petra Dulová, Mária Hudáková, Jana Ptačinová<br>Institute of Materials Science, Faculty of Materials Science and Technology in Trnava, Slovak University of Technology in Bratislava, Trnava, Slovak Republic |
| 12:00 | EFFECT OF MODIFYING X210Cr12 STEEL STOCK STRUCTURE USING HIGH PRESSURE TORSION ON RESULTING STRUCTURE AFTER MINI-THIXOFORMING<br>Bohuslav Mašek, Filip Vančura, David Aišman, Hana Jirková, Martin F. -X. Wagner<br>University of West Bohemia in Pilsen, Research Centre of Forming Technology – FORTECH, Pilsen, Czech Republic, Chemnitz University of Technology, Institute of Materials Science and Engineering, Chemnitz, Germany |
| 12:10 | CORROSION RESISTANCE OF LASER CLADS<br>Pavla Fišerová, Ondřej Chocholatý, Antonín Kříž, Stanislav Němeček, Václav Ocelík, Jeff Th. M. De Hosson<br>University of West Bohemia in Pilsen, Faculty of Mechanical Engineering, Department of Material Science and Technology, Czech Republic<br>MATEX PM, s.r.o., Plzeň, Czech Republic<br>University of Groningen, Department of Applied Physics, Groningen, the Netherlands |
| 12:20 | SINTERING-TEMPERATURE-RELATED AGEING OF ALUMINA- OR/AND SILICA-DOPED 3Y-TZP<br>Anastasia Samodurova, Andraz Kocjan, Tomaz Kosmac<br>Jožef Stefan Institute, Ljubljana, Slovenia |
| 12:30 | PRODUCTION OF SHAPED SEMI-PRODUCTS FROM AHS STEELS BY INTERNAL PRESSURE<br>Ivan Vorel[1], Hana Jirková[1], Bohuslav Mašek[1], Petr Kurka[2]<br>[1]University of West Bohemia in Pilsen, Research Centre of Forming Technology, Pilsen, Czech Republic, [2]Fraunhofer Institute for Machine Tools and Forming Technology IWU, Chemnitz, Germany |
| 12:40 | CREEP AND WEAR BEHAVIOR OF TEMPERED MARTENSITE AS A FUNCTION OF MICROSTRUCTURAL CHANGES<br>Fevzi Kafexhiu[1], Franc Vodopivec[1], Jelena Vojvodič Tuma[2], Bojan Podgornik[1], Igor Velkavrh[3], Igor Belič[1]<br>[1]Institute of metals and technology, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Ljubljana, Slovenia, [3]V-research GmbH, Dornbirn, Austria |
| 12:50 | EFFECTS OF SOME PARAMETERS ON THE GRAIN REFINING EFFICIENCY OF Al5TiB REFINERS ON AN A360 ALUMINIUM ALLOY<br>E. Kocaman[1], S.Sirin[2], M.Colak[3], R.Kayikci[4]<br>Sakarya University, Faculty of Technology, Sakarya, Turkey |
| **13:00<br>14:30** | **LUNCH break** |

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| | **Predsedujoči – Chair: Bojan Podgornik** |
| 14:30 | ANALYSIS OF VANADIUM INFLUENCE TO AlSi10MgMn ALLOY WITH HIGH IRON LEVEL<br>Dana Bolibruchová, Mária Žihalová<br>Department of technological engineering, Faculty of mechanical engineering, University of Žilina, Žilina, Slovakia |
| 14:40 | SWASTIKA SHAPE PATCH STRUCTURE ANTENNA ON A LOW COST POLYMER RESIN COMPOSITE MATERIAL FOR WIRELESS APPLICATIONS<br>M. Samsuzzaman[1, 2], M. T. Islam[2]<br>[1]Faculty of Engineering and Built Environment, Universiti Kebangsaan, Malaysia |
| 14:50 | EFFECTS OF THERMAL GRADIENT ON THE FORMATION OF MICRO POROSITY DURING ONE DIMENSIONAL SOLIDIFICATION OF A356 ALUMINIUM ALLOY<br>S. Sirin[a], M. Colak[b], E. Kocaman[c], R. Kayikci[d]<br>Sakarya University, Faculty of Technology, Sakarya, Turkey |
| 15:00 | DESIGN, FABRICATION AND MEASUREMENT OF A NEW SNG METAMATERIAL<br>[1]Sikder Sunbeam Islam, [1]Mohammd Rashed Iqbal Faruque, [2]Mohammad Tariqul Islam<br>[1]Space Science Centre (ANGKASA), [2]Department of Electrical, Electronic & Systems Engineering, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia |
| 15:10 | CHROMIUM OXIDES IN EAF STAINLESS STEEL SLAGS<br>Jaka Burja[1], Franc Tehovnik[1], Matjaž Godec[1], Jožef Medved[2]<br>[1]IMT, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]UNI-LJ, NTF-OMM, Aškjerčeva cesta 12, 1000 Ljubljana, Slovenia |
| 15:20 | EFFECT OF THERMOMECHANICAL TREATMENT ON THE CORROSION BEHAVIOUR OF HIGH-Mn AUSTENITIC STEEL WITH SILICON AND ALUMINIUM ADDITION<br>Adam Grajcar, Aleksandra Płachcińska, Santina Topolska, Monika Kciuk<br>Silesian University of Technology, Institute of Engineering Materials and Biomaterials, Gliwice, Poland |
| 15:30 | ESTIMATION OF NUMBER OF FORWARD TIME STEPS FOR SEQUENTIAL BECK APPROACH USED FOR SOLVING INVERSE HEAT CONDUCTION PROBLEMS<br>Jan Kominek, Michal Pohanka<br>Brno University of Technology, Faculty of Mechanical Engineering, Brno, Czech Republic |
| 15:40 | ESTIMATION OF THERMAL CONTACT CONDUCTANCE BY CHANGING THERMAL CONDUCTIVITY OF INTERFACE LAYER<br>Jiří Kvapil, Michal Pohanka<br>Brno University of Technology, Faculty of Mechanical Engineering, Brno, Czech Republi |
| 15:50 | NUMERICAL SIMULATION OF DISSIMILAR WELD JOINT IN SYSWELD SIMULATION SOFTWARE<br>Radoslav Koňár, Miloš Mičian, Augustín Sládek, Marek Patek<br>Department of technological engineering, Faculty of mechanical engineering, University of Žilina, Žilina, Slovakia |
| 16:00 | EXPERIMENTAL VERIFICATIONS AND NUMERICAL THERMAL SIMULATIONS OF AUTOMOBILE HEADLAMPS<br>Michal Guzej[1], Jaroslav Horsky[1], David Gallovic[2], Pavel Cerny[3]<br>[1]Brno University of Technology, Faculty of Mechanical Engineering, Brno, Czech Republic, [2]TechSoft Engineering, spol. s r.o., Praha 4, [3]SKODA AUTO a.s., Tr. Vaclava Mlada Boleslav, Czech Republic |
| **16:10** | **Coffee break / Podgornik (EUROPA »B«)**<br>*Presentation of scientific results - guidelines for PhD students on how to make a good presentation* |

| | **Predsedujoči – Chair: Bojan Podgornik** |
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| 16:40 | PILOT-PLANT SHOWER SCRUBBER FOR CLEANING POLLUTED GAS<br>Ondřej Krištof, Tomáš Svěrák, Pavel Bulejko, Pavel Kejík, Kateřina Sikorová<br>Brno University of Technology, Faculty of Mechanical Engineering, Brno, Czech Republic |
| 16:50 | EVALUATION OF CONTACT STRESS DISTRIBUTION MEASURED BY PIN SENSOR AND PIEZOELECTRIC FORCE TRANSDUCER IN HOT AND COLD ROLLING<br>Tomáš Luks[1], Jaroslav Horský[1], Annika Nilsson[2]<br>[1]Brno University of Technology, Faculty of Mechanical Engineering, Brno, Czech Republic, [2]Swerea MEFOS, Luleå, Sweden |
| 17:00 | NUMERICAL SIMULATION OF COMPACTION PROCESS OF SINTERED DOUBLE HEIGHT GEARS<br>Tomaž Verlak, Marko Šori, Srečko Glodež<br>University of Maribor, Faculty of Mechanical Engineering, Maribor, Slovenia |
| 17:10 | USE OF MATERIAL-TECHNOLOGICAL MODELLING IN DIE FORGING<br>Vít Pileček, Filip Vančura, Hana Jirková, Bohuslav Mašek<br>University of West Bohemia in Pilsen, Research Centre of Forming Technology, Pilsen, Czech Republic |
| 17:20 | A MESHLESS MODEL OF THERMOMECHANICS DURING DC CASTING OF ALUMINIUM BILLETS<br>Boštjan Mavrič[1], Božidar Šarler[1,2]<br>[1]Institute of Metals and Technology, Ljubljana, Slovenia, [2]University of Nova Gorica, Nova Gorica, Slovenia |
| 17:30 | A MESHLESS MODEL OF ELECTROMAGNETIC BREAKING FOR CONTINUOUS CASTING OF STEEL<br>Katarina Mramor[1], Robert Vertnik[2], Božidar Šarler[1,2]<br>1 University of Nova Gorica, Nova Gorica, Slovenia<br>2 Institute of Metals and Technology, Ljubljana, Slovenia |
| 17:40 | USING SIMULATION FOR COMPARING THE RESPONSE OF MATERIALS IN TERMINAL BALLISTICS<br>Catalin Pirvu, Lorena Deleanu, Simona Badea<br>"Dunărea de Jos" University, Galati, Romania, [b.] Scientific Research Center for CBRN Defense and Ecology, Bucharest, Romania |
| 17:50 | APPLICATION OF NON-SINGULAR METHOD OF FUNDAMENTAL SOLUTIONS AND IMPROVED NON-SINGULAR METHOD OF FUNDAMENTAL SOLUTIONS FOR TWO-DIMENSIONAL MULTI-GRAIN ELASTICITY PROBLEMS<br>Qingguo Liu[1], Božidar Šarler[1,2,3]<br>[1]University of Nova Gorica, Nova Gorica, Slovenia, [2]IMT, Ljubljana, Slovenia, [3]Center of Excellence BIK, Solkan, Slovenia |
| 18:00 | TRIGGERING PROTEIN ADSORPTION BY CATIONIZATION OF CELLULOSE ULTRATHIN FILMS – CHALLENGES AND APPLICATIONS<br>Katrin Niegelhell[1], Tamilselvan Mohan[2], Rupert Kargl[3], Stefan Köstler[4], David Reishofer[1], Karin Stana-Kleinschek[3], Stefan Spirk[1]<br>[1]Institute for Chemistry and Technology of Materials, Graz University of Technology, Graz, Austria, [2]Institute for Chemistry, University of Graz, Graz, Austria, [3]Institute for the Engineering and Design of Materials, University of Maribor, Maribor, Slovenia, [4]Joanneum Research Materials, Institute for Surface Technologies and Photonics, Weiz, Austria |
| 18:10 | AMORPHOUS NANOMETRIC CELLULOSE ULTRA-THIN FILMS - THE STRUCTURAL REARRANGEMENTS INDUCED BY HEAT TREATMENT AND WATER INTERACTION<br>David Reishofer[a,b], Tamilselvan Mohan[b], Rupert Kargl[b], Katrin Nieglhell[a], Silvo Hribernik[b], Heike M. A. Ehmann[a], Karin Stana-Kleinschek[b], Stefan Spirk[a,b]<br>[a]University of Technology Graz, Institute for Chemistry and Technology of Materials, Graz, Austria, [b]University of Maribor, Institute for Engineering Materials & Design, Maribor, Slovenia |

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| 18:20 | MULTI-WALLED CARBON NANOTUBES EFFECT IN POLYPROPYLENE NANOCOMPOSITES<br>Cristina-Elisabeta Ban[1,2], Adriana Stefan[1], Ion Dinca[1], George Pelin[1, 2], Anton Ficai[2], Ecaterina Andronescu[2], Ovidiu Oprea[2]<br>[1]National Institute for Aerospace Research "Elie Carafoli" Bucharest- Materials Unit, Bucharest, Romania, [2]Polytechnic University of Bucharest, Faculty of Applied Chemistry and Materials Science, Bucharest, Romania |
| **19:30** | **Poster section - Coctail party** |
| **21:00** | |

| **TOREK – TUESDAY 21. 10. 2014 – EUROPA »B«** | |
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| | **Predsedujoči – Chair: Boštjan Markoli, Danijela A. Skobir Balantič** |
| 9:00 | **PLENARY LECTURE**<br>ADDITIVE MANUFACTURING (AM) OF METALLIC PARTS BY SELECTIVE LASER MELTING (SLM)<br>Jan Van Humbeeck<br>KU Leuven, Belgium |
| | **EUROPA »B«** |
| 9:50 | **INVITED LECTURE**<br>SURFACE ANALYSIS IN MATERIAL SCIENCE – AES AND XPS IN METALLURGY<br>Monika Jenko<br>Institute of Metals and Technology, Ljubljana, Slovenia |
| 10:15 | **INVITED LECTURE**<br>THE INFLUENCE OF CARBIDE AND NON-METALLIC INCLUSIONS IN TOOL STEELS SUBSTRATE MATERIALS ON GROWTH OF PVD HARD COATINGS<br>Peter Panjan, Peter Gselman<br>Jožef Stefan Institute, Ljubljana, Slovenia |
| **10:40** | **Coffee break** |
| | **Predsedujoči – Chair: Boštjan Markoli, Danijela A. Skobir Balantič** |
| 11:00 | SHIELDING OF CRACK TIP IN INHOMOGENEOUS WELD JOINT<br>Nenad Gubeljak[1], Otmar Kolednik[2], Jožef Predan[1]<br>[1]University of Maribor, Faculty of Mechanical Engineering, Maribor, Slovenia, [2]Erich Schmid Institute of Materials Science of the Austrian Academy of Sciences, Leoben, Austria |
| 11:15 | INCREASING MICROPURITY AND DETERMINING THE EFFECT OF DIFFERENT PRODUCTION TECHNOLOGIES ON THE QUALITATIVE PARAMETERS OF FORGED STEEL PIECES WITH HIGH ALUMINUM CONTENT<br>Vladislav Kurka, Jaroslav Pindor, Jana Kosnovska<br>MATERIAL AND METALLURGICAL RESEARCH (Ltd.), Ostrava-Vítkovice, Czech Republic |
| 11:30 | THE APPLICATION OF ACTIVATING FLUXES IN THE MANUFACTURE OF MEDIUM PRESSURE PIPELINES<br>Darko Bajić[1], Tomaž Vuherer[2], Mića Đorđević[3], Stefan Ćulafić[1]<br>[1]University of Montenegro, Faculty of Mechanical Engineering, Podgorica, Crna Gora, [2]University of Maribor, Faculty of Mechanical Engineering, Maribor, Republika Slovenia, [3]"TehWeld" d.o.o, Loznica, Srbija |
| 11:45 | THE INFLUENCE OF IRON POWDER PARTICLES MORPHOLOGY ON ITS ABILITY FOR AUTOMATIC DIE COMPACTION<br>B. Šuštaršič[1], M. Godec[1], S. Glodež[2], M. Šori[2], M. Ratej[3], N. Javornik[3],<br>[1]Institute of Metals and Technology, Ljubljana, Slovenia, [2]University of Maribor, FNM, Maribor, Slovenia, [3]UNIOR, Forging Industry, Zreče, Slovenia |
| **12:00** | **LUNCH break** |

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| **13:00** | **EUROPA »A«** |
| | **Predsedujoči – Chair: Matjaž Godec, Jožef Medved** |
| 13:00 | **PLENARY LECTURE** Peter Dahlmann<br>STEEL INDUSTRY IN GERMANY AND EUROPE - EFFICIENT AND INNOVATIVE |
| 13:45 | **PLENARY LECTURE** Andrea Amaldi<br>METALLURGY EUROPE –A RENAISSANCE PROGRAMME FOR 2012-2022 |
| **14:30** | **Coffee break** |
| | **EUROPA »B«** |
| | **Predsedujoči – Chair: Tadeja Kosec, Aleksandra Kocijan** |
| 15:00 | **INVITED LECTURE** CORROSION INHIBITORS: HOW DO THEY ACT AT ROOM AND ELEVATED TEMPERATURES<br>Matjaž Finšgar<br>University of Maribor, Faculty of Chemistry and Chemical Engineering, Maribor, Slovenia |
| 15:25 | STRUCTURE AND MECHANICAL PROPERTIES OF AZ91 ALLOY EXTRUDED BY KOBO METHOD WITH LATERAL OUTFLOW<br>Paweł Ostachowski, Andrzej Korbel, Włodzimierz Bochniak, Marek Łagoda<br>AGH – University of Science and Technology, Cracow, Poland |
| 15:40 | SYNTHESIS AND STUDY OF CARBON NANOTUBES COATED BY METAL OXIDES AS A COMPOSITE MATERIALS FOR INDUSTRIAL METALLURGY<br>Novotortsev R.Y., Savilov S.V.<br>Department of Chemistry, M.V. Lomonosov Moscow State University. Moscow, Russia |
| 15:55 | EFFECT OF UV RADIATION AND ENVIRONMENTAL AGING ON ABRASIVE WEAR AND MECHANICAL PROPERTIES OF A CARBON BLACK FILLED ACRYLONITRILE BUTADIENE RUBBER<br>Sandra Velásquez[1], Diego Giraldo[2], Natalia Zapata[2]<br>[1]Centro de Diseño y Manufactura del Cuero del SENA, Colombia<br>[2]Grupo de Materiales Poliméricos, Universidad de Antioquia, Medellín, Colombia |
| 16:10 | USE OF SEMI-SOLID PROCESSING (MINI-THIXOFORMING) TO PRODUCE AL REINFORCED METALLIC GLASS COMPOSITES<br>Hüsnügül Yilmaz Atay, David Aišman, Hana Jirková and Bohuslav Mašek<br>The Research Centre of Forming Technology, Faculty of Mechanical Engineering, University of West Bohemia, Pilsen, Czech Republic. |
| 16:25 | DETECTION OF MOISTURE TRANSPORT IN THE POROUS MATERIAL VIA MATHEMATICAL METHOD<br>Jan Skramlik, Miloslav Novotny, Karel Suhajda<br>University of Technology, Faculty of Civil Engineering Brno Department of structural engineering, Brno, Czech Republic |
| 16:40 | STUDY ON MAGNETIZATION REVERSAL BEHAVIOR IN ANNEALED Sm-Fe-Co-Zr-Cu RIBBONS<br>Marcin Dośpiał[1], Sebastian Garus[1], Marcin Nabiałek[1], Paweł Pietrusiewicz[1]<br>[1]Institute of Physics, Czestochowa University of Technology, Czestochowa, Poland |
| 16:55 | DETERMINATION OF EMPIRICAL KINETIC PARAMETERS FOR SULFUR VULCANIZATION OF NATURAL RUBBER FROM DSC AND ODR DATA<br>Diego Giraldo[1,2], Mónica Álvarez-Láinez[1]<br>[1]Engineering Materials Group, Product Design Engineering Department, Engineering School, EAFIT University, Medellín, Colombia, [2]Pyrometallurgicals and Materials Research Group (GIPIMME), University of Antioquia, Medellín, Colombia |
| **17:30** | **Visit of Santomas Winecellar** |
| **21:00** | |

| **TOREK – TUESDAY 21. 10. 2014 – EUROPA »D«** | |
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| | **Predsedujoči – Chair: Ema Žagar, Joris Baets** |
| 9:50 | **INVITED LECTURE**<br>STRATEGIES TOWARD SEQUENTIAL POLYMERIZATION OF DIFFERENT TYPES OF HETEROCYCLIC MONOMERS USING ORGANIC CATALYSTS<br>Junpeng Zhao, David Pahovnik, Nikos Hadjichristidis<br>Polymer Synthesis Laboratory, KAUST Catalysis Center, Physical Sciences and Engineering Division, King Abdullah University of Science and Technology (KAUST), Saudi Arabia |
| 10:15 | **INVITED LECTURE**<br>SYNTHESIS AND APPLICATION OF NOVEL POLYMER CARRIERS FOR DELIVERY OF ACTIVE PHARMACEUTICAL INGREDIENTS<br>David Pahovnik, Peter Perdih, Ema Žagar<br>Laboratory for Polymer Chemistry and Technology, National Institute of Chemistry, Ljubljana, Slovenia |
| **10:40** | **Coffee break** |
| | **Predsedujoči – Chair: Ema Žagar, Joris Baets** |
| 11:00 | SYNTHESIS AND CHARACTERIZATION OF ALKYL-MODIFIED POLY(SODIUM GLUTAMATE)S FOR BIOMEDICAL APPLICATIONS<br>David Pahovnik, Miljana Grujić, Ema Žagar<br>Laboratory for Polymer Chemistry and Technology, National Institute of Chemistry, Ljubljana, Slovenia |
| 11:15 | COORDINATION POLYMERIZATION AS A TOOL FOR THE PREPARATION OF POLYMERIC FOAMS WITH SPECIAL PROPERTIES: FROM π-CONJUGATED TO CARBON FOAMS<br>Marjan Ješelnik[1], Jan Sedláček[2], Ema Žagar[1], Christian Slugovc[3], Sebastijan Kovačič[1]<br>[1]National Institute of Chemistry, Laboratory for Polymer Chemistry and Technology, Ljubljana, Slovenia, [2]Department of Physical and Macromolecular Chemistry, Charles University in Prague, Faculty of Science, Praha 2, Czech Republic, [3]Graz University of Technology, Institute for Chemistry and Technology of Materials (ICTM), Graz, Austria |
| 11:30 | ELECTRICAL PROPERTIES OF POLYACRYLONITRILE-HEXYL METHACRYLATE COPOLYMERS<br>Elif Vargün[1], Meryem Çiçek[1], Ufuk Abacı[2], H. Yüksel Güney[2]<br>[1]Department of Chemistry, Mugla Sıtkı Kocman University, Turkey<br>[2]Department of Physics, Kocaeli University, Izmit, Turkey |
| 11:45 | SIMULATANEOUS ANTIMICROBIAL AND ANTICOAGULANT SURFACES ON THE BASIS OF POLYSACCHARIDES AND NANOPARTICLES<br>Stefan Spirk[a,b], Heike M. Ehmann[a], Doris Breitwieser[c], Sascha Winter[a], Uros Maver[b], Günther Koraimann[d], Hubert Fasl[c], Volker Ribitsch[c], Karin Stana Kleinschek[b]<br>[a]Institute for Chemistry and Technology of Materials, Graz University of Technology, , Austria, [b]Institute for the Engineering and Design of Materials, University of Maribor, Maribor, Slovenia, [c]Institute of Chemistry, University of Graz, Graz, Austria, [d]Institute for Molecular Biosciences, University of Graz, Graz, Austria |
| **12:00** | **LUNCH break** |

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| **13:00** | **EUROPA »A«**<br>**PLENARY LECTURES** |
| **14:30** | **Coffee break** |
| | **EUROPA »D«** |
| | **Predsedujoči – Chair: Marjetka Conradi, Darja Jenko** |
| 15:00 | **INVITED LECTURE**<br>TRENDS IN NATURAL FIBRE COMPOSITES<br>Baets J.<br>Department Materials Engineering, University of Leuven, Leuven, Belgium |
| 15:25 | DAMAGE RESISTANCE AND ANTICORROSION PROPERTIES OF NANOSILICA-FILLED EPOXY-RESIN COMPOSITE COATINGS<br>M. Conradi[1], A. Kocijan[1], M. Zorko[2], I. Verpoest[3]<br>[1]Institute of metals and technology, Ljubljana, Slovenia, [2]National Institute of Chemistry, Ljubljana, Slovenia, [3]Department of Materials Engineering, K. U. Leuven, Belgium |
| 15:40 | ON THE IMPACT FAILURE MECHANISMS IN AN ARMOR MATERIAL CONSISTING OF SILICON CARBIDE AND TEMPERED STEEL LAYERS<br>Emre Özer and Mustafa Übeyli<br>Osmaniye Korkut Ata University Engineering Faculty Mechanical Engineering Osmaniye,Turkey |
| 15:55 | CONCRETE EARLY AGE MONITORING BY ACOUSTIC EMISSION METHOD AND DETERMINING CHANGE OF ELECTRICAL PROPERTIES<br>Lubos Pazdera, Libor Topolar, Marta Korenska, Tomas Vymazal, Jaroslav Smutny<br>Brno University of Technology, Faculty of Civil Engineering, Brno, Czech Rep. |
| 16:10 | PROCESSING AND COMPRESSION CREEP RESPONSE OF AlN REINFORCED MAGNESIUM ALLOY ELEKTRON21<br>Lydia Katsarou, Hajo Dieringa<br>Helmholtz-Zentrum Geesthacht, Magnesium Innovation Centre – MagIC, Geesthacht, Germany |
| 16:25 | PREPARATION OF AMORPHOUS SILICA FROM RICE HUSK ASH<br>E.V. Suslova, R.Yu. Novotortsev, S.V. Savilov<br>Chemistry Departmant, Lomonosov Moscow State University, Moscow, Russia |
| 16:40 | COMPOSITE CHROMIUM COATING FOR PISTON RINGS<br>Ondrej Chocholaty[1], Jan Vlcek[2]<br>University of West Bohemia, Czech Republic[1]<br>Buzuluk a.s., Czech Republic[2] |
| 16:55 | FLAME RESISTANCE AND MECHANICAL PROPERTIES OF COMPOSITES BASED ON NEW ADVANCED RESIN SYSTEM FR 4/12<br>Rusnáková Soňa[1a], Fojtl Ladislav[1b], Žaludek Milan[1c] and Rusnák Vladimír[2d]<br>1Department of Production Engineering, FT TBU in Zlín, Zlín, Czech Republic, 2Faculty of Metallurgy and Materials Engineering, VŠB-Technical University of Ostrava, Ostrava-Poruba, Czech Republic |
| **17:30** | **Visit of Santomas Winecellar** |
| **21:00** | |

| **SREDA – WEDNESDAY 22. 10. 2014 – EUROPA »B«** | |
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| | **Predsedujoči – Chair: Monika Jenko, Matjaž Torkar** |
| 9:00 | **PLENARY LECTURE**<br>THE DEVELOPMENT OF CONTINUOUS CASTING PROCESS CONTROL BASED ON ADVANCED MATHEMATICAL MODELLING<br>Jan Falkus, Katarzyna Miłkowska-Piszczek |
| | **EUROPA »D«** |
| | **Predsedujoči – Chair: Božidar Šarler, Darja Steiner Petrovič** |
| 9:50 | **INVITED LECTURE**<br>MODELLING AND SIMULATION OF SOLIDIFICATION PROCESSES: PAST, PRESENT, FUTURE<br>Božidar Šarler[1,2]<br>[1]IMT, Ljubljana, Slovenia, [2]University of Nova Gorica, Nova Gorica, Slovenia |
| 10:15 | AN EXPERIMENTAL METHOD FOR DETERMINATION OF THE CRITICAL FRACTION OF SOLID DURING SOLIDIFICATION OF PM CAST ALUMINIUM ALLOYS<br>R. Kayikci[1], M. Colak[2], S. Sirin[3], E. Kocaman[4]<br>Sakarya University, Faculty of Technology, Sakarya, Turkey |
| 10:30 | PROGRESSIVE EVALUATION OF FLOW CAPACITY FOR CERAMICS FILTERS<br>Marek Brůna, Dana Bolibruchová, Petr Procházka<br>Žilinská univerzita v Žiline, Žilina |
| 10:45 | IMPLICIT NUMERICAL MULTIDIMENSIONAL HEAT CONDUCTION ALGORITHM PARALLELIZATION AND ACCELERATION ON GRAPHICAL CARD<br>Michal Pohanka, Jana Ondroušková<br>Brno University of Technology, Faculty of Mechanical Engineering, Brno, Czech Republic |
| 11:00 | POINT AUTOMATA METHOD FOR MODELLING GRAIN STRUCTURES OF MULTICOMPONENT ALUMINUM ALLOYS<br>Agnieszka Zuzanna Guštin[1], Božidar Šarler[1,2]<br>[1] Institute of Metals and Technology, Ljubljana, Slovenia<br>[2] University of Nova Gorica, Nova Gorica, Slovenia |
| 11:15 | THE PROBLEM DISCRETIZATION OBJECTS IN THE FEM SIMULATION STUDIES<br>Sylwester Korga[1], Aneta Duda[1], Elżbieta Kalinowska- Ozgowicz[2]<br>[1]Fundamentals of Technology, Lublin University of Technology, Lublin, Poland, [2]Mechanical Engineering Faculty, Silesian University of Technology, Gliwice, Poland |
| **11:30** | **Coffee break** |
| | **Predsedujoči – Chair: Božidar Šarler, Darja Steiner Petrovič** |
| 12:00 | EXPERIMENTAL AND NUMERICAL STUDY OF THE HOT STEEL PLATE FLATNESS<br>Jozef Hrabovský[1], Michal Pohanka[1], Pil Jong Lee[2], Jong Hoon Kang[2]<br>[1]Heat Transfer and Fluid Flow Laboratory, Faculty of Mechanical Engineering, Brno University of Technology, Brno, Czech Republic, [2]POSCO, Rolling Technology & Process Control Research Group 1, Pohang, Korea |
| 12:15 | NUMERICAL SIMULATION OF THE EQUILIBRIUM SEGREGATION OF IMPURITIES ON THE GRAIN BOUNDARIES OF COPPER AND ITS ALLOYS<br>Wojciech Ozgowicz<br>Institute of Engineering Materials and Biomaterials, Silesian University of Technology, Gliwice, Poland |

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| 12:30 | MATHEMATICAL MODELING USING TABU SEARCH APPROACH FOR OPTIMIZING OPERATIONAL CONDITIONS OF OXIDATIVE ORGANIC SOLUBILIZATION AND HYDROLYSIS REACTIONS<br>Taekjun Lee[1], Myung-Hwa Jung[2], Young Haeng Lee[1]<br>[1]Center for Water Resource Cycle, Korea Institute of Science and Technology, Seoul, South Korea, [2]Department of Physics, Sogang University, Seoul 121-742, South Korea |
| 12:45 | HIGH CHROMIUM CREEP RESISTANT STEELS – THE NEW CONCEPT OF DISJUNCTIVE MATRIX STATIONARY CREEP<br>Borut Žužek, Franc Vodopivec, Bojan Podgornik, Fevzi Kafexhiu<br>Institute of Metals and technology, Ljubljana, Slovenia |
| 13:00 | TRANSMISSION ELECTRON MICROSCOPY STUDY OF NiTi ORTHODONTIC WIRES<br>Darja Jenko[1], Janko Ferčec[2], Goran Dražič[3], Rebeka Rudolf[2,4]<br>[1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]University of Maribor, Faculty of Mechanical Engineering, Smetanova 17, 2000 Maribor, Slovenia, [3]National Institute of Chemistry, Hajdrihova 19, 1000 Ljubljana, Slovenia, [4]Zlatarna Celje d.d., Kersnikova 19, 3000 Celje, Slovenia |
| 13:15 | AUTOMATIC ANALYSIS OF NONMETALLIC INCLUSIONS IN STEEL USING FE-SEM<br>Gaj Slivnik[1], Boštjan Bradaškja[1], Marjan Marinšek[2]<br>[1]Research Center Jesenice Ltd., Jesenice, Slovenia [2]Faculty of Chemistry and Chemical Technology, University of Ljubljana, Ljubljana, Slovenia |
| 13:30 | MICROSTRUCTURE EVOLUTION OF ADVANCED HIGH-STRENGTH TRIP-AIDED BAINITIC STEEL<br>Adam Grajcar<br>Silesian University of Technology, Institute of Engineering Materials and Biomaterials, Gliwice, Poland |
| 13:45 | THE DISSOLUTION OF Zr IN Al-Mg-Si MELTS<br>Matej Steinacher[a*], Tonica Bončina[a], Peter Cvahte[b], Franc Zupanič[a]<br>[a]University of Maribor, Faculty of Mechanical Engineering, Maribor, Slovenia, [b]IMPOL Aluminium Industry, Slovenska Bistrica, Slovenia |
| 14:00 | LOW-TEMPERATURE EXTRUSION OF TITANIUM<br>Marek Łagoda, Paweł Ostachowski, Andrzej Korbel, Włodzimierz Bochniak,<br>AGH – University of Science and Technology, Cracow, POLAND |
| | **Closing ceremony** |
| **15:00** | **Light LUNCH** |

| **SREDA – WEDNESDAY 22. 10. 2014 – EUROPA »B«** | |
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| | **Predsedujoči – Chair: Monika Jenko, Matjaž Torkar** |
| 9:00 | **PLENARY LECTURE**<br>THE DEVELOPMENT OF CONTINUOUS CASTING PROCESS CONTROL BASED ON ADVANCED MATHEMATICAL MODELLING<br>Jan Falkus, Katarzyna Miłkowska-Piszczek<br>AGH University of Science and Technology, Kraków, Poland |
| 9:50 | **INVITED LECTURE**<br>TRACEABILITY TO INTERNATIONAL SYSTEM OF UNITS (SI) - SOME SPECIFICS AND CONCERNS<br>Zijad Džemić<br>Institute of Metrology of Bosnia and Herzegovina, Sarajevo, BiH |
| 10:15 | MAGNETIC CARBON NANOTUBES: SYNTHESIS AND PROPERTIES<br>Svitlana Kopyl, Igor Bdikin, Antonio C.M. Sousa<br>University of Aveiro, Department of Mechanical Engineering, TEMA, Aveiro, Portugal |
| 10:30 | COMPOSITES OF CARBON NANOTUBES WITH METALS AND METAL OXIDES: SYNTHESIS, STRUCTURES AND CHARACTERIZATION TECHNIQUES<br>Savilov S.V., Chernyak S.A., Novotortsev R.Yu, Egorov A.V., Lunin V.V.<br>M.V. Lomonosov Moscow State University, Chemistry Department, Russia, |
| 10:45 | ANODIC TITANIUM DIOXIDE NANOSTRUCTURES FOR DIFFERENT BIOMEDICAL APPLICATIONS<br>Mukta Kulkarni, Ajda Flašker, Andrej Artenjak, Katjusa Mrak-Poljsak, Saša Čučnik, Tanja Kveder, Snežna Sodin-Šemrl, Aleš Iglič<br>Faculty of Electrical Engineering, University of Ljubljana and University Medical Centre, Department of Rheumatology, Ljubljana, Slovenia |
| 11:00 | CORRUGATED SURFACE CARBON NANOTUBES: *IN SITU* HRTEM STUDY<br>Egorov A.V.[1], Savilov S.V.[1], Popov V.A.[2], Lunin V.V.[1]<br>[1]M.V. Lomonosov Moscow State University, Chemistry Dept. Russia, [2]National University of Science and Technology "MISIS" Russia, Moscow, |
| 11:15 | YATSKIV LOW-ENERGY ION BEAM INDUCED SURFACE ENGINEERING: FROM SELF-ORGANIZED NANOSTRUCTURES TO ULTRA-SMOOTH SURFACES<br>Bashkim Ziberi[a)], Frank Frost[b)], Klaus Zimmer[b)]<br>[a)]State University of Tetova, Tetova, Macedonia, [b)]Leibniz Institute of Surface Modification (IOM), Leipzig, Germany |
| **11:30** | **Coffee break** |
| | **Predsedujoči – Chair: Monika Jenko, Matjaž Torkar** |
| 12:00 | CATALYTIC AND SENSOR PROPERTIES OF $Co_3O_4$ PREPARED BY COMBUSTION SYNTHESIS ROUTE<br>Katarina Vojisavljević[1], Susanne Wicker[2], Nicolae Barsan[2], Brigita Kmet[1], Silvo Drnovšek[1], Barbara Malič[1]<br>[1]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, [2]Eberhard Karls University of Tübingen, Tübingen, Germany |
| 12:15 | FAST AND EFFECTIVE PREPARATION OF NANOCRYSTALLINE CELLULOSE FROM LIGNOCELLULOSIC SOURCES<br>Matjaž Kunaver[1], Tomaž Kos[1], Miroslav Huskić[1], Alojz Anžlovar[1], and Ema Žagar[1]<br>[1]National Institute of Chemistry, Ljubljana, Slovenia |
| 12:30 | ELECTRICAL AND OPTICAL PROPERTIES OF ZnO NANOROD ARRAYS PREPARED COMBINING ELECTROPHORETIC DEPOSITION AND HYDROTHERMAL GROWTH<br>R. Yatskiv, M. Verde, J.Grym, M. Hamplova<br>Institute of Photonics and Electronics AVCR, Czech Republic, Prague |

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| 12:45 | FABRICATION OF NANOSTRUCTURE Fe-DOPED ZnO THIN FILMS FOR ISOPROPYL ALCOHOL SENSORS<br>Brian Yuliarto, Yosandri Meigi, Muhammad Iqbal, Suyatman, Ahmad Nuruddin, Nugraha<br>Advanced Functional Materials Laboratory, Engineering Physics Department, Faculty of Industrial Technology, Institut Teknologi Bandung, Bandung Indonesia |
| 13:00 | SYNTHESIS AND CHARACTERIZATION OF CERAMIC FIBER PRODUCED BY PLASMA SPRAYING METHOD<br>Viktorija Grigaitienė[1], Vitas Valinčius[1], Mindaugas Milieška[1], Romualdas Kėželis[1], Jose Rodriguez Garcia[2], Inmaculada Canadas Martinez[2]<br>[1]Lithuanian energy Institute, Kaunas, Lithuania, [2]Plataforma Solar de Almería, Almería, Spain |
| 13:15 | STABILE DIELECTRIC RESPONSE AND HISTORY DEPENDENT EFFECTS IN LEAD-FREE RELAXOR $K_{0.5}Na_{0.5}NbO_3$-$SrTiO_3$ THIN FILMS<br>Andreja Eršte[1], Alja Kupec[1,2], Brigita Kmet[1], Barbara Malič[1,2] and Vid Bobnar[1,2]<br>[1]Jožef Stefan Institute, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Ljubljana, Slovenia |
| 13:30 | TIME DEPENDENCE OF OCCURRENCE OF TYPICAL DAMAGES ON BEARING SURFACE OF NITRIDED DIES FOR Al HOT EXTRUSION AS INDICATOR FOR INCREASING OF SERVICE TIMES<br>I. Peruš[1], P. Fajfar[1], G. Kugler[1], P. Cvahte[2] and M. Terčelj[1]<br>[1]Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia, [2]Impol, Slovenska Bistrica, Slovenia |
| 13:45 | MAPPING MATERIALS CHARACTERISTICS UNDER FATIGUE LOAD USING BARKHAUSEN NOISE ANALYSIS<br>Kamil Kolařík, Jiří Šimeček, Antonín Kříž<br>University of West Bohemia in Pilsen, Faculty of Mechanical Engineering, Department of Material Science and Technology, Plzeň, Czech Republic |
| 14:00 | PREDICTION OF CHEMICAL NON-HOMOGENEITY OF 30MNVS6 BILLETS WITH GENETIC PROGRAMMING<br>Miha Kovačič, Damir Novak<br>ŠTORE STEEL d.o.o., Železarska cesta 3, SI-3220 Štore |
| 14:15 | NEWLY DESIGNED TEST FOR COMPARATIVE ASSESSMENT OF THERMAL FATIGUE RESISTANCE OF VARIOUS PREPARED SURFACE LAYERS<br>M. Fazarinc[2], P. Fajfar[1*], A. Šalej, M. Terčelj[1]<br>[1]University of Ljubljana, Faculty of Natural Sciences and Engineering, Aškerčeva 12, Ljubljana, Slovenia, [2]Acroni Jesenice, cesta Borisa Kidriča 44, 4270 Jesenice |
| | **Closing ceremony** |
| **14:30** | **Light LUNCH** |

## POSTRSKA SEKCIJA – POSTER SESSION
## PONEDELJEK – MONDAY 20. 10. 2014 (19:30 – 21:00)

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| YR1 | PREPARATION OF HYDROPHOBIC ZINC SUBSTRATES BY SOLVOTHERMAL ROUTE<br>Anže Abram[1,2], Goran Dražić[1,2,3]<br>[1]Department for Nanostructured Materials K7, 'Jožef Stefan' Institute, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Ljubljana, Slovenia, [3]National Institute of Chemistry, Laboratory for materials chemistry, Ljubljana, Slovenia, Ljubljana, Slovenia |
| YR2 | MODEL OF PROGRESSIVE FAILURE OF COMPOSITE MATERIALS USING 3D PUCK FAILURE CRITERION<br>Lukas Bek, Robert Zemcik<br>European Centre of Excellence, NTIS – New Technologies for the Information Society, Faculty of Applied Sciences, University of West Bohemia, Pilsen, Czech Republic |
| YR3 | EFFECT OF BY-PASS CEMENT KILN DUST AND FLUIDIZED BED COMBUSTION FLY ASH ON PROPERTIES OF FINE-GRAINED ALKALI ACTIVATED SLAG-BASED COMPOSITES<br>Vlastimil Bílek[1], Ladislav Pařízek[2], Lukáš Kalina[3]<br>[1,2,3]Brno University of Technology, Faculty of Chemistry, Materials Research Centre, Brno, Czech Republic |
| YR4 | ALUMINIUM FOAMS FILLED WITH POLYMERIC MATERIAL AND THEIR RESPONSE UNDER MODERATE STRAIN RATE LOADING<br>Tomáš Doktor[1], Tomáš Fíla[2], Petr Zlámal[1], Ondřej Jiroušek[1]<br>[1]Institute of Theoretical and Applied Mechanics AS CR, v. v. i,. Prague 9, Czech Republic, [2]Czech Technical University in Prague, Faculty of Transportation Sciences, Prague 1, Czech Republic |
| YR5 | CREEP BEHAVIOUR OF C/PPS COMPOSITE<br>Tomáš Fíla[1], Jan Šleichrt[1], Daniel Kytýř[2]<br>[1]Czech Technical University in Prague, Faculty of Transportation Sciences, Prague 1, Czech Republic, [2]Institute of Theoretical and Applied Mechanics AS CR, Prague 9, Czech Republic |
| YR6 | INFLUENCE OF TYPE AND NUMBER OF PREPREG LAYERS ON FLEXURAL STRENGTH AND FATIGUE LIFE OF HONEYCOMB SANDWICH STRUCTURES<br>Ladislav Fojtl, Soňa Rusnáková, Milan Žaludek and Vladimír Rusnák<br>Department of Production Engineering, FT TBU in Zlín, Zlín, Czech Republic, Faculty of Metallurgy and Materials Engineering, VŠB-Technical University of Ostrava, Ostrava-Poruba, Czech Republic |
| YR7 | PROPERTIES AND STRUCTURE OF Cu-Ti-Zr-Ni AMORPHOUS POWDERS PREPARED BY MECHANICAL ALLOYING<br>Aleksandra Guwer, Anna Lebuda, Ryszard Nowosielski<br>Silesian University of Technology, Faculty of Mechanical Engineering, Institute of Engineering Materials and Biomaterials, Gliwice, Poland |
| YR8 | MODIFIED FINE-GRAIN CEMENT-BASED COMPOSITE SPECIMENS: CRACK INITIATION AND VOLUME CHANGES<br>Ivana Havlikova[1], Vlastimil Bilek Jr.[2], Libor Topolar[1], Hana Simonova[1], Zbynek Kersner[1]<br>[1]Brno University of Technology, Faculty of Civil Engineering, Brno, Czech Republic, [2]Ditto, Faculty of Chemistry |
| YR9 | CHITOSAN ETHYLSULFATES – SYNTHESIS, CHARACTERIZATION AND APPLICATION IN NANOTECHNOLOGY<br>Katja Heise[1], Heike M. Ehmann[2], Katrin Niegelhell[2], Uros Maver[3], Manuel Kaschowitz[2], Karin Stana Kleinschek[3], Stefan Spirk[2,3], Steffen Fischer[1]<br>[1]Institute for Plant and Wood Chemistry, Dresden University of Technology, Germany, [2]Institute for Chemistry and Technology of Materials, Graz University of Technology, Graz, Austria, [3]Institute for the Engineering and Design of Materials, University of Maribor, Maribor, Slovenia |

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| YR10 | EFFECT OF SKIN-CORE MORPHOLOGY ON MECHANICAL PROPERTIES IN INJECTION-MOLDED PARTS<br>Eva Hnátková[1,2], Petra Pavelová[1], Zdeněk Dvořák[1,2]<br>[1]Department of Production Engineering, Faculty of Technology, Tomas Bata University in Zlín, Zlín, Czech Republic, [2]Centre of Polymer Systems, University Institute, Tomas Bata University in Zlín, Zlín, Czech Republic |
| YR11 | HIGH TEMPERATURE ELASTIC BEHAVIOR OF MAGNESIA CHROME REFRACTORY MATERIALS<br>Ilona Jastrzębska, Zbigniew Pędzich, Jacek Szczerba, Jakub Szlęzak, Edyta Śnieżek<br>AGH University of Science and Technology, Kraków |
| YR12 | CORRELATION OF HEAT TRANSFER COEFFICIENT AT SPRINKLED TUBE BUNDLE<br>Petr Kracík, Ladislav Šnajdárek, Martin Lisý, Marek Baláš, Jiří Pospíšil<br>Institute of Power Engineering, Brno University of Technology, Faculty of Mechanical Engineering, Brno, The Czech Republic |
| YR13 | OPTIMISATION OF ANNEALING CYCLE OF PLASTER MOULDS FOR MANUFACTURE OF METALLIC FOAMS WITH IRREGULAR CELL STRUCTURE<br>Ivana Kroupová*, Petr Lichý*, Filip Radkovský*, Jaroslav Beňo*, Vlasta Bednářová*, Ivo Lána**<br>*VŠB-Technical University of Ostrava, Faculty of Metallurgy and Materials Engineering, Department of Metallurgy and Foundry, Ostrava-Poruba, Czech Republic, **Slévárna a modelárna Nové Ransko, Ždírec nad Doubravou, Czech Republic |
| YR14 | TENSILE AND COMPRESSIVE TESTS OF TEXTILE COMPOSITES AND ITS RESULTS ANALYSIS<br>Kryštof Kunc, Tomáš Kroupa, Robert Zemčík, Jan Krystek<br>University of West Bohemia in Pilsen, Czech Republic |
| YR15 | BIOPOLYMER NANOSTRUCTURING BASED ON EXCIMER LASER TREATMENT AND THERMAL ANNEALING<br>I. Michaljaničová, P. Slepička, P. Sajdl, V. Švorčík<br>Department of Solid State Engineering, Institute of Chemical Technology, Prague, Czech Republic |
| YR16 | SYNTHESIS OF Ti-Fe NANOCOMPOSITES FOR ENVIRONMENTAL APPLICATIONS<br>Eleni Petala[a,b], Jan Filip[a], Jiří Tuček[a], Michael A. Karakassides[b], Radek Zbořil[a]<br>[a]Regional Centre of Advanced Technologies and Materials, Faculty of Science, Palacký University, Šlechtitelů 11, CZ-78371 Olomouc, Czech Republic<br>[b]Department of Materials Science and Engineering, University of Ioannina, GR-45110 Ioannina, Greece |
| YR17 | CHARACTERISTICS OF DYE-SENSITIZED SOLAR CELLS WITH CARBON NANOMATERIALS<br>Agnieszka Mucha, Marzena Prokopiuk vel Prokopowicz, Marek Szindler, Aleksandra Drygała, Krzysztof Lukaszkowicz<br>Silesian University of Technology, Gliwice, Poland |
| YR18 | OPTIMISATION OF PREPARATION OF POLYSTYRENE PATTERNS FOR THE LOST FOAM TECHNOLOGY<br>Filip Radkovský, Petr Lichý, Ivana Kroupová, Vlasta Bednářová<br>VŠB-Technical University of Ostrava, Faculty of Metallurgy and Materials Engineering, Department of Metallurgy and Foundry, Ostrava-Poruba, Czech Republic |
| YR19 | IMPACT OF Al-RICH SECONDARY PHASES ON HIGH-TEMPERATURE STABILITY OF Al-DOPED ZnO THERMOELECTRIC MATERIALS<br>Tilen Sever, Boštjan Jančar, Danilo Suvorov<br>Advanced Materials Department, Jozef Stefan Institute, Ljubljana, Slovenia |
| YR20 | PREPARATION OF A POROUS CERAMICS MATERIAL BASED ON $CaZrO_3$<br>Edyta Śnieżek, Zbigniew Pędzich, Jacek Szczerba, Ilona Jastrzębska, Elżbieta Kleczyk<br>AGH University of Science and Technology, Faculty of Materials Science and Ceramics, Krakow, Poland |

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| YR21 | *POST MORTEM* STUDY OF THE REFRACTORY ZIRCONIA METERING NOZZLE EXPOSED TO CORROSIVE EFFECT OF THE MOLTEN STEEL AND SLAG, CD<br>Klaudia Wiśniewska, Dominika Madej, Jacek Szczerba<br>AGH University of Science and Technology, Kraków, Poland |
| YR22 | THE EFFECT OF CURRENT ON THE PRODUCTION OF NiTi INTERMETALLIC VIA ELECTRIC CURRENT ACTIVATED SINTERING<br>Tuba Yener, Sakin Zeytin<br>Sakarya University, Engineering Faculty, Department of Metallurgy and Materials Engineering, Adapazari, Sakarya -Turkey |
| YR23 | METALLIC BIOMATERIALS<br>Aleš Stambolić, Monika Jenko<br>IMT, Ljubljana, Slovenia |
| YR24 | MICROSTRUCTURAL CHANGES OF OCR12 TOOL STEEL MODIFIED BY RARE EARTH ELEMENTS<br>K. Zelič, J. Burja, F. Tehovnik, B. Šetina Batič, M. Godec<br>IMT, Lepi pot 11, Ljubljana |
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| 1 | MATHEMATICAL MODELING OF CEMENT RAW MATERIAL BLENDING PROCESS USING NEURAL NETWORK<br>Aysun Egrisogut Tiryaki, Recep Kozan, Nurettin Gökhan Adar<br>Department of Mechanical Engineering, Sakarya University, Sakarya, Turkey |
| 2 | NON-METALLIC INCLUSIONS IN THE PRODUCTION OF MICRO-ALLOYED STEEL IN THE LADLE FURNACE<br>Boštjan Arh, Franc Tehovnik, Jaka Burja<br>IMT, Ljubljana, Slovenia |
| 3 | THE APPLICATION OF ACTIVATING FLUXES IN THE MANUFACTURE OF MEDIUM PRESSURE PIPELINES<br>Darko Bajić[1], Tomaž Vuherer[2], Mića Đorđević[3], Stefan Ćulafić[1]<br>[1]University of Montenegro, Faculty of Mechanical Engineering, Podgorica, Montenegro, [2]University of Maribor, Faculty of Mechanical Engineering, Maribor, Slovenia<br>[3]"TehWeld" d.o.o, Loznica, Serbia |
| 4 | EFFECT OF DISINFECTANT AGENTS ON CORROSION OF VARIOUS METALS FOR DRINKING WATER SUPPLY SYSTEMS<br>Mirjam Bajt Leban, Tadeja Kosec<br>Slovenian National Building and Civil Engineering Institute, Ljubljana Slovenia |
| 5 | SURFACE FREE ENERGY OF HYDROPHOBIC COATINGS OF HYBRID FIBER REINFORCED HIGH PERFORMANCE CONCRETE<br>Danuta Barnat – Hunek, Piotr Smarzewski<br>Lublin University of Technology, Faculty of Civil Engineering and Architecture,Lublin |
| 6 | EFFECT OF EO AND STEAM STERILIZATION ON MECHANICAL AND ELECTROCHEMICAL PROPERTIES OF TITANIUM GRADE4<br>Marcin Basiaga, Witold Walke, Zbigniew Paszenda, Anita Kajzer<br>Silesian University of Technology, Faculty of Biomedical Engineering, Zabrze |
| 7 | DEPENDENCE OF GROUND MASS TO WATER CONTENT<br>František Vlach, Petr Jelínek, Tereza Bečkovská<br>Brno University of Technology, Faculty of Civil Engineering, Institute of Building Structures, Brno |
| 8 | UPGRADING TWO DIMENSIONAL NEURAL NETWORK BASED MODELS OF POLYCRYSTALLINE MATERIALS TO THREE DIMENSIONAL MODELS<br>Igor Belič<br>Inštitut za kovinske material in tehnologije, Ljubljana, Slovenia |

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| 9 | EVALUATION OF THE THERMAL RESISTANCE OF SELECTED BENTONITE BINDERS<br>Jaroslav Beňo[1], Iveta Vasková[2], Vlastimil Matějka[3], Karel Gál[1]<br>[1]Department of Metallurgy and Foundry engineering, Faculty of Metallurgy and Material Engineering, VŠB-Technical University of Ostrava Ostrava – Poruba, Czech Republic, [2]Technical University of Košice, Faculty of Metallurgy, Department of Ferrous and Foundry Metallurgy, Slovak Republic, [3]Nanotechnology Centre, VŠB-Technical University of Ostrava, Ostrava – Poruba, Czech Republic |
| 10 | MICROSTRUCTURE, MAGNETIC AND MECHANICAL PROPERTIES OF THE BULK AMORPHOUS ALLOY: $Fe_{61}Co_{10}Ti_4Y_5B_{20}$<br>Katarzyna Bloch[1], Marcin Nabiałek[1], Joanna Gondro[1]<br>[1]Czestochowa University of Technology, Faculty of Materials Processing Technology and Applied Physics, Institute of Physics, Poland |
| 11 | MULTI-PASS WELD MICROSTRUCTURE EVALUATION<br>Roman Celin, Matjaž Godec, Nataša Lipovšek<br>Institute of metals and technology, Ljubljana, |
| 12 | STUDY OF DEVELOPMENT OF ASH BODY MICROSTRUCTURE IN THE ARTIFICIAL AGGREGATE PRODUCTION TECHNOLOGY<br>Vit Cerny<br>Brno University of Technology, Faculty of Civil Engineering, Brno, Czech Republic |
| 13 | POLYMERIC HOLLOW FIBERS EMBEDDED IN A PHASE CHANGE MATERIAL: HEAT TRANSFER ANALYSIS<br>P. Charvát, J. Hejčík, L. Klimeš, I. Astrouski<br>Brno University of Technology, Brno, Czech Republic |
| 14 | INFLUENCE OF CARBIDE SPHEROIDISATION PROCESS ON MICROSTRUCTURE AFTER QUENCHING AND ANNEALING OF 100CrMnSi6-4 BEARING STEEL<br>Jaromir Dlouhy, Daniela Hauserova, Zbysek Novy<br>COMTES FHT a.s., Plzen, Czech Republic |
| 15 | DEVELOPMENT OF METHOD OF MEASURING FRICTION COEFFICIENT USING A CLOSED DIE FORGING PROCESS<br>Michal Duchek, Ivana Polakova, Petr Martinek<br>COMTES FHT a.s., Dobrany, Czech Republic |
| 16 | COMPOSITES BASED ON INORGANIC MATRIX FOR EXTREME EXPOSURE CONDIFIONS<br>Ámos Dufka, Tomáš Melichar<br>Brno University of Technology, Faculty of Civil Enginering, Institute of Technology of Building Materials and Components, Brno, Czech Republic |
| 17 | FEM SIMULATION OF WELD USING LOCAL MECHANICAL PROPERTIES DETERMINATION<br>Jan Džugan, Miroslav Urbánek, Martin Rund, Radek Prochazka, Pavel Konopík<br>COMTES FHT Inc., Dobřany, Czech Republic |
| 18 | INCONEL 718 COATING OBTAINED BY ELECTRIC CURRENT ASSISTED SINTERING<br>Nuri Ergin, Ozkan Ozdemir<br>Sakarya University Esentepe, Sakarya/Turkey |
| 19 | THE INFLUENCE OF COATINGS ON WEAR AND DEFLECTION OF POLYMER GEARS<br>Jože Flašker[1], Srečko Glodež[1], Boštjan Zafošnik[2], Boštjan Trobentar[1]<br>[1]University Maribor Faculty of Mechanical Engineering, Maribor, Slovenia, [2]Prometheus, Boštjan Zafošnik s.p., Ljubljana, Slovenia |
| 20 | EFFECT OF ANNEALING TEMPERATURE ON PHOTOCATALYTIC EFFICIENCY OF $In_2O_3$-MODIFIED ZnO NANOCRYSTALLITES IN DEGRADATION OF ALPRAZOLAM<br>Tamara Ivetić[1], Nina Finčur[2], Ljubica Đačanin[1], Biljana Abramović[2], Svetlana Lukić-Petrović[1]<br>[1]Department of Physics, Faculty of Sciences, University of Novi Sad, Novi Sad, Serbia, [2]Department of Chemistry, Biochemistry and Environmental Protection, Faculty of Sciences, University of Novi Sad, Novi Sad, Serbia |

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| 21 | COMPRESSIVE PROPERTIES OF AUXETIC STRUCTURES PRODUCED BY DIRECT 3D PRINTING<br>Petr Koudelka[1], Ondrej Jirousek[2], Tomas Doktor[1], Michaela Neuhauserova[2]<br>[1]Institute of Theoretical and Applied Mechanics, Academy of Sciences of the Czech republic, v.v.i., Prague 9, Czech Republic, [2]Czech Technical University in Prague, Faculty of Transportation Sciences, Prague 1, Czech Republic |
| 22 | EFFECT OF COMMON STERILIZATION TECHNIQUES ON 3D PRINTED MEDICAL TOOLS<br>Ita Junkar[1], Darij Kreuh[2], Janez Kovač[1], Miran Mozetič[1]<br>[1]Jožef Stefan Institute, Slovenia, [2]Ekliptik d.o.o, Ljubljana, Slovenia |
| 23 | KINETICS OF THE PRECIPITATION IN THE AUSTENITE OF HSLA STEEL<br>[1]Elżbieta Kalinowska-Ozgowicz, [2]Wojciech Ozgowicz, [1]Klaudiusz Lenik<br>[1]Fundamentals of Technology, Lublin University of Technology, Lublin, Poland, [2]Mechanical Engineering Faculty, Silesian University of Technology, Gliwice, Poland |
| 24 | MAGNETORHEOLOGICAL SUSPENSION BASED ON SILICONE OIL<br>Sławomir Kciuk, Monika Kciuk<br>Faculty of Mechanical Engineering, Silesian University of Technology, Gliwice, Poland |
| 25 | INVESTIGATION ON NEW CREEP AND OXIDATION RESISTANT MATERIALS<br>Bohuslav Masek[1], Omid Khalaj[1], Jan Vomela[1], Andrea Ronesova[1], Hana Jirkova[1], Jiri Svoboda[2]<br>[1]The Research Centre of Forming Technology, University of West Bohemia, Pilsen, Czech Republic, [2]Institute of Physics of Materials, Academy of Sciences Czech Republic Brno, Czech Republic |
| 26 | MICROSTRUCTURAL CHANGES OF FINE-GRAINED CONCRETE EXPOSED TO SULFATE ATTACK<br>Martin Vyšvařil, Patrik Bayer, Markéta Rovnaníková<br>Brno University of Technology, Faculty of Civil Engineering, Institute of Chemistry, Brno, Czech Republic |
| 27 | FABRICATION OF ELECTROCHEMICAL SENSOR BASED ON GRAPHENE/ZINC OXIDE NANOCOMPOSITE FOR NONENZYMATIC HYDROGEN PEROXIDE SENSING<br>Sze Shin Low[1], Michelle T. T. Tan[1], Poi Sim Khiew[1], Chiu Wee Siong[2]<br>[1]Division of Materials, Mechanics and Structures, Center of Nanotechnology and Advanced Materials, Faculty of Engineering, University of Nottingham Malaysia Campus, Jalan Broga, Semenyih, Selangor, Malaysia, [2]Low Dimensional Materials Research Center, Department of Physics, Faculty of Science, University Malaya, Kuala Lumpur, Malaysia |
| 28 | SYNTHESIS OF REACTIVE ENERGETIC PLASTICIZERS WITH CLICKABLE FUNCTIONALITY TO CONTROL PROCESSING PROPERTIES OF CASTABLE PBX'S<br>Jin Seuk Kim[1], Seung Hee Kim[1], Younghwan Kwon[2], and Kibong Lee[1]<br>[1]The 4th R&D Institute -2nd Directorate, ADD, Daejeon, Korea, [2] Department of Chemical Engineering, Daegu University, Gyeongsan, Korea |
| 29 | PROPERTY CHARACTERIZATION AND EVALUATION OF $Al_2O_3$-$TiB_2$ PRODUCED BY REDUCTION COMBUSTION SYNTHESIS METHOD<br>Caner Kocabaş, Harun Güler, Yiğit Garip, Nuri Ergin, Özkan Özdemir<br>Sakarya University, Technology Faculty, Department of Metallurgy and Materials Engineering, Sakarya-Turkey |
| 30 | ELASTIC-PLASTIC MATERIAL MODEL OF TEXTILE COMPOSITES AND IDENTIFICATION OF MATERIAL PARAMETERS<br>Tomáš Kroupa, Kryštof Kunc, Robert Zemčík,Tomáš Mandys<br>University of West Bohemia in Pilsen, Plzeň, Czech Republic |
| 31 | PHYSICOCHEMICAL PROPERTIES OF TI67 ALLOY AFTER EO AND STEAM STERILIZATION<br>Witold Walke, Marcin Basiaga, Zbigniew Paszenda, Jan Marciniak<br>Silesian University of Technology, Faculty of Biomedical Engineering, Zabrze |

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| 32 | LOAD CAPACITY PREDICTION OF CARBON OR GLASS FIBRE REINFORCED PLASTIC PART OF WRAPPED PIN JOINT<br>Jan Krystek, Radek Kottner<br>University of West Bohemia, Plzen, Czech Republic |
| 33 | EXPERIENCE WITH ACCUMULATIVE ROLL BONDING OF LOW-CARBON STEEL<br>Tomáš Kubina, Jaroslav Gubiš<br>COMTES FHT a.s., Dobrany, Czech Republic |
| 34 | DEFORMATION BEHAVIOUR OF NATURAL SHAPED BONE SCAFFOLD<br>Daniel Kytýř[1], Tomáš Doktor[1], Ondřej Jiroušek[1], Tomáš Fíla[2], Petr Koudelka[2], Petr Zlámal[2]<br>[1]Czech Technical University in Prague, Faculty of Transportation Sciences, Prague 1, Czech Republic, [2]Institute of Theoretical and Applied Mechanics AS CR, Prague 9, Czech Republic |
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# PREPARATION OF HYDROPHOBIC ZINC SUBSTRATES BY SOLVOTHERMAL ROUTE

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Function-guided synthesis of oxide nanomaterials through shape and size tailoring is of great interest due to the demand for advanced materials with novel physical and chemical properties. Controlled oxidation of metallic zinc substrates is essential due to rapid natural passivation of zinc with unordered zinc oxide (ZnO) layer. This was achieved by one-step hydro- and solvothermal synthesis with addition of zinc nitrate hexahydrate ($Zn(NO_3)_2 \cdot 6H_2O$) as another precursor for zinc ions. Samples (discs) were first rinsed in acetone and placed in ultrasonic bath for 10 minutes before hydrothermal treatment for 2-12 hours at 80-125 °C. Dried samples were then dip-coated in aqueous solution of fluoro alkyl silane (FAS, by Evonik) and dried in order to obtain superhydrophobic surface. Coatings were characterized with several techniques (XRD, SEM, TEM/SAED, EDXS) and quality of silane coating determinated by change of contact angle. Uncoated substrate surface with zinc oxide layer exhibits hydrophilic properties (contact angle 40-50 °) compared to silane-coated one which exhibits so called "lotus effect" and general superhydrophobicity (contact angle > 150 °). Different reaction parameters and solvent used in hydrothermal synthesis yield different ZnO surface morphologies like nanowires, nanorods or disc-shaped structures.

# MATHEMATICAL MODELING OF CEMENT RAW MATERIAL BLENDING PROCESS USING NEURAL NETWORK

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The raw material blending is an important process affected cement quality. The task of this process is to mix a variety of materials such as limestone, shale, sandstone, iron and so on, to produce cement raw meal for the kiln. One of the fundamental problems in the cement manufacture is ensuring the appropriate chemical composition of cement raw meal. A raw meal with a good fineness and well controlled chemical composition by control system can improve the cement quality. The first step to design a control system for the process is obtaining an appropriate mathematical model of the process. In this study, Linear and Nonlinear Neural Network model were investigated for raw material blending process in cement industry and these mathematical model results were compared with the experimental data. The results showed that the nonlinear model has higher predictive accuracy.
Key words: Mathematical modeling, Cement, Raw material blending, Neural network.

# METALLURGY EUROPE – A RENAISSANCE PROGRAMME FOR 2012-2022

Andrea Amaldi

The Materials Science and Engineering Expert Committee (MatSEEC), founded at the European Science Foundation in October 2009, hereby presents this position paper entitled "Metallurgy Europe". This document was developed by a working group led by Professor David Jarvis and consisting of Professor Dierk Raabe, Professor Robert Singer, Professor Paul Van Houtte, Dr Constantin Vahlas, Professor Neil Alford, Professor Krzysztof Kurzydlowski, Professor Risto Nieminen, Professor Andreas Mortensen, Professor Herbert Gleiter, Professor Michael Loretto, Professor Yves Brechet and Professor Hans-Jörg Fecht. Europe is very prominent in the field of metallurgy – not only in academic research and invention, but also in industrial alloy production, down-stream processing, end-user applications and recycling Metals and alloys can be found in a wide range of high-tech products such as airplanes, cars, trains, ships, satellites, propulsion systems, power-generating turbines, batteries, fuel cells, catalytic reactors, wind turbines, magnets, electrical cabling, pipe lines, robots, orthopaedics, computers and mobile phones, and many, many more. A modern world without metals and alloys is inconceivable. In order to maintain the high standard of living in Europe, it is essential to keep investing in the next generation of metallic products. This will help us aim for the future and tackle some of the societal challenges related to energy, renewables, climate change reduction, health care and job security. Many national studies have recently been carried out in Europe. They have all concluded that metallurgy, as a fundamental and applied research topic, is suffering from low levels of public investment and student enrolment. More must be done to promote R&D in this field in Europe. The Materials Science and Engineering Expert Committee (MatSEEC), founded at the European Science Foundation in October 2009, hereby presents this position paper entitled "Metallurgy Europe". This document was developed by a working group led by Professor David Jarvis and consisting of Professor Dierk Raabe, Professor Robert Singer, Professor Paul Van Houtte, Dr Constantin Vahlas, Professor Neil Alford, Professor Krzysztof Kurzydlowski, Professor Risto Nieminen, Professor Andreas Mortensen, Professor Herbert Gleiter, Professor Michael Loretto, Professor Yves Brechet and Professor Hans-Jörg Fecht. Europe is very prominent in the field of metallurgy– not only in academic research and invention, but also in industrial alloy production, down-stream processing, end-user applications and recycling.Metals and alloys can be found in a wide range of high-tech products such as airplanes, cars, trains, ships, satellites, propulsion systems, power-generating turbines, batteries, fuel cells, catalytic reactors, wind turbines, magnets, electrical cabling, pipelines, robots, orthopaedics, computers and mobile phones, and many, many more. A modern world without metals and alloys is inconceivable. In order to maintain the high standard of living in Europe, it is essential to keep investing in the next generation of metallic products. This will help us aim for the future and tackle some of the societal challenges related to energy, renewables, climate change reduction, health care and job security. Many national studies have recently been carried out in Europe. They have all concluded that metallurgy, as a fundamental and applied research topic, is suffering from low levels of public investment and student enrolment. More must be done to promote R&D in this field in Europe.

# BIOGENIC MICRO-SILICA: A MULTIFUNCTIONAL RAW MATERIAL IN ENVIRONMENTALLY FRIENDLY APPLICATIONS

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Aim of this study is the characterization of biogenic silica-rich raw materials and the examination of their properties regarding further applications beyond their conventional uses.

Diatomite is a siliceous multifunctional raw material, due to its exceptional properties of heat resistance, high specific surface area, low density, high micro-porosity and absorption efficiency. It is mainly composed of biogenic amorphous micro-silica (opal-A).[1,2]

Since 2003, UoA research team has studying significant clayey and calcareous diatomite deposits and has testing them on a laboratory scale for the production of a) Lightweight aggregates [LWA] and Lightweight Concrete [LWC], b) Absorbents, c) Synthetic Wollastonite [CS] and Belite [$C_2S$], on laboratory scale. Both raw material types and their end – products were examined for their mineralogy, chemistry, texture, specific surface area, absorption capacity, apparent density, porosity and fracture load/compressive strength. Materials characterisation and testing, was implemented jointly with private companies, institutions and universities across Europe.

The Greek raw materials under investigation were: (i) calcareous diatomite that occurs in several islands of the Aegean and Ionian seas, and (ii) clayey diatomite that occurs in Central and Northern Greece, sometimes occurring as Upper Miocene lignite overburden. Based on field work data, materials characterization and laboratory tests, the specific deposits have promising reserves, proper mineralogy and technical characteristics for certain industrial, environmental friendly applications.[3,4,5]

It is noteworthy that these products combine the efficient use of mineral and energy resources for both construction and environment, as well as the cost effectiveness of biogenic opal-A rich raw materials. The innovative end-products have comparable properties to commercial products that are currently in use, exhibiting equal or sometimes better behavior, and are expected to present high commercial interest due to their multiple applications, both as pollutants adsorbents in environmental applications and also as low-cost insulation and construction materials. Finally, it is proposed a further investigation of Greek biogenic micro-silica rich deposits regarding industrial scale production for certain applications.

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# NON-METALLIC INCLUSIONS IN THE PRODUCTION OF MICRO-ALLOYED STEEL IN THE LADLE FURNACE

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The chemical composition of the non-metallic inclusions and their volume fraction are determined with the different steps of the steel production process such as melting, refining and casting. The chemical composition and morphology of inclusions depends from the applied operative parameters and features of the produced steel grade. As a function of their origin a non-metallic inclusion can be classified as endogenous or exogenous. On the basis of chemical composition they can be divided into three groups: oxide, sulfide and nitride nonmetallic inclusions. The oxide compounds are formed by oxidizing added elements to the steel melt in order to reduce the oxygen content. The sulfides are often the consequence of the calcium treatment applied in order to modify the oxide inclusions. On the contrary the MnS non-metallic inclusions are exploited for improving the cutting tool workability. During the manufacturing process problems related to difficulties during the casting operation associated with submerged nozzle clogging between the tundish and the mould can occur. Non-metallic inclusions can also have a detrimental effect on the mechanical properties of the steel. When manufacturing micro-alloyed engineering steel the control of the chemical composition of the non-metallic inclusions takes place mainly during secondary steelmaking process, in the refining of the melt in the ladle furnace (LF). Analysis of typical non-metallic inclusions in micro-alloyed engineering steel is presented in order to establish the processing stages that determine the origin and treatment of inclusions.

# SYNTHESIS AND STUDY OF N-DOPED CARBON NANOFLAKES FROM HYDROCARBONS PYROLYSIS

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Graphene has attracted much interest because of unique physical and chemical properties. Due to the high specific surface area, electrical conductivity, corrosion inertness, controlled pore structure they are used in the chemical industry, electronic devices. Nevertheless synthesis of graphene in pure form in industrial amount is still the quite difficult and expensive task. Low dimensional graphite flakes in its turn are commercially available products and in most cases demonstrate similar properties.

Up to now one of main approaches to improve electronic and acid-base properties of carbon materials is doping by heteroatoms. Introduction of nitrogen in layers is promising way to reach this aim.

N-doped carbon nanoflakes were synthesized by pyrolitic technique using acetonitrile, pyridine, n-butilamine as precursors that are commonly known organic substances containing both N and C atoms. Doping of nitrogen was carried out at temperature 800 and 900 °C with duration of the synthesis 15, 30, 60 and 90 minutes. MgO with S=140 $m^2/g$ was used as the template. Carbon materials obtained have been characterized with SEM and HRTEM and were found to be few-layers nanoscale graphite fragments. N-doping was confirmed by X-ray photoelectron spectroscopy, Raman spectroscopy and elemental analysis. N atoms formed a “pyridinic” nitrogen structure and contents of nitrogen reached up 10.9 at.% (acetonitrile), 7.5 at.% (pyridine) and 6.3 at.% (n-butilamine). It was found the specific surface area depends on time of reaction (15 – 90 minutes) and temperature of the synthesis: the increasing of this parameter led to decreasing of specific surface area from 820 to 170 $m^2/g$, from 670 to 370 $m^2/g$ and from 900 to 550 $m^2/g$, correspondingly to acetonitrile, n-butilamine and pyridine respectively.

# TRENDS IN NATURAL FIBRE COMPOSITES

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The environmental awareness is increasing, which leads to a growing interest in natural fibre reinforced composites (NFC's). NFC's are used because of their renewability, their low energy for production, the fact that they are $CO_2$ neutral and their good mechanical properties [1, 2]. Natural fibre composites are hence sustainable materials, which is proven by different life cycle assessment studies[3].

Besides this ecological advantage of the use of natural fibres in composites, there are also different reasons why you do not see them in your daily life. First there is the adhesion problem between the natural fibres and the matrix. This problem has been investigated a lot and different treatments are available to overcome this problem. Natural fibres are by nature hydrophilic, which means that they absorb moisture, even when used in composites. Also here treatments, mainly the same treatments are available.

Another aspect of natural fibres is that their length is limited, which is opposite to synthetic fibres. For textile applications, an infinite fibre is necessary. This is solved for natural fibres by spinning, leading to a twisted yarn. This twist has huge consequences on the mechanical behavior of the composites, leading to a decrease in properties up to 30%.

Recent developments for the flax industry have led to preforms with a reduced twist and therefore better mechanical properties. These developments evolved in a bunch of new applications, mainly in the prototype phase.

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# THE APPLICATION OF ACTIVATING FLUXES IN THE MANUFACTURE OF MEDIUM PRESSURE PIPELINES

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In the manufacture of medium pressure pipelines the TIG (WIG) welding process is traditionally used. Thanks to its technological advantages, the use of ATIG process is specially recommended for welding of high-alloy austenite steels of thickness more than 3mm. In this paper it is presented the use of ATIG welding process in manufacture of the pipeline No100 (Np81). Used material is corrosion resistant – steel 316L. Dimensions of the pipes are Ø108x4 mm.
Highly-dispersive mixture – activating fluxes for the class of austenite high-alloy steels are used for welding. With the free contraction process it is obtained necessary reinforcement in the weld metal.
Fluxes are highly dispersed mixture which contains necessary micro-amounts of electro-negative and surface active elements, which under the shield of the inert gas in welding allows development of the physical-chemical reactions. Because of the increase in crystallization rate due to the molten metal and the flux due to the presence of micro-alloying, chopping is done to the structure of WM which becomes disoriented [1-10]. In order to provide an acceptable camber of the joint face, it is necessary to apply a method of *free contraction*.
The contribution of this paper is to present the application of new technologies of arc welding in pipelines in order to increase productivity and quality of welds in metallic materials (MM).

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# EFFECT OF DISINFECTANT AGENTS ON CORROSION OF VARIOUS METALS FOR DRINKING WATER SUPPLY SYSTEMS

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Drinking water supply systems consist of pipes (metal or plastic) and accessories (valves, T species, etc.) made from different type of metals: galvanized carbon steel, stainless steel and copper and its alloys. Lifetime of installations for drinking water should be designed for at least 50 years, but in many cases they fail much earlier - usually due to corrosion. The main reason for corrosion of drinking water supply systems is the corrosivity of water as well as the different chemical and physical methods of disinfection of water systems. In Europe and the world, there are known standardized tests for determination of impact of the disinfectants on sustainability of materials used for drinking water systems. However, the standardized tests are time consuming and expensive.

The main aim of our research is to characterize corrosion behavior of commonly used metal materials in Slovenia (galvanized steel, stainless steel and copper and its alloys) in local water with additions of disinfectants (concentration for continuous disinfection and increased concentration used for chemical shocks). In addition, tests will be performed at room and at elevated temperature. Various electrochemical methods (potentiodynamic polarization and polarisation resistance) are used for determination of electrochemical properties. The metal materials are studied in drinking water with different additions of disinfectant agents at two different temperatures, room temperature and elevated temperature of 80 °C. Type and extent of corrosion products is studied by scanning electron microscope and Raman spectroscopic methods after 7 and 40 days of exposure).

The results of tests have shown increased corrosion activity at elevated temperatures. Also, different disinfectants have different influence to different types of metals. It was observed that the results of electrochemical tests are in accordance to observations obtained by visual examination of surfaces after exposures.

# MULTI-WALLED CARBON NANOTUBES EFFECT IN POLYPROPYLENE NANOCOMPOSITES

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Polymer nanocomposites have gained interest in the last decades due to the attractive properties of nanostructured fillers, and their ability to enhance the matrix performance when added in low contents (1- 5%), improvements comparable to those achieved by conventional loadings (15- 40%) of traditional fillers [1].

The paper presents a study concerning thermoplastic nanocomposites having polypropylene as matrix and different contents of carboxyl functionalized multi-walled carbon nanotubes as nanofiller. The materials are obtained by melt compounding of the nanofiller powder and polymer pellets through extrusion process followed by injection molding into specific shape specimens for mechanical testing of the samples. The materials are evaluated in terms of mechanical properties regarding tensile and flexural strength and modulus, thermal stability under load (heat deflection temperature) and thermal behavior properties using TG-DSC analysis. The fracture cross section is analyzed using FT-IR spectroscopy and SEM microscopy to evaluate the bulk characteristics of the materials.

The results show positive effects concerning the effect of nanofiller addition to the thermoplastic polymer concerning mechanical strength and modulus of the materials at flexural and tensile tests, while in the case of thermal stability under load, nanofiller addition has minor influence on the heat deflection temperature values.

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# SURFACE FREE ENERGY OF HYDROPHOBIC COATINGS OF HYBRID FIBER REINFORCED HIGH PERFORMANCE CONCRETE

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The aim of the research presented in the paper was to evaluate the feasibility of using hydrophobizing preparations based on organosilicon compounds for protection treatment on hybrid fiber reinforced high perfomance concrete (FRHPC) surface. The wettability of concrete has a direct effect on the durability and corrosion resistance [1, 2]. The wetting properties of FRHPC were evaluated through the measurement of the contact angle between the surface of these materials using water and glycerine as probe liquids. On this basis, the surface free energy (SFE) was determined. The polar and disperse components of the SFE are obtained by means of the Owens–Wendt Method [3]. The three different siloxane preparations are deposited onto the seven types of concretes, with fiber content ranging from 0 to 1%. SEM examination of the coated concrete surface confirmed that the preparations A÷C can effectively cover the voids and pores present on the concrete surface, Fig. 1.

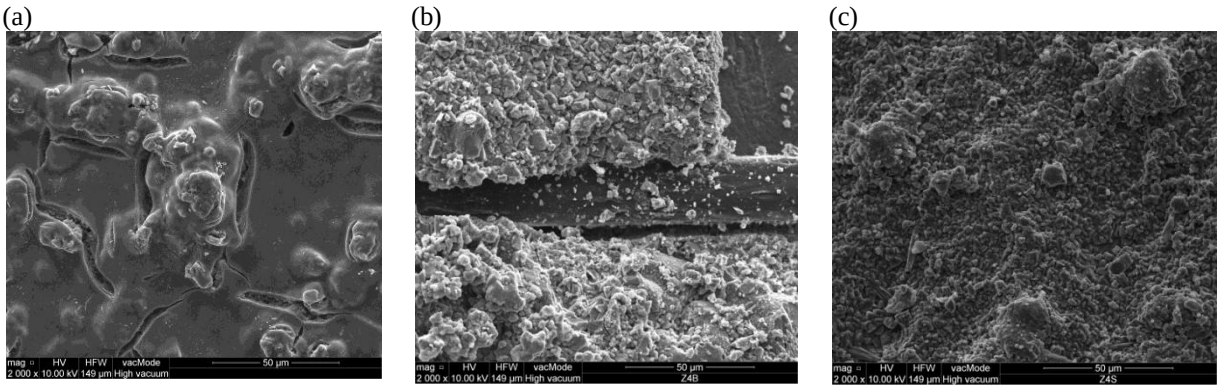


Fig. 1. The organosilicon compounds in the microstructure of FRHPC: (a) water-soluble preparation – A, (b) alkyl alkoxysilane oligomers – B, (c) methylosilicone resin – C

The present results indicate that surfaces of concrete with silanes film have got a wide range of SFE, depending on kind the agents. The SFE depends on the chemical reactivity of the silanes used, the type of solvent, the viscosity and surface tension of the solution. The evaluation of contact angle and SFE help to efficiently select the most appropriate preparation.

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# EFFECT OF EO AND STEAM STERILIZATION ON MECHANICAL AND ELECTROCHEMICAL PROPERTIES OF TITANIUM GRADE4

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Currently, various modifications of surface are made more and more frequently in order to improve implants haemocomatibility. The main criterion determining applicability of the respective surface modification method is obtaining a product featuring suitable functional properties. These properties depend on a great extent on corrosion resistance in the environment of human blood. Subject-matter literature does not devote much attention to sterilisation process of titanium and cpTi alloys with surface modification [1, 2]. A problem that still remains unsolved is selection of proper test showing full characteristics of their behaviour contact with blood environment during the time the implant is used [3]. Therefore, the authors of this study made an attempt at evaluation of the impact of medical sterilisation methods, i.e. ethylene oxide anodic oxide and $SiO_2$ layer by means of sol-gel method. Efficiency of the suggested technology of oxide layer application was evaluated on the ground of mechanical and electrochemical tests. Sterilisation in ethylene oxide and steam had a favourable influence on electrochemical and mechanical properties of cpTi, irrespective of the way of surface preparation. In order to simulate real conditions, the tests were performed in artificial plasma at the temperature of T = 37±1°C and pH = 7.0 ± 0.2. Obtained results proved diversification of electrochemical properties of oxide layers, depending on technological parameters of its application. Suggestion of proper variants of surface modification with application of electrochemical and chemical methods is of a long-range importance and will contribute to development of technological conditions with specific parameters of creation of oxide layers on metallic implants made of cpTi.

Acknowledgments
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# DEPENDENCE OF GROUND MASS TO WATER CONTENT

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This paper deals with the influence of moisture in the soil to depth of freezing. Soil is an essential material for applications in construction and agriculture. The purpose of the research is to determine the thermal effects of freeze to soils. The depth of freezing depends on the type of soil and moisture content. Influence of the composition of water and soil is generally perceived to be substantial for depth of freezing. Sub-zero temperatures significantly change soil's properties. The soil is very important material for civil engineering and similar specializations.
The paper shows consequences effects enthalpy of water per field measurements and a laboratory experiment. We performed numerical modeling of monitored phenomena to determine the time limit for effects of frost in the soil.

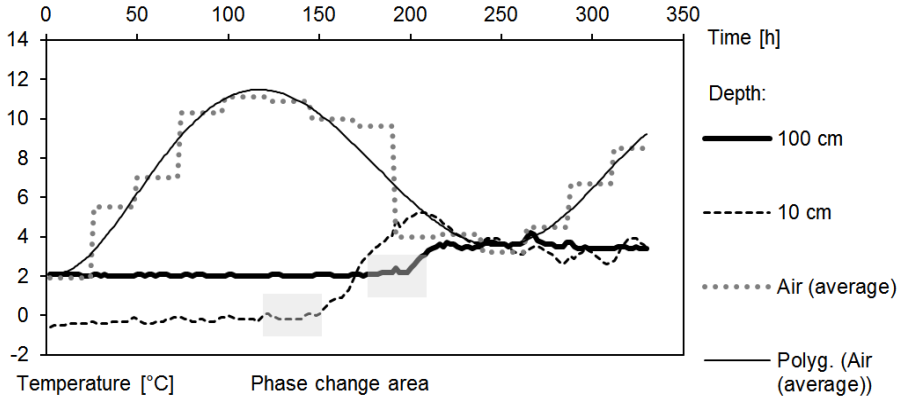


*Figure 1: Temperatures measured during the field measurement. Intervals during which the phase change occurred are highlighted.*

Figure 1 illustrates the effect of frozen water in the soil at the temperatures in different depths. The experiments show that frozen water contained in the soil significantly reduces the depth of freezing.

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# MODEL OF PROGRESSIVE FAILURE OF COMPOSITE MATERIALS USING 3D PUCK FAILURE CRITERION

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Composite materials are frequently used in aerospace, automotive, and marine industries and in civil engineering due to their high stiffness-to-weight and strength-to-weight ratios. Due to complex loading in applications, finite element (FE) analyses are usually used for the investigation of stress state and failure of structures. However, commercial FE software systems are usually able to predict only first failure which can occur at 20% of a total strength of structures. In order to investigate the total strength, the progressive failure must be considered and implemented into the software using a user defined material subroutine.

In this work, the model of progressive failure of layered composite materials was developed and implemented into the FE Abaqus software using the user defined material subroutine UMAT [1]. Non-linear material behaviour was assumed and modelled using the non-linear function with constant asymptote [2]. For prediction of the failure, the 3D Puck failure criterion was used [3]. The influence of fibre parallel-stress extension and the influence of non-fracture plane stresses extension were used with this criterion [4]. The progression of the failure was simulated using the stiffness matrix degradation where the degradation parameters were functions of the fracture angle. Furthermore, a simplified approach for simulation of delamination was implemented. For this reason, the model assumes thin layer of isotropic matrix between each orthotropic lamina.

The model was tested on failure simulations of a pin-loaded composite plate and of a composite tube subjected to compressive loading perpendicular to the tube axis.

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# UPGRADING TWO DIMENSIONAL NEURAL NETWORK BASED MODELS OF POLYCRYSTALLINE MATERIALS TO THREE DIMENSIONAL MODELS

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We have already published our modelling approach of so called non-mesh based modelling, where the presented modelling techniques were given in a two dimensional (2D) space. The main building block of the modelled material is the random grain. In 2D space the random grain modelling starts with the generation of random geometric shape defined by the set of lines intersecting in corner points. The line sections between the corners ("valid" sections) are represented by several points that serve as the training data set for the neural network. Once neural network is trained, it holds and represents the entire random grain boundary. Grains that are stored as weights of neural networks are easy to manipulate, they can be placed anywhere in the coordinate system, rotated, elongated, scaled, their boundary roughness can be changed at will. In three dimensional (3D) space the random grain generation starts with the selection of random planes defining the grain boundary. Each 3D plane is defined by the plane norm and one point being the base of the plane norm. The random process selects the random number of boundary planes (with reasonable limitations). Follows the definition of border lines representing the intersections of border planes and the selection of points representing the valid sections of border planes. From here on, the process of neural network training is exactly the same as in 2D only that in 3D case each grain border point is defined by two angles and one radius (polar coordinate system). Generated random grains (weights) are stored and a large library of random grains is prepared. By forming the grains library the process of generation of virtual material is fast since the neural network training process (which is slow) is avoided. 1 T Bytes hard disc can contain approximately $10^8$ different virtual grains. The modeled material is then constructed by the extremely large number of uniquely shaped virtual grains.
The 3D virtual random grains are prepared to be used for modelling of polycrystalline materials and to be represented by the virtual reality technology.

# EVALUATION OF THE THERMAL RESISTANCE OF SELECTED BENTONITE BINDERS

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Bentonite is one of the most widespread used clays connected with various applications. In the case of foundry technology, bentonite is primarily used as a binder for mold manufacture. Thermal resistance of bentonite binders, also called as thermal stability, is a natural property of clay minerals, depends on genesis, source and chemical composition of clay and it is also closely connected to bentonite structure. Generally, there are various methods for evaluation this property. This contribution describes a various methods of bentonite thermal stability determination based on evaluation of technological parameters of bentonite molding mixtures and their comparison. These methods were chosen on the basis of backround research and practical experiences. For the experiments commonly used bentonites in foundries of Czech and Slovak region were selected.

# EFFECT OF BY-PASS CEMENT KILN DUST AND FLUIDIZED BED COMBUSTION FLY ASH ON PROPERTIES OF FINE-GRAINED ALKALI ACTIVATED SLAG-BASED COMPOSITES

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Binders based on alkali activated slag (AAS) are considered as an ecological alternative to ordinary Portland cement (OPC) based binders, which are most common in the concrete production. AAS in comparison with Portland cement can have better durability, lower hydration heat, better resistance to elevated temperature, aggregate-matrix interphase and other benefits [1]. On the contrary, main disadvantages of AAS are very high shrinkage and poor rheology, especially relatively rapid setting in the case of waterglass activation [2].

The aim of this work is to investigate the influence of the by-pass cement kiln dust (CKD) and two types of fluidized bed combustion (FBC) fly ash on the workability, shrinkage and mechanical properties (compressive and flexural strength) of waterglass activated slag. Utilization of CKD and FBC is very problematic. One of the main reasons for this is high lime and sulfate content in these wastes, which can lead to forming of expansive hydration products and consequently to cracking of OPC. On the other hand these products might act against high shrinkage of AAS.

In order to investigate this assumption and influence of these admixtures on the other properties mentioned above, fine-grained AAS-based composites were prepared. Ground granulated blast furnace slag (reference binder) was partially replaced (0–50 %) by one type of CKD and two types of FBC fly ash. Significant reduction of shrinkage was observed on samples containing even low amount of fly ash, while composites with CKD did not show significant shrinkage reduction. By using both admixtures at higher dosages mechanical properties were reduced, but at lower dosages especially compressive strength was not affected as much. Workability was also strongly dependent on the admixture dosage. Its improvement was observed especially in the case of slag replacement by CKD up to 30 %.

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# INTERACTION OF $Cr_2N$ AND $Cr_2N$/Ag THIN FILMS WITH CuZn-BRASS COUNTERPART DURING BALL-ON-DISK TESTING

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$Cr_2N$- and $Cr_2N$/Ag-nanocomposite thin films were deposited on substrate made of Cr-V ledeburitic tool steel Vanadis 6 by reactive magnetron sputtering, at a deposition temperature of 500 $^oC$, using pure Cr and Ag targets, in a composite low pressure $N_2$/Ar atmosphere. The additions of silver in $Cr_2N$/Ag coatings were 3, 7, 11 and 15 wt.%, respectively. Tribological testing using a ball-on-disc apparatus has been realized at ambient temperature and, for the $Cr_2N$ with additions of 7 and 11 wt.% Ag at elevated temperatures 300, 400 and 500 °C, respectively, also. Balls made of binary CuZn-brass (55% Cu, 45% Zn) have been used as counterparts. Wear tracks after ball-on-disc testing and worn balls were analyzed by scanning electron microscopy and microanalysis, and wear rates were calculated. Adhesive wear was derived from quantitative point metallographical analysis. The obtained results infer that considerable material transfer from the counterpart onto the surface of coatings takes place during dry sliding. The material transfer (and adhesive wear of counterpart) is mainly due to low shear strength of the brass used. Two main trends were observed. The first one is that the adhesive material transfer decreases with increasing silver content when tested at ambient temperature. The second trend indicates that the use of higher testing temperature leads to higher adhesive wear of counterpart.

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# THE POSSIBILITIES OF ASCERTAINING CEMENT COMPOSITE STRUCTURE USING METHODS FOR DETERMINING THE AIR CONTENT AND COMPUTED TOMOGRAPHY

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The paper deals with the possibilities and explanatory power of selected methods for determining the volume of air pores in concrete surface layer or of concrete structure and cement composites in general. These characteristics decide about the usability of concrete in construction and products because concrete surface layer is exposed to the influence of the environment and protects the whole concrete element during use.[1]

For their determining, standardized and non-standardized testing methods with the possibility of comparing their results were used. The measurement was conducted using 4 kinds of cement concrete without admixtures and additives differing only in water ratio while maintaining consistency. The kinds of raw materials were kept unchanged.

The AVA[2] (Air Void Analyzer) and equipment for measuring air content according to EN 12350-7 were used for determining air content in fresh concrete. Porosity of hardened concrete was determined by mercury intrusion porosimetry, monitoring of air pore distribution and size according to EN 480-11 and further by computed tomography[3,4].

Volume, size and distribution of air pores has an influence not only on durability but also on physical-mechanical characteristics of cement composites and concrete structures in general. The life cycle of a concrete construction can be deduced based on values of current durability and micro air content $A_{300}$.

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# MICROSTRUCTURE, MAGNETIC AND MECHANICAL PROPERTIES OF THE BULK AMORPHOUS ALLOY: $Fe_{61}Co_{10}Ti_4Y_5B_{20}$

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Industrial organizations are continuously searching for new materials that will exhibit much-improved properties over those which are currently used. Such materials include bulk amorphous alloys, which, compared with crystalline materials with the same chemical compositions, exhibit much more useful property parameters [1]. The reason for the improvement of these properties is the specific structure of amorphous materials [2]. One of the most interesting groups of amorphous alloys includes some of the iron-based alloys, which exhibit both excellent magnetic and mechanical properties [3].
This paper presents the results of studies into the: microstructure, magnetic and mechanical properties of bulk amorphous alloy samples. These samples were produced in the form of rods, using the suction-casting method. The structure and microstructure of the prepared samples were examined using an X-ray diffractometer, a scanning electron microscope and a computer tomograph. The magnetic and mechanical properties were studied using: a Lakeshore vibrating magnetometer, a Zwick testing machine and a FutureTech microhardness tester, respectively.
On the basis of the obtained results, it was found that, throughout their volume, the investigated rods have an amorphous structure. Using computer tomography, three-dimensional images of the tested samples were reconstructed, which enabled the imaging of material defects occurring throughout the bulk volume of the sample. Additionally, the tested Fe-based material should be included in the subset of electrotechnical materials exhibiting good soft magnetic and mechanical properties.
In view of their properties, these materials can be used successfully in energy-efficient transformers, replacing conventional Fe-Si steel in this, and other, applications.

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# INFLUENCE OF ARAMID FIBERS ON MECHANICAL PROPERTIES OF TWO POLYMERIC BLENDS

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Knowledge of short-term tensile characteristics can supply specialists and designers with the potential performances of a material and a reliable basis of comparing them [Brown]. This paper presents experimental data concerning mechanical properties of two polymeric blends in order to establish the influence of aramid fibers: polyamide +10% wt. aramid fibers (code PAX) and PBT +10% wt. aramid fibers (code PBX). Samples were obtained by extruding the mixtures of granulated PBT (commercial grade Crastin 6130 NC010) and of PA (commercial grade Relamid-B), at ICEFS Savinesti, Romania. A thermal treatment was applied to the bone samples, as recommended by the producers. The rate of separation of the tensile machine grips was 20 mm/min during the test and it was calculated the tensile (engineering)stress. A minimum of 5 test pieces (type 1, ISO 527-1) were tested for each material.
Adding aramid fibers in these two polymers has a different influence on mechanical properties. The Young modulus is less sensitive when adding aramid fibers in PA and PBT, the values being lower with 1.4 % for PBX and with 6.8 % for PAX. But elongation at break is drastically diminished when adding aramid fibers, the values being lower with 76.7 % for PBX and with 83.3% for PAX. The same tendency is kept for the energy at break (Fig. 1)

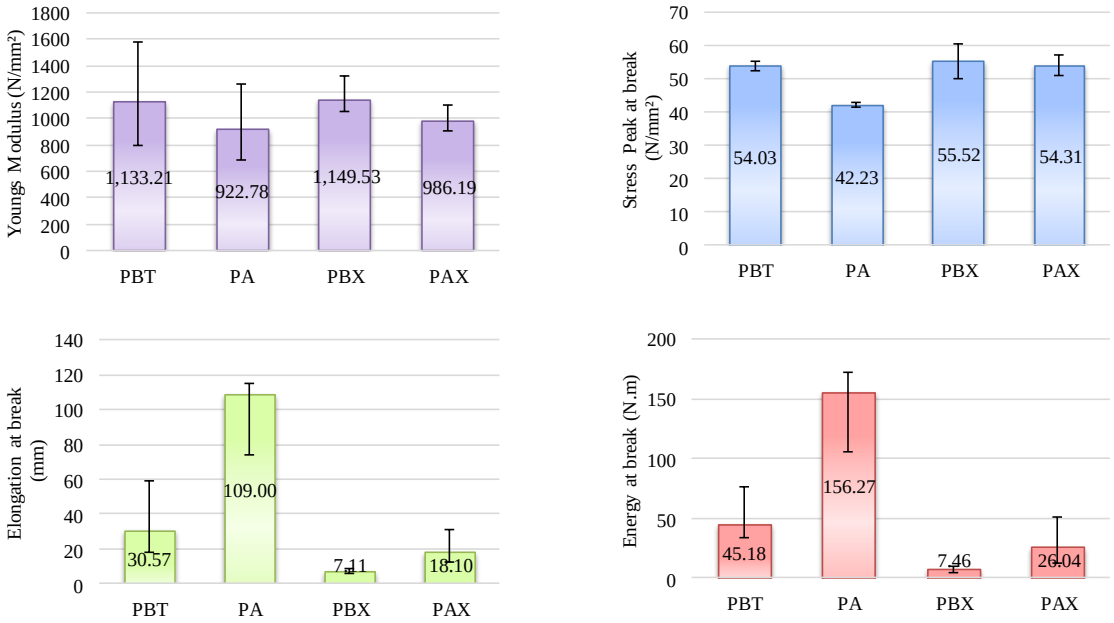


Figure 1 Average values and data spread ranges for mechanical properties of tested materials

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# PROGRESSIVE EVALUATION OF FLOW CAPACITY FOR CERAMICS FILTERS

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The main goal of sumbited article is to describe a newly created measuring device for determining the flow capacity of the ceramic filters. The work is focused on the study and analysis of the flow through ceramic filters for aluminum alloys. For experimental work were used 5 types of ceramic filters with different parameters. Monitored was the impact of parameters on the flow capacity of the individual filters and then comparison the results with simulations made by simulation software ProCAST.
The aim of the experimental works is to find out what effect have the selected types of filters (used for casting aluminium alloys) on the hydraulic resistances in the inlet system and the speed of mold filling. For accurate and efficient measurement, it was necessary to design an experimental system consisting of a mold in the shape of an open gating system and the digital platform for measuring time vs weight increase cruves. System has been designed, so that the mold can be used also for other types of filters, therefore it consists fixed and a replaceable part. Replaceable part serves for placing the filters. In order to use the above mentioned methodology for examining the properties of filters, it was necessary to first perform the calculation of the whole inlet system. For the experimental part was chosen aluminum alloy AlSi7Mg0.3. In article will be discussed effect of filters on mold filling, but also effect of filter on character of melt flow through filters, which was analysed thanks to simulation software ProCAST. For simualtion was used especially fine mesh, so the results are precise. Calculating time for one model took 5 days. Thanks to simualtion software we were also able to monitor the velocity of the melt near the filtration media. Velocity of the melt in the surrounding area of the filtration media is important factor, because turbulent flow may occur, which is during casting of aluminium alloys a negative effect. All results will be discussed in article.

# FILTRATION MEMBRANES BASED ON SECONDARY MATERIALS: PREPARATION, CHARACTERIZATION, PROPERTIES

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This work aims at preparation and characterization of compact porous bodies for filtration applications without additional heat treatment by firing. The materials used to produce porous barriers were milled excluded porcelain and milled waste glass (with various particle size distributions) and a binder based on Portland and aluminate cement. The prepared materials were tested in accordance with CSN EN 196-1 for flexural strengths using a three-point bending test, and were tested for compressive strength, as well. The structure of the materials was observed using light and scanning electron microscopy, and characterized using a capillarity test to determine mean pore radius and the diffusion coefficient of water in the materials. Disc-shaped barriers with 90-mm diameters were prepared by uniaxial pressing in a mold. They were tested using air flux to determine their effective permeability.

The experimental results show that the mechanical properties and permeability are sufficient for utilization in filtration applications. The results of permeation measurement show permeability at a relatively high level, which means good penetrability of fluid through the material and thus low resistance to fluid flow. Filtration barriers based on this material have the potential to replace sintered metal or ceramic membranes in certain applications, especially where the use of the sintered materials is cost-prohibitive or in the case of polymeric membranes which fail at high temperatures and in chemically aggressive environment.

# CHROMIUM OXIDES IN EAF STAINLESS STEEL SLAGS

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Chromium is an important alloying element in steels, especially in stainless steel grades. Stainless steel grades usually contain more than 10 % Cr, and because chromium has high affinity to oxygen it is regularly oxidized during melting and oxygen blowing. Chromium oxidation is especially problematic during the melting and processing of stainless steel scrap. Chromium oxides that form during oxidation accumulate in the slag phase. When the slag is saturated with chromium oxides, chromium rich phases like chromite spinel and calcium chromite precipitate, these phases have high melting points and are therefore solid at steel processing temperatures. Because the chromium oxide phases are solid, the reduction kinetics are impaired and in turn the reduction process is compromised. That is why the understanding of chromium oxide solubility and activity in the slag is of great importance for stainless steelmaking process.

# MULTI-PASS WELD MICROSTRUCTURE EVALUATION

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There is wide variety high strength steel grades available for steel structure production. One of such is quenched and tempered structural steel S890QL quenched and tempered structural steel. Welding of a quenched and tempered steels with multi-pass technique is an established practice and better than single-pass welding, because of lower heat input. An evaluation was done in order to determine influence of welding procedure on the weld joint microstructure formation in the parent metal, heat affected zone and weld metal. Etching of welded joint specimen revealed a reheat thermal cycle of each weld pass. Microstructure investigation was done on optical microscope and scanning electron microscope.

# STUDY OF DEVELOPMENT OF ASH BODY MICROSTRUCTURE IN THE ARTIFICIAL AGGREGATE PRODUCTION TECHNOLOGY

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Artificial aggregate based on self firing process is often produced with outdated technology without innovations and research. Knowledge of production of ceramic material is a useful but fly ash is quite heterogeneous material influenced by thermal processes occurring during production, therefore this problem has to be solved. The aim of the research work is evaluation of influence of character of fly ash on formation, structure and properties of sintered fly ash body using laboratory firings of testing samples and also using the heating microscopy, XRD with the annealing chamber etc. The main difference as regards behavior is between fly ash originating from high temperature and fluidized bed combustion. While the first type of ashes contain mainly mullite and other high temperature minerals, fluidized bed combustion ashes contain mainly anhydrite and free lime. These increase for example manipulation strength of fly ash mix, but they also increase the amount of mixing water, emissions, content of extractable sulphur and weaken the sintered fly ash body. Content of $Fe_2O_3$ and its modifications and proportion of $SiO_2$ in amorphous phase or mullite are important parameters for evaluation of various types of high temperature combustion fly ash. Content of $Fe_2O_3$ together with carbon caused reduction to FeO, which consequently works as a very effective fluxing agent. Thus, the surface of the specimen was sintered and swelling was considerable due to product gases CO and $CO_2$. After exceeding the melting point, melting begins. Higher proportion of $SiO_2$ contained in amorphous phase increase strength and quality of fly ash body. Higher content of $SiO_2$ in crystal phase causes higher heat quantity need to get solid structure. Therefore, the content of $SiO_2$ is not the main parameter to evaluation of the usability of ashes.

# POLYMERIC HOLLOW FIBERS EMBEDDED IN A PHASE CHANGE MATERIAL: HEAT TRANSFER ANALYSIS

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Phase change materials, which utilize the latent heat of phase change to enhance heat storage capacity, have been used in many technical applications[1]. The phase change materials offer a significantly larger amount of thermal storage capacity and also a higher energy storage density than sensible heat storage materials. Nevertheless, this major advantage of phase change materials is often thwarted or significantly limited due to their low thermal conductivity[2] which reduces heat transfer between a phase change material and a heat carrier medium. Beside the various ways[3] of increasing the thermal conductivity of phase change materials, the increase of the heat transfer area is a common approach to overcome this problem. The larger heat transfer area can be achieved with the use of the hollow fibers embedded in a phase change materials. The paper deals with a theoretical analysis of heat transfer in case of a liquid heat carrier flowing through the hollow polymeric fibers embedded in a phase change material. The polymeric hollow fibers with the diameter of less than one millimeter were considered in the analysis. The correlations for heat transfer coefficient obtained from the earlier experiments with hollow fibers as well as the correlations from the literature were used in the theoretical analysis of the problem. Since the hollow fibers embedded in a phase change materials represent a kind of PCM-fluid heat exchangers, the NTU-effectiveness was further considered and evaluated in the performed analysis. The results indicate that the hollow fibers embedded in a phase change material can mitigate the drawback of low thermal conductivity of the phase change materials. Such design can increase heat transfer rates and thus improve the performance of PCM-based thermal storage.

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# COMPOSITE CHROMIUM COATING FOR PISTON RINGS

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Hard chromium plating has been used on piston rings since the Second World War. Its first applications were found in aircraft engines. Hard chromium reduces the wear of the ring and decreases the friction in the cylinder-piston ring system. The ever-increasing requirements on combustion engines render the properties of chromium coatings inadequate. The response to this development is the use of porous chromium and chromium composites. The most common representative of the latter is the chromium-corundum composite which, however, proves inadequate in some case as well. The present paper discusses the Cr-UDDG composite coating. UDDG (Ultra Dispersed Diamond Graphite) is an advanced nanomaterial produced by detonation synthesis. It consists of nanodiamond and nanographite particles. The material was used as the filler in the chromium coating for piston rings. First, the tribological properties of this material were compared to standard-produced chromium coatings. Then, a test was performed in a diesel engine, where the performance of the Cr-UDDG material was compared with that of the standard-produced Cr-corundum coating. The wear of the working surface of the piston ring with the Cr-UDDG coating was lower than that of the Cr-corundum coated reference sample by more than 25 %.

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# DAMAGE RESISTANCE AND ANTICORROSION PROPERTIES OF NANOSILICA-FILLED EPOXY-RESIN COMPOSITE COATINGS

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Silica nanoparticles surface-capped with diglycidyl ether of bisphenol A were dispersed in a solution of epoxy resin, hardener and acetone. The resultant suspension was then coated onto the surface of duplex stainless steel of type DSS 2205 and cured with temperature, generating a 50 µm thick silica/epoxy coating. Epoxy coating without nanosilica was also prepared as a reference in the same manner. Mechanical properties of these coatings were compared and characterized using the Vickers hardness test. Three-point bending test was performed in combination with acoustic emission to analyse the damage initiation and development in the coating. The effects of incorporating the silica particles on the surface characteristics and the corrosion resistance of the epoxy-coated steel were investigated with contact-angle and surface energy as well as by potentiodynamic polarization and electrochemical impedance spectroscopy in a 3.5 wt.% NaCl solution. Results indicate, that silica particles significantly improved the microstructure of the coating matrix, which was reflected in an increased damage resistance, reduced degree of delamination, increased surface roughness and induced hydrophobicity. The silica/epoxy coating was proven to serve as a successful barrier in a chloride-ion-rich environment with an enhanced anticorrosive performance, which was confirmed by the reduced corrosion rate.

# INFLUENCE OF CARBIDE SPHEROIDISATION PROCESS ON MICROSTRUCTURE AFTER QUENCHING AND ANNEALING OF 100CrMnSi6-4 BEARING STEEL

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Bearings are used mostly in quenched and tempered state. Typical examples are bearings made of steel 100CrMnSi6-4. The bearing microstructure is composed of low-tempered martensite and carbides undissolved during quenching austenitization. The size and density of carbides is determined by spheroidisation annealing which is standard operation at the beginning of bearing production process. Carbides in structure also constrain austenitic grain growth before quenching and thus determine structure fineness after quenching.

Process of Accelerated carbide Spheroidisation and Refinement (ASR) was developed and used as a replacement of conventional spheroidisation soft annealing. The ASR process produces structure composed of ferritic matrix and fine globular carbides. Carbide size is several times smaller in comparison with conventional soft annealing. Such structure is favourable for quenching and tempering because results in finer and more homogeneous structure promising better bearing performance[1].

The article compares structure and properties of quenched and tempered steel 100CrMnSi6-4 treated by conventional soft annealing and ASR process before. Presence of finer carbides after ASR process allows using lower quenching temperatures to reach desired final hardness. Significantly finer structures were obtained than after conventional soft annealing. Samples in hardened state were compared in view if prior austenite grain size, carbide size and distribution and hardness.

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# ALUMINIUM FOAMS FILLED WITH POLYMERIC MATERIAL AND THEIR RESPONSE UNDER MODERATE STRAIN RATE LOADING

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This paper deals with experimental study on deformation response of open-cell aluminium foams under moderate strain rate compressive loading. The metal foams show a promising potential in energy absorption applications. However the low strength of the metal foam is limiting for such applications[1] and the strain rate sensitivity is mainly observed in closed-cell metal foams[2]. On the other hand the open-cell foams provide a better control of morpological parameters of the cellular structure. To enhance the properties of the open-cell metal foams polymeric filling was tested in conjunction with the foam.

A comparative study open-cell aluminium foam samples was tested in three groups: (i) plain open-cell foam, (ii) with polyurethane filling and (iii) with polyurea filling. Prismatic samples with square cross-section were prepared from the open-cell aluminium foam. The 2$^{nd}$ and 3$^{rd}$ group of samples were then equipped with the polymeric filling. Control samples were then cut again in order to inspect homogeneity of distribution of the polymeric filling across the cellular structure. The sample's surface was finalised to lower its roughnes in order to enable optical strain measurement. The specimens were tested using custom drop tower at several levels of impact energy. The drop tests were intsrumented by triaxial accelerometer (EGCS3, Measurement Specialties, USA) and high speed camera (NX3, Integrated Design Tools, Inc., USA) to measure the mechanical response and the strain evolution during the impact.

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# FACTORS INFLUENCING LITHIUM SULPHUR BATTERY CYCLE LIFE

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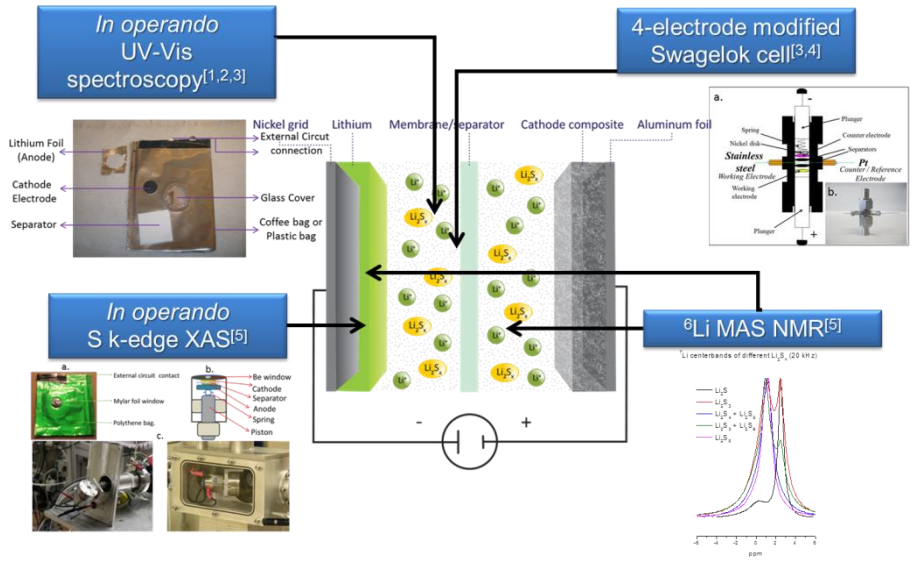
Lithium–sulphur batteries (LSB) are one of the most promising candidates for green transportation owing to their various desirable characteristics including competitive cost, attractive energy density and low environmental impact. In spite of attractive properties, Li-S cells were not commercialized on the large scale. Issues related to the solubility and diffusion of the intermediate discharge/charge products (polysulphides) in organic electrolytes, insulating nature of sulphur and problems with metallic lithium are still subject of the research. The lack of understanding how small changes influence Li-S battery mechanism, particularly polysulphide shuttle mechanism, is one of the major reasons for holding that technology in the research laboratories. Among the factors that negatively affect the development of Li-S batteries is also a lack of analytical tools.
Here we show application of three different *in operando* mode analytical techniques developed for Li-S batteries that are capable to detect changes related to polysulphides diffusion (migration). A selected systems (different electrolytes, ion selective separator, …) will discussed in terms of polysulphide migration.

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# COMPARISON OF CORROSION BEHAVIOUR OF AUSTENITIC STAINLESS STEEL IN SEAWATER AND 3.5 % NACL SOLUTION

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The evolution of the passive films on austenitic stainless steel AISI 316L stainless steel in seawater and in pure 3.5 % NaCl was studied using potentiodynamic measurements (PD), X-ray photoelectron spectroscopy (XPS) and electrochemical impedance spectroscopy (EIS). The paper describe and evaluate the comparison of pure 3.5 % NaCl with seawater trough surface and corrosion measurements. The formation of the passive film was studied by EIS at the open-circuit potential (OCP), by potentiodynamic measurements and by X-ray photoelectron spectroscopy where their compositions were analysed as a function of depth, and the cationic fraction of the passive film was determined. The passive films on both materials predominantly contained Cr-oxides, whereas the Fe species were markedly depleted.

# STUDY ON MAGNETIZATION REVERSAL BEHAVIOR IN ANNEALED Sm-Fe-Co-Zr-Cu RIBBONS

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The paper presents studies of structure and magnetic properties of Sm-Fe-Co-Zr-Cu ribbons obtained by melt-spinning technique, annealed at 1123 K for 3 hours. The phase composition studies, were made using D8 Advance Bruker X-ray diffractometer. Basing on obtained results it was found that studied alloy have multi-phase composition. The Bragg equation was used in order to estimate moderate grain size. These studies were of crucial importance in the interpretation of results from magnetization reversal analysis. The magnetic measurements i.e. major hysteresis loop and recoil curves were performed using LakeShore vibrating sample magnetometer, by applying maximum magnetic field up to 2T. Basing on recoil curves, hysteresis loop was decomposed onto the reversible and irreversible magnetization components. The decomposed curves have been used to describe processes, which are influencing reversal magnetization in studied permanent magnets. Further, these components have been used to model the recoil curves using modified hyperbolic T(x) model, basing on method described elsewhere []. The modeled hysteresis loop and recoil curves revealed high compliance with experimental data, what proves the validity of the assumptions made in the modeling of described curves.

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# DEVELOPMENT OF METHOD OF MEASURING FRICTION COEFFICIENT USING A CLOSED DIE FORGING PROCESS

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The present paper gives a description of a new technological test for measuring friction coefficient using a closed die forging process. The test specimen is a cylinder of pre-defined dimensions. The result is a forging whose shape reflects the magnitude of the friction coefficient. The magnitude of the friction coefficient varies with the forging temperature and the lubricant used. The test is thus suitable for obtaining direct comparison between lubricants. Its results can be used as input data for the DEFORM simulation tool, improving the accuracy of the material model, and thus the entire process simulation.

# COMPOSITES BASED ON INORGANIC MATRIX FOR EXTREME EXPOSURE CONDIFIONS

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Composite materials with an inorganic matrix are essential in the civil engineering, when this material can be widely used in many types of constructions and particular construction units. The paper presents partial results of the research focused on composite materials with inorganic matrix designed for environments with extreme conditions. Emphasis is placed on the use of appropriate physico-chemical methods for the assessment of the effects of selected types of aggressive environments. Investigation is also accompanied by the results of the determination of basic physico-mechanical parameters. The influence of short-term exposure time in an environment simulating real aggressive influences was monitored. With regard to the evaluation it can be stated that the physico-chemical methods are an essential tool for the evaluation of parameters and clarification of changes occurring in the structure of materials exposed to adverse conditions. It was also shown that it is possible to produce high-quality materials by using alternative material sources (by-products of steel production, etc.).

# TRACEABILITY TO INTERNATIONAL SYSTEM OF UNITS (SI) - SOME SPECIFICS AND CONCERNS

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Measurement is a process of experimentally obtaining one or more quantity values that can reasonably be attributed to a quantity. Measurement assumes a description of the quantity corresponding with the intended use of a measurement result, a measurement procedure, and a calibrated measuring system operating according to the specified measurement procedure, including the measurement conditions.
Calibration is operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication. Main reasons for having an instrument calibrated: to establish and demonstrate traceability to International System of Units (SI), to ensure readings from the instrument are consistent with other measurements, to determine the accuracy of the instrument readings, to assure appropriate measurement result with statement of complete uncertainty contributions, to establish the reliability of the instrument i.e. that it can be trusted.
Calibration under laboratory conditions does not match the conditions of operations of meters in real environments and therefore the calibration as such, and consequently the uncertainty and traceability of the final result could be questioned.
Traceability to SI and dissemination to lower levels of measurements are closely linked to measurements uncertainty budgets evaluations. Many applications are not solved since: accuracy of measurements not adequate, sources of uncertainty ignored, some relevant phenomena ignored, specific meters not developed, traceability route unclear.
What a meter cannot do and what it can do depends on responses on: is the measurement for process control, or for custody transfer, is local indication or a remote signal required, what rates are involved in the application, what are the processes' operating parameters. Then uncertainty evaluations, calibration and traceability to SI can be considered. Specifics and concerns of traceability to International System of Units (SI) come to be evident.

# FEM SIMULATION OF WELD USING LOCAL MECHANICAL PROPERTIES DETERMINATION

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The crucial role in the case of any FEM simulation play input data. There is significantly increasing demand on material data measurement for FEM simulation and on their accuracy. In the case of many simulations, the material cannot be considered as continuum with uniform properties over whole volume and in all directions. Therefore local measurements are necessary. Standard samples are in many cases too big to allow such a detailed local studies and thus miniature samples based techniques have to be applied. The paper deals with the simulation of heterogeneous weld bending determination with the use of local mechanical properties measurements using micro tensile samples. Newly developed Micro-Tensile test technique (M-TT) is employed here. M-TT specimen dimensions are: thickness of 0.5 mm, width of 1.5 mm and parallel length of 3 mm. ARAMIS system using Digital Image Correlation method (DIC) enables precise strain measurement in the course of M-TT.
I the current paper, comparison of heterogeneous weld simulation using "standard material data" such as base metal and weld metal with local material properties determined with the use of M-TT measured from the first base metal, across heat affected zone, weld to the other heat affected zone and second base metal. The simulation is compared to experimental bending of heterogeneous weld. In order to be able to perform a detailed comparison of the results obtained by the experiment and simulation, next to standard load displacement measurement in the course of tests, also local strain measurements were carried out using digital image correlation systems. A final comparison confirmed significantly better agreement of the simulation using local data measurements in both investigated fields, load-displacement record and the local strain distribution in the course of bending.

# CORRUGATED SURFACE CARBON NANOTUBES: *IN SITU* HRTEM STUDY

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Nanostructured carbon forms are highly used in various areas of chemistry, electronics and medicine. It is caused by variety of chemical and physical properties as well as a huge potential to be introduced to different matrixes: polymer, metallic, ceramic, etc. for improvement of their physicochemical and consumer characteristics. For most of these applications strong interactions between the tubular structure and the matrix are require. In this regard, the aim of the present work is to study the modification processes as well as phase and structural transformations of cylindrical and conic multiwall carbon nanotubes when heated in the microscope column after oxidative conversion.

Oxidative conversion of CNTs was performed by several steps: the tube were impregnated by calcium nitrate and then calcined in air in a muffle furnace at 400 °C for 1 hour. After that the calcium carbonate was washed with hydrochloric acid under ultrasonication followed by washing with distilled water and drying. Annealing the material at the final stage was performed in nitrogen atmosphere at 700 °C for 2 hours. Studying the phase transitions in the column of the microscope JEOL JEM-2100F/Cs was performed using these samples and commercially available detonation synthesis nanodiamonds using the holder with precision temperature control.

On the basis of data[1] CNTs are oxidize locally by calcium nitrate accordingly to the scheme: $2Ca(NO_3)_2 + C \rightarrow 2CaO + CO_2 + 4NO_2$, $2CaO + C + O_2 \rightarrow CaCO_3$. It leads to formation on the CNT surface of uniformly distributed $CaCO_3$ particles with the size of 5-30 nm. This prevents the direct observation of defects in the CNT by TEM. After removing $CaCO_3$ by acid treatment it becomes possible to observe formation of cavities and decreasing of the CNTs wall thickness: the fact of local destruction of graphene layers. Subsequent heating lead to the removal of most of the surface oxygen-containing groups and formation of onion-like structure due to the transition of carbon atoms from $sp^2$ to $sp^3$-hybridized state, which is thermodynamically more stable. *In situ* experiment with nano-diamonds(ND), contained only $sp^3$-hybrid carbon atoms, confirms this assumption: nanodiffraction of ND is typical for crystals, while after annealing it demonstrate different orientation of planes by broadened rings, corresponded to graphite.

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# INCONEL 718 COATING OBTAINED BY ELECTRIC CURRENT ASSISTED SINTERING

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In this study, Inconel 718 coating was carry out on AISI 1010 steel by electric current-assisted sintering method in open air under an uniaxial pressure of 500 MPa at 2500-4500 A for 6 minutes using Al, Ni, Fe, Cr, Ti, Co, Fe-Nb and Fe-Mo powders. This alloy was heat treated, following the conventional treatment which consists of a 1 h solutioning at 980°C, followed by air cooling and double ageing, 8 h at 720°C, furnace cooling at 55°C/h down to 620°C and ageing for 8 h. The microstructures and phase constitutions were characterized by optical microscopy (OM), scanning electron microscopy (SEM-EDS), X-ray diffraction (XRD). Microhardness of sintered test materials was determined by using micro-hardness tester with a load of 50 for 15 s on polished cross-sectional area of test materials.
Keywords: Intermetallic Materials, $Fe_3Al$, Electric Current Assisted Sintering, Coating

# STABILE DIELECTRIC RESPONSE AND HISTORY DEPENDENT EFFECTS IN LEAD-FREE RELAXOR $K_{0.5}Na_{0.5}NbO_3$-$SrTiO_3$ THIN FILMS

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Relaxor ferroelectrics are very compelling for a variety of electronic applications due to high values of the dielectric constant and a high strain across a broad temperature range. Due to the toxicity of lead, lead-containing ternary compounds and solid solutions (e.g., $Pb(Mg_{1/3}Nb_{2/3})O_3$ and $(Pb,La)(Zr,Ti)O_3$), which are currently used in electronic applications, represent an ecological hazard. In order to gradually substitute these hazardous substances by safe materials, research has been directed towards environmentally friendly materials, such as $K_{0.5}Na_{0.5}NbO_3$-$SrTiO_3$ (KNN-STO) solid solutions. Over the last decade, structural and dielectric properties as well as history-dependent effects of KNN-STO ceramics were studied and characterized extensively.[1,2]

We report the results of the structural and dielectric investigations, as well as studies of the history-dependent effects, of $K_{0.5}Na_{0.5}NbO_3$ (KNN) and $K_{0.5}Na_{0.5}NbO_3$-$SrTiO_3$ (KNN-STO) thin films. While structural investigations confirmed the formation of perovskite solid solution in all developed films, dielectric experiments revealed a relaxor broad dispersive maximum in sample with 15 molar % of STO, exhibiting for a thin film high $\varepsilon'$~330 at ~210 K. The history-dependent effects of this relaxor sample were compared to those of KNN-STO ceramics and, furthermore, shown to be much weaker than in widely used lead-based ferroelectric and relaxor $(Pb,La)(Zr,Ti)O_3$ (PLZT) ceramics: While fatigue endurance results revealed a slight drop in polarization after $3\times10^5$ switching cycles, the results of aging of the dielectric constant revealed no notable decrease in its values after $10^6$ s.

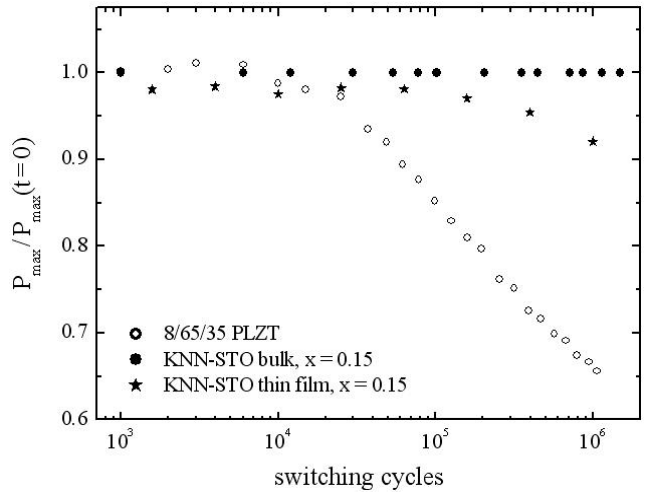


Figure 1: Normalized maximal polarization in KNN-STO thin films with 15 molar % of STO as a function of switching cycles, compared to data obtained in ferroelectric PLZT ceramics (from Reference 3) and KNN-STO ceramics with 15 molar % of STO (from Reference 1).

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# NEWLY DESIGNED TEST FOR COMPARATIVE ASSESSMENT OF THERMAL FATIGUE RESISTANCE OF VARIOUS PREPARED SURFACE LAYERS

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For better understanding behavior of materials subjected to thermal fatigue a new test was developed. The test rig with computer guidance so of specimen heating as well as of its cooling was designed and carried out on Gleeble 1500D thermomechanical simulator. Thus the new test enables testing at selected temperature, generation of different temperature gradients; i.e. stress fields, on tested specimen surface layer at same selected test temperature as well as comparative testing of maximal six different materials simultaneously. Verification of the test characteristics was carried out on specimens with different nitriding depths, PVD coated, nitrided + PVD coated, welded, etc whereas AISI H13 was applied as a base tool steel. The thermal checking that appeared on the surface of the specimen is characteristic for the type of cracks that appear on the surface of the dies subjected to thermal fatigue during hot working. A special specimen was prepared to measure the measured temperatures in the surface layers. Measured temperatures on different depths of samples served for calculation of the stress fields generated at selected different thermal loadings; finite element analysis were used. Moreover, besides thermal loadings also simultaneously mechanical loadings was applied on one specimen. The compression stresses detained the growth of cracks normal to the direction of the applied load. Main characteristics at cracks growth of different tested materials will be given and explained.

# THE DEVELOPMENT OF CONTINUOUS CASTING PROCESS CONTROL BASED ON ADVANCED MATHEMATICAL MODELLING

Jan Falkus, Katarzyna Miłkowska-Piszczek

The method of continuous casting of steel – due to its ability to maximize the yield of liquid steel, along with a substantial reduction of the energy consumption of the production process – has become the fundamental method for obtaining steel semi-products. Nowadays, over 90% of global steel production is cast with the continuous method.

In recent years the ability to numerically model metallurgical processes – including the continuous process of steel casting – has been very important for creating new technologies, along with modifying those that already exist. The mathematical modelling of solidification processes with numerical methods has put together a full comprehensive reconstruction of the complex physical and chemical nature of the solidification processes. However, having to formulate a numerical model of the continuous casting process is an extremely complex task because the requirements stipulate that the correct set of material parameters, along with the process data, have to be implemented.

As regards the formulation of a mathematical model of the continuous steel casting process, a comprehensive description of heat transfer during the continuous casting is an important item. The complexity of this issue requires that conscious simplifications have to be made when formulating mathematical models when it comes to the calculation of the cast strand solidification process. The number and type of simplifications – which in this case, are necessary – are key to the correctness of the results obtained, and they also influence the scope and accuracy when it comes to verifying the model. It is crucial to define the problem based on the finite element theory, and the elimination of numerical errors is obviously a necessary condition to ensure correctness of the analysis performed.

This paper contains a description of a number of solutions that are based on the finite element method (FEM) for models using the Euler's, Lagrange's and MILE mesh. All model concepts are illustrated with examples of calculations that have been completed with the use of actual industrial data, along with the properties of materials as determined by laboratory tests. The pivot of the considerations conducted is related to the verification of the correctness of calculations, plus the sensitivity analysis of individual model types. What the conclusion presents is an assessment as regards the progress of the current numerical models of the continuous casting process, along with the directions of their further development.

# MECHANOCHEMISTRY IN THE SYNTHESIS OF Ca-Al LAYERED DOUBLE HYDROXIDES

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In the synthesis of a Layered Double Hydroxides (LDHs) many solution phase methods were developed and used, in this contribution a different approach is presented, mechanochemistry that is. The main objective was the synthesis of Ca-Al LDHs via a mechanochemical method, and optimizing a set of parameters in order to gain a phase pure product. The following parameters were changed systematically in the used two-step milling operation: the amount of added water, the ball/sample weight ratio, and the grinding frequency.

The samples were investigated by various structural characterization methods, such as X-ray diffract-tomtry (XRD), thermogravimetry (TG/DTA), scanning electron microscopy (SEM) and energy dispersive X-ray fluorescence (EDX).

The XRD measurements show that typical reflections of the LDHs are present in the samples *i.e.* LDH formation is indeed possible under these conditions. With the optimization of the procedure a set of parameters were determined where the product of the synthesis was the phase pure LDH, with no unreacted precursors present in the system. The SEM images show that the sample prepared with the optimized parameters has an LDH like morphology. The EDX spectrum revealed that the components of the grinding balls and grinding jars did not pollute sample, while the SEM-EDX elemental maps reveal that the distribution of the layer-forming metals is uniform within the particles. The thermo-gravimetric measurements also evidenced the LDH like behavior of the sample.

It may be concluded that in the synthesis of the LDHs the mechanochemical procedure can be a viable alternative to the solution phase methods, evidenced by the fact that phase pure LDH can be obtained by this procedure.

# CREEP BEHAVIOUR OF C/PPS COMPOSITE

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Composite materials with polymeric matrix reinforced by carbon fibres are nowadays widely used as high-tech structural materials with excellent mechanical properties particularly stiffness and strength. Application of this type of composite to structural parts exposed to thermal loading has been recently proposed. Such an application requires investigation and analysis of mechanical behaviour under long term exposure to simultaneous thermal and mechanical loading [1], [2]. In this paper measurements and results of creep behaviour of composite with polyphenylene sulphide matrix reinforced by poly-acrylonitrile carbon fibres (C/PPS) proposed to be used as structural material for jet-engine frame in aerospace industry are presented.
Custom experimental device designed for creep measurements of composite materials was used for measurement of strain-time dependency at constant tensile stress and temperature. C/PPS samples with mounted heat resistant extensometers were placed into thermal chamber and heated. Samples were then exposed to constant tensile force using compound levers. Short-term creep tests with continuous strain monitoring were performed at various stress levels and elevated temperatures. Measured data were fitted by several creep models (i.e. Findley's model) to evaluate the creep strain dependency.

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# CORROSION INHIBITORS: HOW DO THEY ACT AT ROOM AND ELEVATED TEMPERATURES

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Corrosion cannot be prevented, however it can be mitigated. Appropriate corrosion control can help to avoid many potential disasters and reduce the operational costs connected with operating problems and equipment maintenance, leading to recurrent partial and even total industrial process shutdown. One of the effective ways to control corrosion is to use corrosion inhibitors. A corrosion inhibitor is a compound which when added to the corrosive medium in small amounts provides a certain degree of corrosion protection for metallic materials. However, corrosion inhibitors usually only work for a specific metallic material in a certain environment.

This work will present the action of different organic compounds as corrosion inhibitors used at room temperature up to the temperature relevant for oilfield applications (up to 180 °C). In this study, copper-based, steel, and stainless steel materials will be investigated as materials that need to be protected. It will be shown that individual compounds that are very efficient corrosion inhibitors at room temperature are no longer effective at elevated temperature. However, it is possible to design a special mixture consisting of corrosion inhibitor(s), surfactant(s), a solvent, and intensifier(s) (this mixture is called a corrosion inhibitor formulation) that substantially improves corrosion inhibition effectiveness compared to the individual corrosion inhibitor compound. The research will focus in particular on ascertaining the right surfactants and intensifiers for the formulation to become effective in mitigating corrosion. Not only the performance of such designed corrosion inhibitor formulations, but also the cost and environmental impact of the chemistry used are crucial for such mixtures to be employed in real industrial operational procedures.

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# CORROSION RESISTANCE OF LASER CLADS

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The technology of laser cladding has been known since the late 70s. The first reference to the application of laser claddings dates from 1981 when a coating was deposited by laser on a turbine blade-rotor joint in the Rolls Royce company . For an overview reference is made to [1]. Typically, laser clads are used in two different fields. The first one comprises weld deposits on engineering parts for the protection of the base material from effects of the operating environment. The other field involves the repair of parts. Laser cladding relies on the high-energy-density laser beam to melt the substrate as well as the filler material. The latter may be in the form of powder, wire or paste. The cladding process causes the filler material and the base material to form a narrow track, in which the moltenmaterials become metallurgically bonded. Their solidification then creates strong bonds providing a good cohesion as well as adhesion of the clad to the base material. The goal of laser cladding is to form a weld deposit of required properties and chemical composition on the substrate without extensive dilution (>10 %) between clad and substrate materials.
The present paper aims at evaluating the corrosion losses and exploring corrosion processes in Metco 41C, Stellite 21 and Inconel 625 laser claddings on S355 steel substrate. The corrosion resistance of the claddings was correlated with the dilution between the deposit and the substrate. The weld deposits were created using a LaserLine LDF 5000-40 VGP high-power direct diode laser. Corrosion tests were conducted in Q-FOG-CCT600 salt spray test chamber using salt fog of 5 % solution with 6.5-7.2 pH at 35 °C. The specimens were exposed to the corrosive environment for 200 hrs. Finally, potentiostatic polarization curves were measured on the clads using the Garmy Reference 600 potentiostat. The corrosion rate was evaluated with respect to the dilution between the substrate and the clad material.

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# ANODIC TITANIUM DIOXIDE NANOSTRUCTURES FOR DIFFERENT BIOMEDICAL APPLICATIONS

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Titanium is considered as the most promising biomaterial because of its properties like high biocompatibility, its resistance to body fluid effects, great tensile strength, flexibility and high corrosion resistance. Because of these properties titanium biomaterials can be used in medical devices which interact with biological systems to evaluate, treat, augment or replace any tissue, organ or function of the body[1]. In the present work, we prepared different topographies of titanium nanostructures in same electrolyte by tailoring different anodization parameters[2]. These structures have more nanorough regions and more surface area which can promote protein binding and cell adhesion to increase life of implants and other medical devices. Titanium and its alloys are often used in artificial bones, joints replacements, and dental implants, cardiovascular implants, for example in prosthetic heart valves, protective cases in pacemaker, artificial heart and circulatory devices etc. Inert, strong and non-magnetic properties of titanium and its alloys has received more attention in magnetic resonance imaging (MRI) which is a very powerful diagnostic tool. In our work nanostructures made by electrochemical anodization method have more sharp edges and spike which promote the binding of proteins and thus better and stronger adhesion of cells which is important to increase life of the implants and also for other different biomedical applications.

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# INFLUENCE OF TYPE AND NUMBER OF PREPREG LAYERS ON FLEXURAL STRENGTH AND FATIGUE LIFE OF HONEYCOMB SANDWICH STRUCTURES

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This research paper deals with an investigation of flexural properties measured in three-point bending test depending on the type and number of E-glass prepreg layers applied for facing sides of resulting sandwich structure. The values of low-cycle fatigue were measured according to the values of flexural strength obtained from static test. Cycling was performed at 70, 60 and 50 % value of ultimate flexural load. Moreover, decrease of flexural strength and stiffness depending on the number of cycles was also studied. Results from static and dynamic tests were supported by measurement of ultimate peel force from SCB peel test, which describes quality of individual layer bonding. For the production of samples, one type of aluminum honeycomb core and various phenol prepregs in a different number of layers were used. These samples were produced by two in practice commonly used methods – compression molding and vacuum bagging. The measured results show that the production technology has a certain influence on the mechanical behavior in bending and fatigue life of sandwich structures. Experimental results proved that the type of prepreg (defined by reinforcing fabric and amount of resin) and number of layers also affects properties of these structures.

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# NANOPARTICULATE BIOACTIVE GLASS-REINFORCED GELLAN-GUM HYDROGELS FOR BONE TISSUE ENGINEERING

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Combining three dimensional construct with cells to regenerate damaged tissue seems one of the most promising approaches to replace the clinical techniques in use. To ensure effective development of new tissue, scaffolds mimicking natural conditions are required. Hard tissues like bone and cartilage are complex structures of more than one material, therefore replacing them with composites of polymer-glass material is an obvious choice. Novel gellan gum (GG) hydrogel reinforced with nano-sized bioactive glass (BAG) is proposed as a potential material for regeneration of osteochondarl lesions.

BAG[1], in composition of 70 mol. % $SiO_2$ and 30 mol. % CaO, was added to GG matrix as reinforcement of 0 wt. %, 25 wt. %, 50 wt. %, 70 wt. % or 90 wt. %. With increasing percentage of the BAG the mechanical properties improved, likewise, clear changes in the porosity were evident. With higher percentage of reinforcement (70 and 90 wt. %) the size of interconnected pores was lowered to such manner that additional pore-maker had to be introduced to obtain the required porosity. Furthermore, as BAG particles embedded into polymer matrix formed agglomerates, another step using ultrasonic treatment to obtain more uniform distribution was performed. Even distribution resulted in higher mechanical properties in comparison to the initial measurements. To assess degradation of the composite materials by measuring mechanical properties, the materials were soaked into a simulated body fluid and measured before and after *in vitro* immersion. As it was expected the mechanical properties changed due to the degradation of the GG and the dissolution of BAG, which dissolution products promote precipitation of hydroxyapatite, resulting in increased mechanical properties. As the osteochondral scaffold should consist out of two regions for separate bone and cartilage regeneration, gradiently reinforced matrix is presented. The uniqueness of the presented gradually reinforced scaffold is that it was prepared with the use of undemanding technique – electrophoretic deposition. With this technique bi- and multilayered scaffolds were prepare and later on characterized in terms of microstructure and also mechanical properties. Nevertheless, as the *in vitro* biocompatibility tests revealed that GG-BAG did not alter cell adhesion and viability in comparison to GG it is expected for the gradiently reinforced composite scaffold to perform in favor of good tissue development.

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# DETERMINATION OF EMPIRICAL KINETIC PARAMETERS FOR SULFUR VULCANIZATION OF NATURAL RUBBER FROM DSC AND ODR DATA

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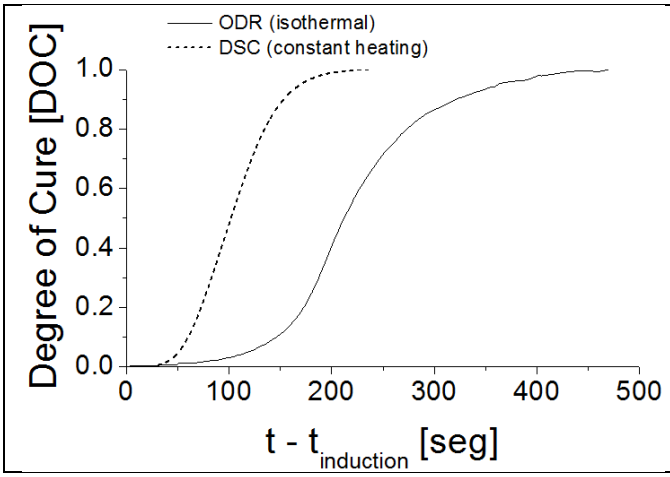
Empirical kinetic models for rubber vulcanization are regression models that fit the experimentally measured degree of curing (DOC) based on the assumption of a particular functional form. Various models have been developed to predict cure behavior of rubber compounds, being the model proposed by Kamal and Sorour (K-S model), the autocatalytic model and the $n^{th}$-order model the most extensively used in rubber curing problems[1]. In last decade, improvements to the K-S model in order to get a better prediction of isothermal and non-isothermal processes were studied[2]. This research work is devoted to determinate empirical kinetic parameters of a sulfur accelerated natural rubber compound. Oscillating-disk rheometry (ODR) at different temperatures was carried out for studying isothermal curing, and differential scanning calorimetry (DSC), at a constant heating rate, was used for determination of DOC at non-isothermal curing. Empirical kinetic parameters of various models were determinated by GRG regression methods, and significative differences in accuracy at the beginning and at the end of the cure reaction were found. The effect of measurements inaccuracy on the modeling of rubber curing process is discussed, and the relevance of getting parameters that could be correlated to curing reaction phenomena is presented.




| Model | Reference |
|---|---|
| — | $n^{th}$-order kinetic |
| — | Autocatalytic |
| — | Kamal-Sourour |
| — — | Rafei *et al.* |

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# THE INFLUENCE OF COATINGS ON WEAR AND DEFLECTION OF POLYMER GEARS

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Some applications using thermal spray coatings on plastic machine elements and components are used today. Most of these coatings are based on zinc and aluminium, which are mainly used for R.F.I. shielding and electrical conductivity where mechanical properties of the coating are not of prime importance. The use of polymer as a base material is an alternative against metallic materials in some components because of good strength to weight ratio. The main disadvantage is the poor wear resistance of contacting surfaces.

Recent research work regarding these problems has indicated that the thermal spray coatings on polymers can be performed in many engineering applications. Careful selection of material combinations and the use of special process parameters can produced relatively thick coatings in metals, ceramics and carbides which can be machined or ground. In this work different coatings and the influence of coating thickness on wear and tooth deflection will be examined considering different gear combinations such as polymer/polymer, polymer/coated polymer, polymer/steel and coated polymer/steel gear pair. Additional study will be focused on the wear and temperature conditions due to relative sliding of gear flanks.

# MICROSTRUCTURE EVOLUTION OF ADVANCED HIGH-STRENGTH TRIP-AIDED BAINITIC STEEL

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Mechanical behaviour and technological properties of Advanced High Strength Steels (AHSS) for the automotive industry depend on volume fractions and properties of individual microstructural constituents. Their characteristic feature is the good combination of strength, ductility and technological formability. At present, there is the tendency to further improve a strength-ductility range of steel sheets to satisfy the needs of the automotive market. One of the ideas is to replace a ferritic matrix by carbide-free bainite containing a large fraction of interlath austenite. It is a low-cost concept covering medium-C steels with strength levels up to 900 MPa and elongation from 20 to 30% [1, 2]. The strength-ductility balance of AHSS is dependent on strain-induced martensitic transformation of retained austenite upon straining.

The present work is focused on monitoring the microstructure evolution of the thermomechanically processed medium-C multiphase steel microalloyed with Nb (Fig. 1). The sheet samples were subjected to 5%, 10%, and 15% elongation applying uniaxial tensile test. The evolution of the bainitic-austenitic microstructure and the identification of strain-induced martensite was carried out using light microscopy, electron transmission microscopy and electron scanning microscopy equipped with EBSD (Electron Backscatter Diffraction). Morphological details affecting the stability of retained austenite were indicated.

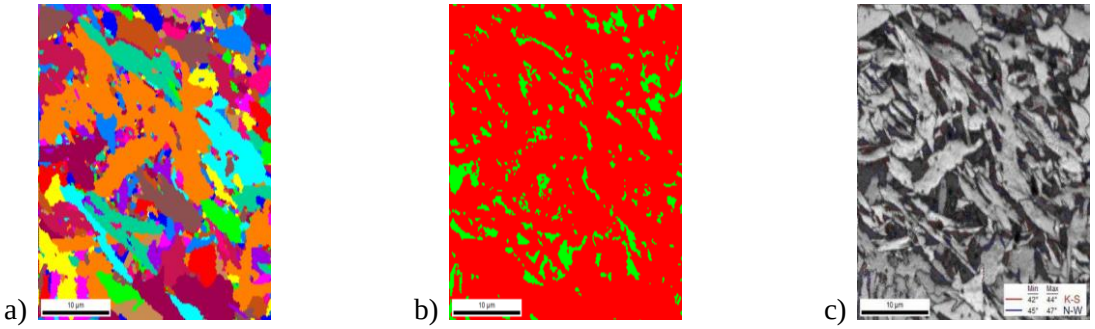


Fig. 1. Unique grain color map of the bainitic steel (a), marked regions of retained austenite (b) and image quality map with boundaries showing the Kurdjumov-Sachs and Nishiyama-Wassermann relationships (c)

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# SYNTHESIS AND CHARACTERIZATION OF CERAMIC FIBER PRODUCED BY PLASMA SPRAYING METHOD

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High thermal resistant ceramic fiber has been produced from aluminium oxide, zeolites, quartz sand employing a specific atmospheric pressure plasma spray technique. The research presents results of experimental and numerical investigation on behaviour of dispersed ceramic material particles outflowing from the atmospheric pressure plasma torch and the characterization of the obtained product. Produced fiber could be used as high temperature insulation, as filter for ultrafine particles or as a catalyst for effective conversion processes in burning devices. Experimental installation was developed for operating by feeding air, nitrogen or hydrocarbon containing gases mixed with dispersed particles. The power of plasma torch was in the range of 53 – 90 kW, the mean temperature of gas leaving the reactor – 1800 – 3500 K, plasma flow velocity in the outlet – 500 – 1300 m/s. A high-speed video camera and shadowgraph system were used for instantaneous imaging of plasma spray process. Observations by visualization system shows that multiphase jet in exhaust plasma chemical reactor nozzle consists of melted domains, grains of different sizes and fiber filaments. The high-speed imaging let to observe moving structures, calculate the magnitude and speed of sprayed materials. The interaction of plasma jet and hard ceramic particles were also investigated by the numerical simulation.
The structural and chemical composition of produced mineral fiber was analyzed using SEM, EDX methods and the research on thermal resistance was done by solar power equipment in Plataforma Solar de Almeria. Mineral fiber consists of filaments which average thickness is 1-5 μm and thermal resistance at application above 900 °C temperature was reached.

# SHIELDING OF CRACK TIP IN INHOMOGENEOUS WELD JOINT

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**Abstract.** A weld joint is a critical part of a welded structure with respect to defects, pores, geometry, misalignments and mechanical anisotropy. Global differences in mechanical properties appear between weld metal, heat affected zone, and base metal. Therefore, different microstructures within a weld joint have different elastic modulus, yield strengths and strain hardening exponent. Fracture toughness testing exhibits variations in stable crack growth resistance of the weld metal as a consequence of local variations in the material properties. In this paper the crack propagation from under-matching to over-matching weld metal has been analyzed by comparison between fracture testing of specimens and numerical modeling. Concept of configuration forces has been employed in order to evaluate the crack driving force (CDF) for inhomogeneous materials. The CDF varies, depending on the distance between crack tip and fusion line of two weld metals and the material properties of the weld metals. The experimental investigation includes fracture mechanics tests of standard bend specimens machined from the inhomogeneous welded joints with varying distances between the crack tip and the fusion line of the over-matched weld materials. In weld materials with local variations in the material properties, the local near-tip CDF becomes different from the nominally applied far-field value. The reason is that the material inhomogeneity induces an additional crack-driving force term, called the material inhomogeneity term, which leads to shielding (or anti-shielding) of the crack tip. The numerically obtained results for the near-tip CDF, the material inhomogeneity term, and the far-field CDF are used in order to explain the fracture behaviors of specimens with fatigue pre-cracks in the middle of the inhomogeneous welded joint.
Keywords: Fracture toughness, Crack driving force, J-integral, Strength Mis-match Interface, Mis-match Weld joints

# POINT AUTOMATA METHOD FOR MODELLING GRAIN STRUCTURES OF MULTICOMPONENT ALUMINUM ALLOYS

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Numerical modelling of the solidification in metallic alloys received a great interest with the development of computing technology and algorithms. Casting process modelling involves the simulation of mould filling, solidification of cast metal, microstructures formation, stress analysis on casting and so on. Prediction the microstructure formation such as equiaxed, columnar or dendritic structures is an important key factor in controlling solidification. In the literature three different approaches for prediction the microstructure can be distinguish: Front Tracking (FT), Phase-Field (PH) and Cellular Automata (CA) models. The CA modelling is an algorithm used to simulate nucleation and growth by applying stochastic transformation rules. The CA models require a coupling scheme with macroscopic solvers to predict the grain structures. Unfortunately, the most significant limitation of the CA model is still the strong artificial anisotropy of the CA mesh. All the simulated grains growth aligned with the mesh. In order to resolve this problem, a novel PA method was developed [1] where PA nodes instead of regular CA cells are located randomly on the domain what allows to simulate growth of grains in any directions.

This contribution presents two numerical 2D models to simulate the growth of dendritic structures and equiaxed - columnar grain structures for multicomponent aluminium alloys. For both models the phase change kinetics are based on modified KGT growth model solved by the PA method which involves calculations of undercooling, curvature, kinetic and thermodynamic anisotropy.

The dynamics of the interface are controlled by convective-diffusive heat and species transfer. For the dendritic growth the transfer models are solved on a regular grid by the standard explicit Finite Difference Method (FDM) and straightway coupled with PA calculations [2]. The equiaxed - columnar model is combined with the multiscale and multiphysics model where the governing transfer equations are solved by Diffuse Approximate Meshless (DAM) method. This simple grain growth model is a part of low frequency electromagnetic DC casting model which calculates the Lorentz force, temperature, velocity, concentration and deformation [3]. Simulations are shown for Al-5.3 wt% Zn-2.35 wt% Mg-1.35 wt% Cu-0.5 wt% Cr aluminium alloy.

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# PROPERTIES AND STRUCTURE OF Cu-Ti-Zr-Ni AMORPHOUS POWDERS PREPARED BY MECHANICAL ALLOYING

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This paper presents a method of fabrication, investigation and comparison of the structure, size and shape of the quaternary Cu- Ti- Zr -Ni alloy. Cu-based amorphous alloys have high strength, ductility, fracture toughness, fatigue strength and excellent corrosion resistance in solutions such as: H2SO4, NaOH, NaCl and HNO3. Samples of powders were prepared by mechanical alloying. Mechanical alloying was performed in a high energy ball mill SPEX 8000. In order to obtain the amorphous structure of the Cu47Ti34Zr11Ni8 powder various milling times were used. Finally four samples for testing were obtained with pure Cu, Ti, Ni, Zr (99,99 %). The structure of Cu47Ti34Zr11Ni8 powders was examined by X-ray diffraction (XRD) after 7h, 8h, 9h and 10h. Chemical composition, particle size and shape of the prepared powders were investigated by scanning electron microscopy (SEM). Microhardness was measured by using Vickers hardness testing machine with automatic track measurement.
The amorphous powders were obtained after 8 hours of milling. Prolonged time of milling resulted in increased of particle size and changed the shape of powders. The highest microhardness showed amorphous samples.
In the future, the studied amorphous powders will be sintered by using spark plasma sintering, which is an innovative method for the production of amorphous alloys.
Keywords: mechanical alloying, Cu-based amorphous alloys, SEM, XRD, microhardness

# EXPERIMENTAL VERIFICATIONS AND NUMERICAL THERMAL SIMULATIONS OF AUTOMOBILE HEADLAMPS

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Despite the fact that it is not an ideal concept, today the most important criterion in designing automobile headlamps is the outer design. During the last decade, headlamps became a design feature of a car's body, and to preserve their main purpose they are much more complex than in the past. The strategy of automobile manufacturers is to keep costs low; therefore, they use materials whose qualities only meet minimum requirements. Today's car headlamps contain powerful light sources which utilize new technologies such as dot concentrated light (LED chips or xenon discharge tubes). One of the unfavourable properties of these products is a high amount of thermal energy production in a small area, and thus higher thermal stress on the components. For this reason, it is important to know the temperature in critical locations and avoid damaging the headlamp's body or causing a defect in the light source itself. Numerical simulations are a powerful tool which can help to predict conditions and physical processes in a headlamp's body. All of the temperature and velocity diagrams presented in this paper were calculated using the ANSYS program. Because of possible deviations between an actual situation and a computer-calculated simulation, it is necessary to verify the results with adequately-designed experiments. This paper deals with the numerical simulation of the headlamp, the thermocouples measurement theory, the procedure of embedding the thermocouples to control spots, and an experimental design providing authentic conditions. The verification procedure was developed at the Heat Transfer and Fluid Flow Laboratory of BUT in partnership with Skoda Auto a.s.

# MODIFIED FINE-GRAIN CEMENT-BASED COMPOSITE SPECIMENS: CRACK INITIATION AND VOLUME CHANGES

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The aim of this paper is to quantify crack initiation and volume changes of three types of fine-grain cement-based composite: reference one (R) with Portland cement (PC) only, concrete with 20 % weight of PC replaced by granulated blast-furnace slag (S) or high-temperature fly ash (F). Half of the specimens from each mixture were cured according to [1] and [2] (H), other specimens were cured in water (W). During this process, length changes were measured. Furthermore, the three point bending test was performed on these specimens, which was evaluated using double-*K* fracture model [3]. Selected results are presented in Tab. 1: elasticity modulus $E$, fracture toughness $K_{Ic}^{un}$, relative resistance to stable crack propagation $K_{Ic}^{ini}/K_{Ic}^{un}$, relative expansion in 14 days aged specimen $\varepsilon_{I,14d}$ (the risk of alkali-silica reactivity); and relative values. Values measured are presented first in relation to the reference specimen, then in relation to specimens cured in water. It was shown that the type of specimen curing has a significant effect on volume changes and moderate influence on elasticity modulus, crack initiation as well as fracture toughness values.

Tab. 1 Mean (left part) and relative values (1.00…R_|1.00…_W) of selected parameters of composite R, S, F; and curing condition W, H

| | $E$ [GPa] | $K_{Ic}^{un}$ [MPa·m$^{1/2}$] | $K_{Ic}^{ini}/K_{Ic}^{un}$ [−] | $\varepsilon_{I,14d}$ [%] | $E$ [−] | $K_{Ic}^{un}$ [−] | $K_{Ic}^{ini}/K_{Ic}^{un}$ [−] | $\varepsilon_{I,14d}$ [−] |
|---|---|---|---|---|---|---|---|---|
| R_W | 27.9 | 0.569 | 0.542 | -0.004 | 1.00\|1.00 | 1.00\|1.00 | 1.00\|1.00 | 1.00\|1.00 |
| S_W | 24.8 | 0.606 | 0.555 | -0.002 | 0.89\|1.00 | 1.06\|1.00 | 1.02\|1.00 | 0.44\|1.00 |
| F_W | 23.5 | 0.631 | 0.384 | -0.005 | 0.84\|1.00 | 1.11\|1.00 | 0.71\|1.00 | 1.23\|1.00 |
| R_H | 18.2 | 0.624 | 0.340 | 0.190 | 1.00\|0.65 | 1.00\|1.10 | 1.00\|0.63 | 1.00\|46.0 |
| S_H | 18.6 | 0.613 | 0.384 | 0.124 | 1.02\|0.75 | 0.98\|1.01 | 1.13\|0.69 | 0.65\|68.9 |
| F_H | 20.8 | 0.616 | 0.347 | 0.099 | 1.14\|0.88 | 0.99\|0.98 | 1.02\|0.90 | 0.52\|19.5 |

This outcome has been achieved with the financial support of the junior specific research program at Brno University of Technology, project No. FAST/FCH-J-14-2371.

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# CHITOSAN ETHYLSULFATES – SYNTHESIS, CHARACTERIZATION AND APPLICATION IN NANOTECHNOLOGY

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In this contribution, several anticoagulant chitosan ethylsulfates (Figure 1) with different $DS_{SO3}$ have been synthesized, characterized and used as templates for the generation of silver nanoparticles. The resulting suspensions contain nanoparticles with a size of ca 10 nm (Figure 1) which are enwrapped in a chitosan ethylsulfate shell.

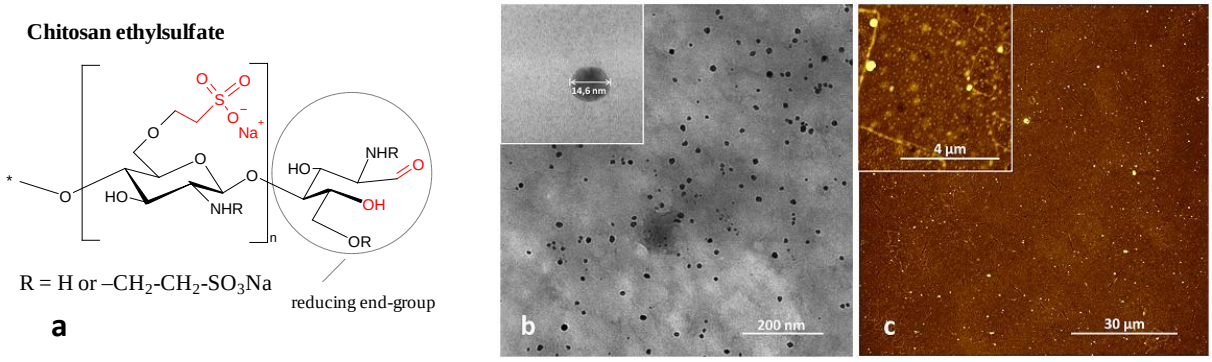


Figure 1. (a) Molecular structure of chitosan ethylsulfate/ (b) Characterization of the nanoparticles using transmission electron microscopy/ (c) atomic force microscopy images of the nanoparticles immobilized on the positively charged surface.

These nanoparticle suspensions have been subjected to anticoagulant testing using human blood plasma and lead to a significant prolongation of aPPT and PT. A further application is demonstrated by immobilization of the particles on positively charged surfaces, which is monitored in real time using a QCM-D device. It turned out that the particles are penetrating the cationically charged layer and arrange in an array like manner due to electrolyte templating as proven by AFM (Figure 1).

# EFFECT OF SKIN-CORE MORPHOLOGY ON MECHANICAL PROPERTIES IN INJECTION-MOLDED PARTS

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**Abstract**
The presented study deals with an effect of different processing parameters during injection molding on morphological stucture and on mechanical properties. In this work tensile bars of an isotactic polypropylene were injected under different conditions as flow rate, melt temperature and mold temperature. The morphological stucture was investigated by polarized light microscopy of a thin section cut perpendicular to the flow direction. Fountain flow in the mold cavity influenced the crystalization kinetics and the presence of three distinct crystalline zones was observed; namely, a highly oriented non-spherulitic skin, a row shear-nucleated spherulitic intermediate layer, and an inner core composed of spherulites with a low orientation. The results showed that flow rate will have the greatest influence on the thickness of the oriented skin layer. Mechanical properties of the tensile samples demonstrated, that the larger thickness of two outer skins will provide a higher tensile strenght. The same effect was confirmed also by the microharness test, where the skin layer was harder than inner spherulitic core.
Keywords: skin-core, polypropylene, morphology, tensile strength, microhardness

# ANALYSIS OF THE EFFECTS OF ANTENNA SUBSTRATE MATERIALS ON SAR IN THE HUMAN HEAD

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The effects of antenna dielectric substrate materials on the specific absorption rate (SAR) towards the human head are presented in this investigation. The variation of radiation efficiencies of antenna due to different substrate materials are also analyzed and discussed in the close vicinity of head model. A planar inverted-F antenna (PIFA) is used in analysis with five different dielectric substrate materials—Bakelite, FR4 glass epoxy, Rogers R04003, Taconic TLC and RT Duroid. Moreover, two different thicknesses of each substrate are considered in the experimental setup.

The studied cell phone are located beside a specific anthropomorphic (SAM) head phantom[1] in a position of actual handset use. The finite-difference time-domain (FDTD) method with the lossy-Drude[2] model is utilized in this study by using CST Microwave Studio. The SAR values and radiation efficiencies are calculated for two global system for mobile (GSM) frequency band at 900 MHz and 1800 MHz.

The results show that the SAR values are affected due to the variation of substrate materials and its thickness. PIFA with RT Duroid substrate is found to be better over all other substrates, which results lower SAR values to the human head in both GSM frequency bands. In addition, the substrate materials affect the SAR values much more at 1800 MHz than that of at 900 MHz. The thickness of substrate affects SAR values greatly at the lower frequency band. On the other hand, the antenna radiation efficiencies are not affected at the upper frequency band, but they show small variation at the lower frequency band due to different substrate materials.

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# EXPERIMENTAL AND NUMERICAL STUDY OF THE HOT STEEL PLATE FLATNESS

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One aspect of steel product quality is the flatness of the steel plate. This is one of the reasons why it is important to describe and understand the process the steel plate deformation during the cooling process. Temperature distribution has the most impact on the deformation of the strip. The temperature distribution is affected by the cooling process. The cooling homogeneity or inhomogeneity is the most important factor influencing the final flatness of the cooled strip or steel plate. The inhomogeneous cooling can lead to large differences in thermal distribution inside the material and also to high deformations. The cooling homogeneity is mainly influenced by the water distribution of the cooling section.
The goal of this paper is to experimentally and numerically study and describe the deformation process of a hot steel plate during the cooling process. To meet these goals, experimental measurements of a cooled steel plate were carried out and the boundary conditions and temperature field was obtained. Based on this data, two numerical models were created. The first numerical model focused on the cooling process, thermal field simulation and input data preparation for next step. In the next step, a second numerical model was generated through the finite element method and structural analysis and deformation of the steel plate was simulated. The description of shape deformation of the cooled steel plates should lead to the improved flatness of final products.
Keywords: cooling process, deformation, flatness, numerical simulation

# THE ROLE OF THE NIOBIUM PENTOXIDE PRECURSOR IN THE HOMOGENEITY AND DENSIFICATION OF THE POTASSIUM SODIUM NIOBATE LEAD-FREE CERAMICS

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In the field of piezoceramics the last decade, a huge effort has been dedicated to the development of lead-free substitutes of the lead zirconate titanate. Among the most studied are the materials based on the solid solution of potassium sodium niobate (KNN).[1] Different authors reported preparation of qualitatively different ceramics, although they used comparable processing methods. The repeatability of the preparation of the potassium sodium niobate systems therefore is an issue and together with the difficult densification hinders the production of the KNN-based ceramics in the larger scale.
In this study, two batches of $K_{0.5}Na_{0.5}NbO_3$ were prepared, using the orthorhombic or the monoclinic $Nb_2O_5$ polymorphs for the solid-state synthesis. While the orthorhombic $Nb_2O_5$ formed homogeneous $K_{0.5}Na_{0.5}NbO_3$ and after sintering had uniform microstructure, the monoclinic $Nb_2O_5$ suffered partial phase transformation to the orthorhombic nanocrystals during wet planetary milling, which together with the resulting bimodal particle size distribution caused the formation of the inhomogeneous potassium sodium niobate solid solution. Further, this ceramic exhibited abnormal grain growth that caused mechanical instability of the ceramic. Our results showed a clear influence of the $Nb_2O_5$ polymorphic form on the formation of a homogeneous potassium sodium niobate solid-solution and its further densification behavior.[2] To achieve a good reproducibility in the potassium sodium niobate ceramics processing this point is crucial and was not considered so far.

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# ADDITIVE MANUFACTURING (AM) OF METALLIC PARTS BY SELECTIVE LASER MELTING 5SLM)

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Additive manufacturing (AM) depends on building three-dimensional parts by adding base material in a layer-by-layer fashion.
Different processes fit within the group of AM technology. A very successful one is Selective Laser Melting (SLM).
SLM applies heat in a high-energy beam (laser) to a powder bed. The powder is fully melted layer by layer and consolidated upon cooling to a nearly full dense part.
This lecture will shortly explain the processing technique illustrated by some specific products.
Special attention will be given to the ultra-fast solidification of the extreme small melting pool and its consequences on the material properties of the as-produced parts.
Special issues such as strength, density, surface quality, microstructures and residual stresses of the as produced parts will be highlighted with special attention to stainless steel, Ti-6Al-4V and AlSi10Mg alloys.
A focus on future trends and perspectives will be treated shortly.

# A PRINTED MICROSTRIP LINE-FED PATCH ANTENNA ON HIGH DIELECTRIC MATERIAL FOR C-BAND APPLICATIONS

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In this paper, a printed microstrip line-fed patch antenna with high dielectric material that attains a compact triple-resonant profile physically belonging to nearly omni-directional radiation characteristics, gain and reasonable current distribution is proposed. The mentioned printed microstrip line-fed antenna is made of circular radiating patch with a partial ground plane generating three resonances for C-band applications.The antenna formation is smooth with simple design and assembly fabrication. The proposed microstrip line-fed antenna originates three resonances to cover C-band applications. The measured results exhibit impedance bandwidth of 160 MHz, 100 MHz and 160 MHz at three resonances on the C-band. Due to the radiating patches with partial ground, nearly omni-directional radiation properties are realized over the entire operating bands with reasonable gain. A hexagonal scrimps horn antenna with different aperture sizes was proposed for operating in C-band applications [1]. A compact broadband slot antenna was proposed with circular polarization for C-Band applications, where two rectangular stubs are embedded to excite two orthogonal E vectors in the feedline structure [2]. This printed line-fed antenna with high dielectric material is very effective for C -band applications. The overall performance analysis and nearly omnidirectional radiation pattern makes the proposed antenna as a promising figure for C-band applications.

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# EFFECT OF ANNEALING TEMPERATURE ON PHOTOCATALYTIC EFFICIENCY OF $In_2O_3$-MODIFIED ZnO NANOCRYSTALLITES IN DEGRADATION OF ALPRAZOLAM

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Alprazolam is a new generation benzodiazepine which is extensively consumed as psychiatric pharmaceutical that acts on the central nervous system for anxiolyc, sedative and hypnotic effects. Like other pharmaceuticals it has been continuously introduced into the environment which is a potential risk for aquatic and terrestrial organisms and therefore the efficient way of its removal from the water system should be found as soon as possible. Modification of ZnO [1], the most admirable material for photocatalysis with $In_2O_3$ should greatly enhance its stability, reduce its size and enable better control of the charge carrier's recombination in order to enhance the photocatalytic efficiency [2]. $ZnO/In_2O_3$ catalysts were prepared via conventional solid-state method where starting precursors (ZnO, $In_2O_3$) were stoichiometrically mixed to achieve about 5% (w/w) of In-doping in an agate mortar for 10 min, pressed under 50 kg/cm$^2$ load, annealed at 700 °C and 900 °C for 1 h and ground again for 10 min. Catalysts structure was examined by XRD and Raman spectroscopy, that both confirmed the presence of hexagonal wurtzite ZnO with crystalline nature and obvious structural disorder induced by the preparation procedure and doping. Powder-like agglomeration and nano-particle sizes were observed using SEM while actual Zn/In ratios were determined by EDS. Using DRS we estimated optical band gaps of 3.23 eV and 3.07 eV for sample annealed at 700 °C and 900 °C, respectively. On the basis of these values, we studied the efficiency of $ZnO/In_2O_3$ water suspensions in the photocatalytic degradation of alprazolam under simulated solar irradiation.

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# ANALYSIS OF THE INFLUENCE OF TiO2-NANOPARTICLES IN A POLYAMIDE6-MATRIX ON THE PROPERTIES OF MELT-SPUN FILAMENTS

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Light weight construction becomes nowadays more and more important. Especially in the automotive industry the prevailing motto is: The lowest possible weight at constant or better mechanical properties. Reduced weight means reduced costs. In Order to put this in effect, thermoplastic composite components, so called organic sheets, are developed. Therefor thermoplastic fibers are intermingled with reinforcement fibers and processed into textile fabrics. Subsequently, consolidation and forming follow in a hot press under the influence of temperature. The material needs to be heat up homogeneously. An adjusted temperature too high, leads to damage in the polymer structure. A lower temperature requires more dwell time in the hot press. This step is actually the rate-determing part of the process chain. A reduction of costs is the result of a faster process. One solution for shorter cycle times was presented in the BMBF-project "NanoOrgano", which was performed at ITA. In this project, nanoparticles were added to the polymer to increase its thermal conductivity. The goal of the project "VIP Organo" is the validation of the innovation potential of this previous project. Based on the collected knowledge further experiments will be conducted to find a compromise between increased thermal conductivity and reduced strength and rigidity caused by increasing the concentration of particles. Among others, also the influence of various titanium dioxide particle types is investigated. Distinction can be made between the two crystal forms rutile or anastase. The size of particles is different, but is always smaller than 100 nm. In addition, a following surface treatment is varied. This is necessary because $TiO_2$ is a photo semiconductor, which can lead to rapid polymer degradation. The bonding of the particles and polymer matrix can also be improved by the mentioned treatment. Furthermore, the way of compounding and the influence of dispersant on the particle dispersion in the polymer matrix are examined. New markets will be opened by cost efficient production of organic sheets.

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# HIGH TEMPERATURE ELASTIC BEHAVIOR OF MAGNESIA CHROME REFRACTORY MATERIALS

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The rapidly growing interest in the high temperature elastic properties arises from their great usefulness in the range of designing of refractory materials as well as predicting their lifetime. The Young's modulus, as one of the most relevant elastic material constant, is directly associated with thermal shock resistance, which is very important issue during first heating up of the refractory furnace lining, or when it is subjected to permanent thermal stresses as in steel ladles, tundishes or oxygen convertors dedicated for iron pig production in metallurgy industry.

This work aims to assess the high temperature elastic behaviour of 4 varieties of magnesia chrome products, characterizing by a slightly different content of major oxides MgO and $Cr_2O_3$ as well as admixture oxides, determined by XRF method. The phase composition of the test materials was identified by XRD. The physical properties like open porosity, apparent density and thermal shock resistance were also investigated. Additionally, the SEM observation of starting materials microstructure was performed. The Young's modulus measurements were conducted from ambient temperature up to 1500°C, with special heating and cooling program applied. Moreover, the elastic behaviour of magnesia chrome materials was complemented by the measurements of Young's, Kirchoff's as well as Poisson's modules, carried out at ambient temperature.

The comprehensive investigation on magnesia chrome refractory materials showed a similar elastic behaviour all of the test materials. The curve of Young's modulus change as a function of temperature exhibited close to hysteresis character. The higher the temperature, during heating up, the Young's modulus was increased. The curve of cooling cycle was generally lowering, but with the higher value of the end-Young's modulus, when compared to the starting one. It was examined that, materials with lower open porosity and higher apparent density possess higher values of Young's modulus.

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# TRANSMISSION ELECTRON MICROSCOPY STUDY OF NITI ORTHODONTIC WIRES

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The Shape Memory Alloys (SMA) nickel – titanium (NiTi) are very useful materials in medical use because of their good biocompatibility and functional properties. Especially, they are used in the field of orthodontics as, for example, for orthodontic wire, because of their lowest force delivery (small modulus of elasticity) and for their large recoverable strain for time continuous orthodontic treatment (superelasticity).
This study presents the results of the microstructure observation of six different types of NiTi orthodontic wires in stress free conditions by using Transmission Electron Microscopy (TEM, Jeol Jem-2100 HR). Within these analyzes the chemical compositions of each wire were observed in different places by applying an Energy Dispersive X-Ray Spectroscopy (EDS) detector. Namely, the chemical composition in the orthodontic wires is very important because it shows the dependence between the phase temperatures and mechanical properties.
Microstructure observations showed that orthodontic wires consist of nano-sized grains containing precipitates of $Ti_2Ni$ and/or TiC. The first precipitated $Ti_2Ni$ is rich in Ti, while the precipitated TiC is rich in C. Further investigation showed that there was a difference in average grain size in the NiTi matrix. The sizes of grains in orthodontic wires are in the range from approximately 50 nm to 160 nm, and the sizes of precipitates are in the range from 0.3 µm to 5 µm.
Key words: Transmission Electron Microscopy, Shape Memory Alloys, Nickel – Titanium

# SURFACE ANALYSIS IN MATERIAL SCIENCE – AES AND XPS IN METALLURGY

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The surface behaviour of materials is decisive in our lives. The properties, in terms of oxidation, corrosion resistance, carburizing, nitriding, soldering, powder metallurgy, machining, wear resistance, lubrication and wide range of general interfacial fracture problems in single phase, multiphase and composite materials as well as nanostructured materials and weight reduction for a given application have all improved steadily over the years in response to a growing competition in the market place. It is therefore significant, that the surface properties and behaviour of the materials used are fully understood.

Techniques are required which enable us to analyse the surface chemical and physical state and clearly distinguish it from the underlying solid.

To understand the properties and reactivity of a surface the following information are required: the physical topography, the chemical composition, the chemical structure, the atomic structure, the electronic state and a detailed description of bonding of molecules at the surface. There is no technique that can provide all these different information. A full investigation of a surface phenomenon will always require several techniques. To solve particular problems it is seldom necessary to have all these different aspects covered; however it is almost always true that understanding is greatly advanced by applying more than one technique to a surface study.

A considerable contribution to the advancements on all the frontiers of metallurgy in last decades has been made by surface analysis, in particular by using Auger Electron Spectroscopy (AES) and X-ray Photoelectron Spectroscopy (XPS).

AES is today the most important chemical surface analysis tool for conducting samples.

In metallurgy, material characterization on a nano scale is often an essential part for understanding material behaviour. It is very much so in situations where inclusions, precipitates, grain boundaries, and other inhomogeneity essentially influence properties of the substance under study. The high surface sensitivity of AES may enable us to get an insight in the bulk properties of the metallic sample. By fracturing the sample in UHV environment fresh transcrystal and intercrystal facets, grain boundaries and phases are exposed to examination. In such a way, truly bulk material as well as phenomena on grain boundaries and phases may be studied.

Several typical examples where AES and XPS are used at the Laboratory for surface characterization at IMT to resolve problems related to metallurgy will be presented.

# COMPRESSIVE PROPERTIES OF AUXETIC STRUCTURES PRODUCED BY DIRECT 3D PRINTING

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One of possible approaches how to deal with absorption of enormous amounts of deformation energy during blast and impact loading of structures is to produce a highly optimized porous (e.g. auxetic) structure taking advantage of negative Poisson's ratio of its skeleton[1].
In this work three different designs of optimized auxetic structures were prepared by direct 3D printing (Multi Jet Modelling technology) from VisiJet EX200 material. Samples of these auxetic structures were mechanically tested in quasi-static compression to obtain experimental stress-strain curves. During the tests the strains were measured using high-resolution camera and evaluated with digital image correlation algorithm[2].
To gain a thorough understanding of the deformational behavior of the auxetic structures, mechanical behavior of the structures was investigated numerically using both analytical and finite element (FE) models. The analytical model was used to obtain the response of the material for whole range of applied deformation up to complete solidification of the structure. FE simulations of the compression tests were used in iterative manner to obtain identical stress-strain curves numerically and test the proposed material model for the base material.
Described methods enable to comprehensively understand and fully describe the mechanical behavior of the studied auxetic structure. Knowledge gained in the combined experimental/numerical approach can be used to tailor sandwich panels utilizing auxetic materials for potential applications.

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# EFFECT OF COMMON STERILIZATION TECHNIQUES ON 3D PRINTED MEDICAL TOOLS

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In the last few years 3D printing technology has gained its importance also in the field of personalized medical implants, tools and guiding templates. Printing of 3D personalized guiding templates for orthopedic surgery is a rapidly growing filed as usage of such tools in surgery provides the surgeons with the exact location for drilling or cutting which increases accuracy and minimizes the use of x-ray during surgery. Moreover such procedures are less invasive and reduce postoperative complications. As the materials used for guiding templates come into contact with human body they should withstand standard sterilization procedures. Materials used for 3 D printing, which are appropriate for medical applications, are widely studied and one of such materials is also poly (utrethana-acrylate), which was shown to be biocompatible and could be easily UV photopolymerized.
For the purpose of our study the 3D printed materials (Figure 1) made by UV photopolymerization of poly (utrethana-acrylate)s were sterilized by different standard sterilization procedures; autoclave, ethylene oxide and plasma. In order to use this material for medical application their chemical composition after sterilization should remain unchanged. To determine which sterilization technique would be most appropriate for 3D printed poly (utrethana-acrylate)s the changes in chemical composition of surfaces were analyzed by X-ray Photoelectron Spectroscopy (XPS). Indeed differences in chemical composition between different sterilization techniques were observed. Our study showed that only plasma sterilization did not have any effect on the chemical composition of the surface.


Figure 1. Guiding template made with 3D printing technology

# CREEP AND WEAR BEHAVIOR OF TEMPERED MARTENSITE AS A FUNCTION OF MICROSTRUCTURAL CHANGES

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Effect of growth, redistribution, and change in mutual spacing of carbide precipitates on the creep rate of two heat affected zone (HAZ) microstructures and base metal of two martensitic creep-resistant steels, DIN X20CrMoV121 (X20) and DIN X10CrMoVNb91 (P91), tempered for 17520 hours at 650 °C and 4320 hours at 750 °C was investigated. On the tempered samples, accelerated creep tests lasting up to 100 hours, were performed at 580 °C and 170 MPa. From the same samples, metallographic specimens were prepared and SEM imaging at magnifications of 3000× and 10000× was performed, aiming to analyze the microstructural changes due to the tempering. Results from SEM image analyses and experimental results from creep tests were correlated, where the theoretical creep rate was expressed as a function of inter-particles spacing, the latter being a function of tempering time and temperature. In addition, wear tests on specimens at the initial, one-week, and one-month tempered states at both 650 and 750 °C were performed. Test lasted 15 minutes at room temperature, applying 30 N of load at a frequency of 20 Hz and a dry contact ball-plate.
Tempering at 750 °C for 6 months showed much greater effect on the microstructure evolution and properties deterioration for both steels, compared to the 2 years of tempering at 650 °C. The inter-critical ($\alpha+\gamma$) region showed the highest creep rates, especially after tempering at 750 °C. A simple power function provided an excellent fit with experimental data, and could be compared with the Garofalo equation if the latter uses adjustable parameters for the primary creep. Wear test results did not show a direct correlation to creep properties, but there was an influence of microstructure on wear, which in the case of the P91 was more pronounced than for the steel X20.
Keywords: creep, wear, tempered martensite, microstructure, carbide precipitates.

# KINETICS OF THE PRECIPITATION IN THE AUSTENITE OF HSLA STEEL

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The paper presents the results of experimental investigations concerning the kinetics of static precipitation in HSLA steels with microadditions of Nb, V, Ti and N in the course of isothermal holding between the successive cycle of plastic hot deformation. The process of deformation was realized making use of a torsional plastometer and Gleeble's thermomechanic simulator. Particularly, the kinetics of static precipitation in unstrained austenite of steel B2 (0,16%C, 0,030%Nb, 0,01%V, 0,0060%N) was tested applying the method of hot torsion, and the precipitation in steel G1 (0,16%C, 0,037%Nb, 0,002%V, 0,004%Ti, 0,0098%N)both its unstrained state and after the deformation of austenite at elevated temperature by means of the method of axial-symmetric compression of the samples. The curves of the kinetics of precipitation in the austenite were determined basing on measurements of changes of the value $\varepsilon_m$ [1,2], corresponding to $\sigma_{max}$ on the flow curves obtained in the course of continuous deformation, carried out after a varying duration of isothermal holding (from 1 to 10800 seconds). The kinetics of static precipitation concerning steel B2 were tested at a temperature of 900°C after its austenization at 1150°C, whereas in the case of steel G1 this was accomplished at a temperature of 1100°C after its austenization at 1200°C. The process of precipitation of this kind of steel was tested also after its initial deformation ($\varepsilon = 0,2$) at a strain rate of $1,0s^{-1}$, the conditions of temperature remaining unchanged.
The precipitation in the matrix of stable austenite of steel G1 was also investigated using a electron transmission microscope on samples quenched immediately after their hot deformation and at a varying duration of isothermal holding. The effects of precipitation in the phase γ, taken over from martensite, were analyzed mainly by means of electron diffraction and verified by observations in the dark field, aided by X-ray microanalysis.

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# PROCESSING AND COMPRESSION CREEP RESPONSE OF AlN REINFORCED MAGNESIUM ALLOY ELEKTRON21

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The European Community research project ExoMet that started in mid 2012 targets high performance aluminium and magnesium based materials by exploring novel grain refining and nanoparticle additions in conjunction with melt treatment by means of external fields (electromagnetic, ultrasonic, mechanical). Ceramic AlN nanoparticles added to magnesium alloy Elektron21 melt under assistance of mechanical stirring and sonification for deagglomeration is investigated in terms of metallography, hardness, compression creep resistance and mechanical compression strength. Creep tests at constant temperature of 240°C and constant stresses between 100 and 200 MPa reveal an improvement in creep strength due to the addition of 1 wt.-% of AlN nanoparticles. Minimum creep rates are determined and stress exponents are calculated in order to determine rate controlling deformation mechanisms.

# AN EXPERIMENTAL METHOD FOR DETERMINATION OF THE CRITICAL FRACTION OF SOLID DURING SOLIDIFICATION OF PM CAST ALUMINIUM ALLOYS

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During solidification of aluminium alloys flow of the interdendritic liquid through mushy zone plays an important role on shrinkage driven porosity formation. Therefore, in almost all the casting modelling studies, determination of the mushy zone properties must be taken into account. Past work on modelling of mushy zone behaviour have been mainly based on four different approaches. These are namely, models of porous media permeability based on Darcy's Law or its various modified versions, volume change approaches based on heat and mass transfer, criteria functions based on thermal parameters and direct measurements of mushy zone permeability limit through flow channels or torque measurements.

In this study, limit of the mushy zone permeability has been investigated. A novel experimental technique has been developed to quantify this in permanent mould casting of aluminium alloys. Grain-refined and non-grain refined aluminium alloys were used as well as mould initial temperature has been changed to determine the critical fraction of solid (CFS) value for the feeding limit in solidifying castings.

Results showed that the CFS values of solidifying aluminium alloys may vary from 35% to 55% depending on the casting conditions. Results also showed that the CFS value is not an alloy property, yet it is significantly depending on such parameters as grain refinement, cooling rate and applied pressure.

# MAGNETORHEOLOGICAL SUSPENSION BASED ON SILICONE OIL

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Magnetorheological materials (MR fluids) are a class of smart materials whose rheological properties (e.g. viscosity) may be rapidly varied by applying a magnetic field. Under influence of magnetic field the suspended magnetic particles interact to form a structure that resists shear deformation or flow. This change in the material appears as a rapid increase in apparent viscosity or in the development of a semisolid state [1,2].

In order to prepare the prototype magnetorheological fluid the carbonyl iron powder was selected (CI, reduced penta-carbonyl iron, $SiO_2$ – coated, BASF, Germany) as for a model particle suspended system. CI is magnetically soft material characterized by high saturation magnetisation. The average particle size and tap density was 7.0 μm and 4.3 g/cm$^3$, respectively. Magnetorheological particles were dispersed in colorless silicone oil (SO, type OKS, Germany).

In the aim of reduction of sedimentation process of the CI particles additional components (1 against CI amount) were added to the fluids. For the silicon oil the fumed silica (Aerosil 200, Degussa, Germany) was chosen. Magnetorheological characteristics were examined using laboratory test stand, which could work as viscometer or it could perform a function of laboratory clutch.The sedimentation was measured by visual observation of the position changes of boundary between clear and turbid part of carrier oil at room temperature.

It was found that added submicron-sized particles (fumed silica) in 1% with relation to CI amount further inhibited sedimentation of the carbonyl iron particles. The dynamic viscosity of investigated magnetorheological fluids increase in the response to presence of an external magnetic field with the amount of CI and augmentation of the carrier liquid viscosity, presence of the stabilizer additive (Aerosil 200).

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# COIR-BASED FILLERS GRINDING AND BULK PROPERTIES

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The work deals with the preparation of wood based fillers for plastics using coir as a raw material. This work presents the raw material and milling product's basic particulate variables and pilot scale Attritor-type mill grinding characteristics when both steel grinding bodies and typical grinding ingredients were used. The paper provides the repose behavior diagrams of feedstock material and finished microfine fillers, both measured by a standard Jenike shear tester. Dependence curves are then compared with conventional carbonate filler parameters. It was concluded that coir-based microfine fillers for plastics provide interesting application properties to polymer matrix composite materials. Additionally, they can be prepared using technologically-feasible processes to a state where favorable rheology fillers indicate that conventional composite processing paths can be used with minor adjustments.

# PREDICTION OF CHEMICAL NON-HOMOGENEITY OF 30MnVS6 BILLETS WITH GENETIC PROGRAMMING

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Štore Steel ltd is small and flexible steel plant. They produce also 30MnVS6 steel grade which is used for crack connection rods in automotive industry. Chemical elements are not uniformly distributed over the billet's cross-section. Chemical distribution depends mainly on casting parameters. In the article the attempt for prediction of chemical non-homogeneity of 30MnVS6 billets is presented. According to chemical elements distribution (%C, %Si, %Mn, %V, %S) over billet's cross-section and casting parameters (casting speed, casting tmperature) several models for chemical non-homogeneity prediction were developed with genetic programming method. The results of modeling can be practically implemented in order to reduce chemical non-homogeneity of billets.

# INCREASING MICROPURITY AND DETERMINING THE EFFECT OF DIFFERENT PRODUCTION TECHNOLOGIES ON THE QUALITATIVE PARAMETERS OF FORGED STEEL PIECES WITH HIGH ALUMINUM CONTENT

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MATERIAL AND METALLURGICAL RESEARCH carried out the development 1.8504 steel quality production technology. The aim was to achieve the required internal micropurity and determine the effect of different production technologies on the qualitativer parameters of forged steel pieces. Firstly, polygonal ingots for forging were produced using different production technologies. Weighing 1,600 kilograms, the ingots were produced using a vacuum and pressure induction melting furnace (VPIM) with vacuum treatment and a controlled atmosphere induction melting furnace (IM) without vacuum treatment. Subsequently, the ingots were reshaped by open-die forging into bars with rectangular cross-section. The effect of the ingot production technology was evaluated by comparing the forged steel pieces in terms of their purity, macrostructure and microstructure.

# QUANTITATIVE ANALYSIS OF CARBIDE FRACTION IN PM390

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Steel with high carbon content are produced by powder metallurgy process (PM) due to strong segregation of alloying elements. The PM process enables the formation of microstructure with finely dispersed carbides which are favorable for mechanical properties. PM steel grades have high hardness and wear resistance that is the result of microstructure. The microstructure of PM390 consists of $M_6C$ and MC carbide types and martensite matrix. The ratio of different carbide types can be influenced by austenitization temperature variation, this in turn is expected to influence the tribological properties of the steel. The quantitative analysis of carbide fraction was determined for three different heat treatment regimes. Scanning electron microscope backscatter images (BEI) were used in order to determine carbide fraction. The results show that higher austenitization temperatures favor the formation of MC type carbides while the $M_6C$ type is more stable at lower temperatures.
Keywords: PM390, carbides, quantitative phase analysis, heat treatment

# APPLICATION OF NON-SINGULAR METHOD OF FUNDAMENTAL SOLUTIONS AND IMPROVED NON-SINGULAR METHOD OF FUNDAMENTAL SOLUTIONS FOR TWO-DIMENSIONAL MULTI-GRAIN ELASTICITY PROBLEMS

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The purpose of the present paper is to show the application of the Non-singular Method of Fundamental Solutions (NMFS) [1, 2] and the very novel Improved Non-Singular Method of Fundamental Solutions (INMFS) based on Boundary Distributed Source [3] method for linear isotropic and anisotropic multigrain elasticity problems. In the NMFS and INMFS, the source points and the collocation points coincide and both are positioned on the boundary of the problem domain. In order to remove the singularities of the fundamental solution, are the concentrated point sources replaced by the distributed sources over the disks around the singularity. The values of distributed sources are calculated directly and analytically in case of Dirichlet boundary conditions. In case of Neumann boundary conditions, the respective values of the derivatives of the fundamental solution, as required in the calculations, have been in NMFS calculated indirectly from the considerations of the solution of the linearly varying simple displacement fields [4]. The balance of the forces [5] is used for calculation of the these derivatives in INMFS. The performance of INMFS is shown for multigrain problems with inclusions and voids. A simulation of deformation of a peace of a realistic microstructure of the spring steel C45 on a 50μm square with 19 grains is given. In the future, the INMFS will be upgraded for 3D problems.

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# INVESTIGATION ON NEW CREEP AND OXIDATION RESISTANT MATERIALS

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New unconventional structure with specific mechanical and physical properties with new application possibilities in some areas of industry can be obtained using conventional materials through innovative technological techniques. One of the possibilities is enabled by combination of powder metallurgy with processing of materials in semi-solid state or create a microstructure consisting of a metal matrix and dispersed stable particles in order to developing a new material resistant to high-temperature creep. For making intricately shaped components from such materials, new processes must be found to allow near net shape products to be manufactured in a simple and rapid manner. The specific mechanical property and structure of the material could be achieved by combining various types of materials and technologies. The main motivation of this paper is to develop new creep and oxidation-resistant materials (ODS) (new ODS Fe-Al based alloys and ODS composites) applicable at high temperatures up to about 1100°C. The new ODS composite consist of the ferritic Fe-Al matrix strengthened with about 2 to 30 vol. % of $Al_2O_3$ particles. In order to find out the optimum material structure, 3 different containers were mixed with different oxide percentage. Also to find out the influence of the temperature on obtained structure, three processing temperatures 26°C, 750°C and 1150°C with specific deformation profile were used. The analysis of structures was performed using different analytical methods such as optical microscopy, scanning electron microscopy and x-ray diffraction analysis.
Key words: ODS steel, alloys, composite, Creep, Fe-Al

# FABRICATION OF ELECTROCHEMICAL SENSOR BASED ON GRAPHENE/ZINC OXIDE NANOCOMPOSITE FOR NONENZYMATIC HYDROGEN PEROXIDE SENSING

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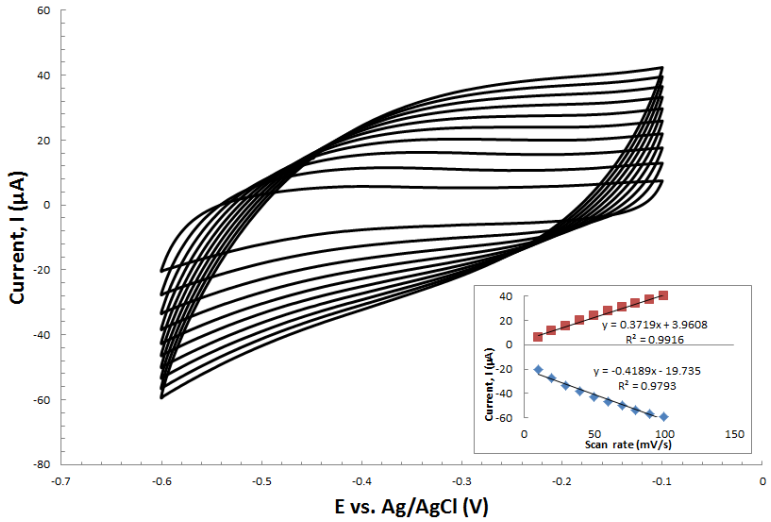
In the present study, disposable electrochemical biosensor for hydrogen peroxide ($H_2O_2$) was fabricated using graphene/ZnO nanocomposite-modified screen printed carbon electrode (SPCE). The current method adopted is simple, cost feasible and avoids the usage of harsh oxidants/ acid during the synthesis. Graphite material was subjected to liquid phase exfoliation with the aid of ultrasonication, without going through the intermediate graphene oxide phases that can disrupt the pristine structure of the yield. The as-prepared graphene/ZnO nanocomposite was then thoroughly characterized to evaluate its morphology, crystallinity, composition as well as product purity. All the results clearly indicate that pristine graphene was successfully produced from the graphite exfoliation and ZnO nanoparticles are homogeneously distributed on the graphene sheet, without any severe aggregation. The biosensing capability of the graphene/ZnO nanocomposite-modified SPCE was evaluated electrochemically, via cyclic voltammetry (CV) and amperometric analysis. The resulting electrode is found to exhibit excellent elctrocatalytic activity towards the reduction of $H_2O_2$. The graphene/ZnO-modified SPCE could detect $H_2O_2$ in a linear range of 1 to 15 mM with a correlation coefficient of 0.9859. The electrode is found to have higher sensitivity, selectivity and superior reproducibility for non-enzymatic detection of $H_2O_2$ compound.



# SYNTHESIS OF REACTIVE ENERGETIC PLASTICIZERS WITH CLICKABLE FUNCTIONALITY TO CONTROL PROCESSING PROPERTIES OF CASTABLE PBX's

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Plasticizers are additives widely used in the polymer industry [1]. Generally, they are known to improve processability by lowering the viscosity during the formulation as well as impart low temperature flexibility by lowering the glass transition temperature of the polymers [2-4]. For specific applications in the field of high energy materials, energetic functional groups such as azido, nitro and difluoramine groups have been introduced in the plasticizers, known as energetic plasticizers [5,6]. Incorporation of these explosophores increases the internal energy of the formulation, in addition to improving the overall oxygen balance. Since plasticizers, either inert or energetic, used in these applications are externally incorporated with the polymers, they are inherently hampered by the migration of plasticizers out of the polymer matrix, resulting in long-term deterioration of properties such as impact sensitivity, storage stability, and mechanical properties, etc.

Therefore, it has been one of major issues, especially in the field of high energy materials, to provide energetic plasticizers with new concepts. Hence, this research focuses on the design, synthesis and characterization of reactive energetic plasticizers and their application to polyurethane binders in the formulations of castable plastic bonded explosives (PBXs). Figure 1 presents ideal structure for ester-linkaged reactive energetic plasticizers.

The reactive energetic plasticizers are synthesized by using either the aldol condensation reaction of alcohol compounds and formaldehyde catalyzed with Lewis acid, or the esterification between corresponding alcohols and carboxylic acids compounds. Structural integrity of the synthesized reactive energetic plasticizer is identified by using elemental analyzer, GC-Mass, $^{1}H$ and $^{13}C$ NMR. Plasticization performance and click reaction using reactive energetic plasticizers are also investigated. These results indicate that these reactive energetic plasticizers work properly as a general plasticizer in the beginning of the formulation process and then are incorporated in curing process of PU binders through the click reaction, preferably, of alkyne groups in the plasticizer and azide groups in the prepolymer.

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# PROPERTY CHARACTERIZATION AND EVALUATION OF $Al_2O_3$-$TiB_2$ PRODUCED BY REDUCTION COMBUSTION SYNTHESIS METHOD

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In this study the production process of the in-situ composite was carried out in an electrical resistance furnace in open air under, 150 MPa uniaxial pressure, 1200°C for 4 hour period. During this process aluminum powder (99% purity, 15 µm), $TiO_2$ powder (98.8% purity, less than 1 µm), $B_2O_3$ (99.99% purity, less than 38 µm) and additive material $Al_2O_3$(99.99% purity, ≈<1 µm) were used. The main physic-mechanical properties of $Al_2O_3$-$TiB_2$ composite (density, hardness, oxidation, microstructure and phase constitutions) were studied.
Keywords: In-situ composite, $Al_2O_3$-$TiB_2$, Sintering, Reduction Combustion Synthesis, Oxidation

# EFFECTS OF SOME PARAMETERS ON THE GRAIN REFINING EFFICIENCY OF Al5TiB REFINERS ON AN A360 ALUMINIUM ALLOY

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Grain refinement in aluminium alloys is important for improving mechanical properties, increasing the resistance to hot tearing and pressure tightness, especially when producing larger size or slow cooling sand castings. It has been reported in the literature that the presence of high levels of silicon in aluminium faundry alloys reduces the efficiency of grain refiner addition, such as Al-5Ti-1B and that grain size increases with increasing silicon content above about 3-4 wt % Si. Since Al-Si casting alloys are the most widely used alloys, it is important to investigate and understand the phenomena governing the mechanisms of grain refining by addition Al-5Ti-1B type master alloy addition.

The aim of this study is therefore to determine the effects of some parameters on the grain refining efficiency of Al5TiB refiners on a sand cast A360 (AlSi10Mg) aluminium alloy. 8 Kg of A360 alloy cut from primary ingots was melted in a SiC curable in a electrical resistance furnace. The temperature of the melt was increased to 730 $^{o}$C at which Al-5Ti1B master alloy and Al-10 Sr modification master alloys were added. After hydrogen removal for 10 minutes the surface of the melt was skimmed. Finally the melt was poured into green sand moulds.

The effects of three different parameters with four different levels as shown in Table 1 were investigated on the final grain size and secondary dendrite arm spacing. Results showed that amount of master alloy and the pouring temperature of the castings together are the most influential factors on the final grain size of the castings. The holding time of the liquid alloy after the master alloy addition was made has been found less influential.

Table 1: Process parameters and their levels.

| Parameter | Level1 Level2 Level 3 Level 4 |
|---|---|
| Pouring Temperature ($^{o}$C) | 680 690 700 710 |
| Al5Ti1B Addition (as %Ti) | 0.15 0.20 0.25 0.30 |
| Holding Time after addition (minutes) | 15 20 25 30 |

# MAPPING MATERIALS CHARACTERISTICS UNDER FATIGUE LOAD USING BARKHAUSEN NOISE ANALYSIS

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One of the most serious occurrences in engineering parts in service is fatigue damage. It develops under ordinary service stress that is always less than the yield point of the material, provided that the structure has been designed correctly. The life of an engineering part is typically designed for a certain number of service cycles. The destruction of the part itself is a statistical occurrence. Therefore, predicting the destruction of an engineering part is not straightforward.

In-service fatigue damage results in degradation of the material. It is not simple to detect and map, unless samples are taken from the part and examined. However, not even the examination can guarantee that fatigue damage will be detected and correctly evaluated. In the present study, fatigue test specimens will be examined using Barkhausen noise analysis in the course of fatigue testing. The effect of fatigue damage propagation on the magnetization parameter and remanent magnetization will be monitored. The potential for predicting failure in service by this method will be explored.

# VALIDATION OF METHODS FOR DETERMINING PERMEABILITY OF CEMENT COMPOSITE STRUCTURE BY MEANS OF COMPUTED TOMOGRAPHY

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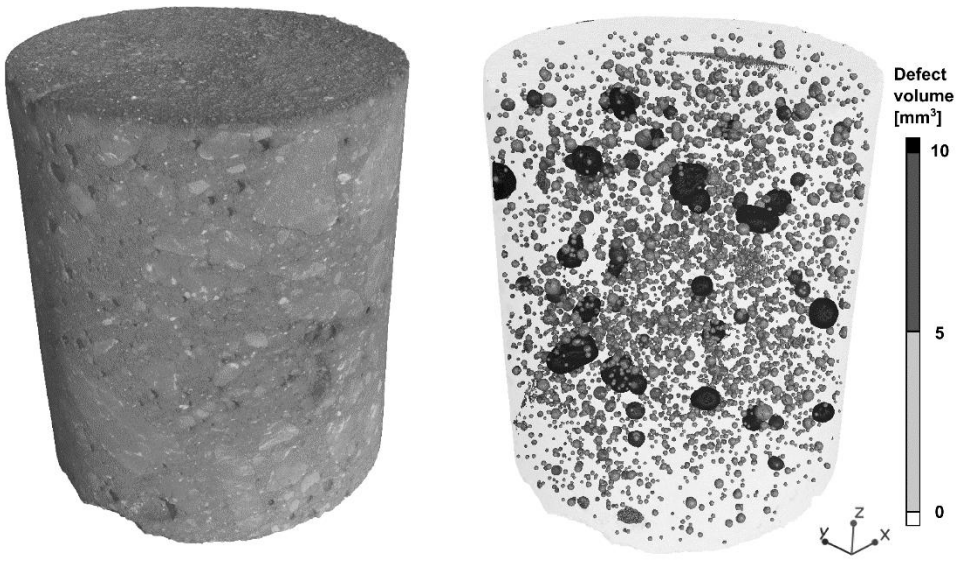
The paper deals with various testing methods for evaluating the surface layer (concrete cover) of concrete on which depends the durability of the whole composite. A key parameter for determining concrete permeability is ascertaining pore volume, size and distribution in the material and water and air permeability related to those.
Standardized and non-standardized methods for the evaluation of surface layer of concrete are used in Europe[1, 2]. One of the modern methods is internal structure monitoring by means of computed tomography[3] which enables to display the monitored specimen in three dimensions. The authors aim to compare test method results and conclusions with commonly used methods, which are not well known to the academic audience, however, according to the authors, they show great potential and the resulting findings, compared to other methods, are most revealing as far as the determined parameters of cement composite are concerned.

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# ESTIMATION OF NUMBER OF FORWARD TIME STEPS FOR SEQUENTIAL BECK APPROACH USED FOR SOLVING INVERSE HEAT CONDUCTION PROBLEMS

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Direct heat conduction problems are those whose boundary conditions, initial state, and material properties are known and the whole temperature field in the model can be calculated. In contrast, an inverse problem is defined as the determination of unknown causes based on the observation of their effects. The inverse heat conduction method is often used for problems where boundary conditions cannot be measured directly but are computed from a recorded temperature history inside the model. A very effective method for solving this ill-posed problem is the sequential Beck approach we are dealing with. To stabilize this ill posed invers problem a proper regularization parameter must be used. For this method the regularization parameter is the number of forward time steps which stabilize this process. This paper describes an approach which calculates the number of recommended forward time steps for nonlinear heat conduction models with temperature dependent material properties. This approach is based on tracking the sensitivity (at the point of measurement) to the Dirac heat flux pulse on the surface. The stability and noise (in the results) of several variants of this method are compared.

*Comments: To make the abstract more 'informative and readable I suggest:*
The inverse heat conduction method is often used for problems where boundary conditions cannot be measured directly but are computed from a recorded temperature history inside the model.
*The inverse heat conduction method is often used for problems where boundary temperatures cannot be measured directly but are computed from a measured temperature(s) inside the observed object.*

A very effective method for solving this ill-posed problem is the sequential Beck approach we are dealing with.
*A very effective method for calculation of boundary temperatures of the inverse heat transfer problem is the sequential Beck approach.*
To stabilize this ill posed invers problem a proper regularization parameter must be used. For this method the regularization parameter is the number of forward time steps which stabilize this process
*For Beck's approach, proper regularization parameters are to be found. In this case, regularization parameters to be found are reduced to a single number of forward steps.*

# MAGNETIC CARBON NANOTUBES: SYNTHESIS AND PROPERTIES

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Carbon nanotubes were synthesized inside the pores of an alumina membrane by a non-catalytic chemical vapour deposition technique (CVD) based on the pyrolysis of ethylene. The carbon nanotubes were formed in straight cylindrical pores, which run through the membrane thickness. The resulting CNTs have a wall thickness of approximately 40 nm and, at least, one end open, and diameter about 120 nm. To fill the CNTs with magnetic particles, were used different types of commercially available ferrofuids, EMG 911 ($Fe_3O_4$ nanoparticles, diameter 5-10 nm). The technique is based on the spontaneous penetration of the fluid by capillary action. The level of filling the CNTs with $Fe_3O_4$ is 32%[1]. In order to get the iron-filled carbon nanotubes the resulting $Fe_3O_4$–CNTs were recovered in the flow of $H_2$. X-ray diffraction, electron microscopy and magnetometry were used to characterize the structural and magnetic properties of the grown samples.
Detailed investigation of magnetic behaviour of resulting composites was done at different temperatures. The both resulting composite (CNTs-$Fe_3O_4$ and CNTs-Fe) at room temperature shows excellent superparamagnetic properties in perfect consonance with other magnetic materials.
Magnetically active carbon nanotubes are believed to be attractive for the production of magnetic nanofluids and in magnetic separation applications.

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# THE PROBLEM DISCRETIZATION OBJECTS IN THE FEM SIMULATION STUDIES

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The implementation process of numerical simulation studies of plastic deformation requires the selection of appropriate boundary conditions. Boundary conditions has a significant impact on the final results of the FEM. Each calculation of the FEM test relates to the physical model contained in the space that is local or primary coordinate system.

This is an area calculation defined by partial differential equations and the equations defining the behavior of the function on the shore so-called boundary conditions. Each of the models tested has edges and is considered as bounded by the edges. Solid model is divided into sub-areas of simple shapes called finite elements. The calculation process of shaping plastic solver for a metal depends on the number of finite elements, the number of degrees of freedom of the shape and the geometry of the elements. The main purpose of the discretization is to divide the real object model for simple geometric shapes containing nodes and interpolation functions also called nodal or shape. They are used to describe the size distribution analyzed in its interior and on its sides.

An important factor considered in the context of the boundary conditions is the size of the finite element. Reducing the size of the finite element results in an increase in the accuracy of the calculation process. In contrast, decreasing the size of the finite elements increase the amount of the finite element model, the computation time extension. A main cause of long calculation time is the amount of equations to be solved.

Reducing areas of elements causes the nodal values of the search function, approach to solve much more accurate. So, it was considered necessary to determine the appropriate criterion called meshing density boundary discretization. The paper discusses the conditions for the selection of the finite element discretization process and discusses how they impact on the work of the solver.

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# COORDINATION POLYMERIZATION AS A TOOL FOR THE PREPARATION OF POLYMERIC FOAMS WITH SPECIAL PROPERTIES: FROM Π-CONJUGATED TO CARBON FOAMS

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PolyHIPE foams exhibit a fully interconnected macroporous cellular structure and are usually prepared by polymerization of the continuous phase of high internal phase emulsion (i.e. HIPE).[1] Various chemistries and mechanisms for HIPEs polymerization have been already applied to prepare highly porous materials for wide range of applications. PolyHIPE materials for advanced applications, like batteries, capacitors or light-emitting diodes, demands tailored physical and electronic properties and, therefore, the preparation of the conjugated materials is an attractive prospect.

The present work relates to the preparation of a three-dimensional micro-/macroporous hierarchically structured polymeric foams using a high internal phase emulsion (HIPE) templating technology. Ring opening metathesis polymerization (ROMP) and catalytic insertion polymerization (CIP) were used to solidify HIP emulsions, whereafter poly(dicyclopentadiene)[2] and poly(diethynylbenzene)[3] foams with special electronic properties were obtained. Moreover, poly(dicyclopentadiene) foams were further carbonized and carbon foams with 80% porosity, high (macro)pore volume of up to 10 $cm^3/g$, conductivity of more than 2500 S/m and Young's modulus of more than 1 GPa can be prepared.

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# CORROSION PROTECTION OF POLYETHYLENE GLYCOL AND POLYDIMETHYLSILOXANE BASED COATINGS ON AISI 316L STAINLESS STEEL

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AISI 316L stainless steel is widely applied material in food industry, biomedical applications as well as in the marine environment due to its good corrosion resistance and excellent mechanical properties [1]. Regardless of these advantages and its good cleanability, the accumulation of biological matter at the surface is an unavoidable event in all environments where natural or man-made materials are used [2]. Biofouling causes problems ranging from reduced efficiency of materials and equipment to structural instability [3]. Microorganisms may deeply influence the corrosion process: they may initiate or accelerate the surface degradation in the form of biofilms. In order to prevent the attachment of fouling organisms to the exposed surfaces, the application of coatings with antifouling properties is required. Most recent research efforts concerning biofouling have been focused on development of non-toxic coatings, which are able to repel or minimize the adhesion of fouling organisms to surfaces [4].

Polyethylene glycol (PEG) and polydimethylsiloxane (PDMS) based corrosion protection and antifouling coatings of the AISI 316L stainless steel surface were investigated. X-ray photoelectron spectroscopy (XPS) was used to confirm successful deposition of the coatings on the substrate as well as to estimate the thickness for both coating types. Contact angle measurements were used to evaluate wetting properties of non-coated, PEG coated and PDMS coated substrate. Potentiodynamic measurements established enhanced corrosion stability of PEG and PDMS coated stainless steel. Electrochemical Impedance Spectroscopy (EIS) was also performed.

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# CORRELATION OF HEAT TRANSFER COEFFICIENT AT SPRINKLED TUBE BUNDLE

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The paper presents research on heat transfer coefficient at the surface of sprinkled tube bundle with boil simulation. A tube bundle comprises of thirteen copper tubes divided into two rows and it is located in a low-pressure chamber where vacuum is generated using an exhauster via ejector. The liquid tested was water at absolute pressure in a chamber in between 96.8 kPa up until 12.3 kPa and a thermal gradient 55 to 30 °C between the cooled liquid flowing inside the exchanger upwards and the falling film heated liquid. The flow of the falling film liquid ranged from zero to 17 litres per minute. Two types of tubes have been tested, a smooth one and a sandblasted one. The correlation of average heat transfer coefficient at the surface of both tube types has been created.

# PILOT-PLANT SHOWER SCRUBBER FOR CLEANING POLLUTED GAS

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Organic and inorganic gaseous antropogenic pollutants have become a serious problem due to negative effect on climate change. To separate these pollutants primarily absorption processes are used due to their relatively low costs and low technology requirements compared to other chemical engineering operations. There are more basic principles of an absorption, in this case where gaseous absorbate should be trapped by liquid absorbent a chemical reaction principle is mostly favourable.
The goal of this work is to verificate a sorption capacity of the ZK 400 pilot-plant wet shower scrubber. Carbon dioxide was absorbed into an aqueous solution of sodium hydroxide. The effectiveness of the chemisorption was investigated by changing the sodium hydroxide (absorbent) flow rate. Winkler's volumetric acid-base titration method was used to analyse the individual samples collected at specified times of the absorption process. The medium ZK 400 scrubber's flow rate (450 $dm^3/h$) provided the best conditions for chemisorption.

# ELASTIC-PLASTIC MATERIAL MODEL OF TEXTILE COMPOSITES AND IDENTIFICATION OF MATERIAL PARAMETERS

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New simple elastic-plastic material model for textile composites loaded in the state of plane stress was proposed in this work. The model considers non-linear elasticity in principal material directions, plasticity in shear only and is able to calculate so called weave locking angle. Hardening function was proposed in the form of power-law. Hashin's criterion was used for prediction of material failure. Finite element model built in Abaqus software is fully parameterized using programming language python. Material model was implemented using umat subroutine. Identification of material parameters was performed using optimization software optiSLang, where differences between numerical and experimental data (pure tensile, cyclic tensile and compressive tests) were minimized. Thirteen parameters including elasticity moduli, strengths and plasticity parameters were identified. Identification was performed for three materials, each of them with two types of weave (plane and quasi-unidirectional plane weave). One set of specimens (material and type of weave) was loaded (tensile and compressive) in directions which formed angles between 0° and 90° with step of 15° with principal material orientations of the weaves. Afterwards, the locking angle was compared to experimental results.

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# OPTIMISATION OF ANNEALING CYCLE OF PLASTER MOULDS FOR MANUFACTURE OF METALLIC FOAMS WITH IRREGULAR CELL STRUCTURE

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Metallic foams are materials, the research of which is still ongoing, with the broad applicability in many different areas (e.g. automotive industry, building industry, medicine, etc.). These materials offer interesting perspectives due to the combination of properties, which on one hand are related to the metallic character, and on the other hand to the porous structure.
Since the discovery of porous metallic materials numerous methods of production have been developed. The work deals with an optimisation of the foundry method for manufacture of metallic foams with use of evaporable polymeric pattern. This technology was used for manufacture of metallic foam with irregular cell structure with fully open pores.
Attention in the experimental part is devoted particularly to the chosen moulding material – plaster. Suitably proposed procedure of manufacturing of plaster mould, drying process and subsequent annealing have principal influence on the final properties of the mould and therefore on the quality of the resulting casting of the metallic foam.

# LOAD CAPACITY PREDICTION OF CARBON OR GLASS FIBRE REINFORCED PLASTIC PART OF WRAPPED PIN JOINT

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Joint using a metal pin is one possibility how to achieve removable joint of composites. The load capacity of the wrapped pin joint depends on many parameters, especially on the type of fibres and resin and geometric properties of the joint. The composite part of the wrapped pin joint is exposed to the combination of tension in the longitudinal direction and localized compression in the transverse direction. Values of compressive stress in the transverse direction can exceed several times the uniaxial compressive strength [1].

In this work, two types of fibres (carbon or glass) were used for manufacturing of the wrapped pin joints. The experimental specimens with different geometries were exposed to quasi-static loading. *Zwick/Roell Z050* testing machine were used for the tensile test. The load capacity of the carbon or glass composites parts was predicted using the finite element analysis. An adjusted failure criterion *LaRC04* [2] was used for the prediction of the load capacity. The numerical model was validated by means of the comparison of the numerical and experimental results.

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# EXPERIENCE WITH ACCUMULATIVE ROLL BONDING OF LOW-CARBON STEEL

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Severe plastic deformation (SPD) methods belong to techniques for producing fine-grained microstructure in metals, through which their strength is improved by the grain size strengthening mechanism. To date, about a dozen methods have been developed for achieving fine-grained microstructure by applying large plastic deformation with the strain level of more than 2, while preserving the workpiece dimensions [1].

ARB (Accumulative Roll-Bonding) method was developed by the team of Prof. Saito in Japan in 1999 [2]. It essentially involves piling and bonding metal sheets by repeated cold rolling or warm rolling. Microalloyed IF (Interstitial-Free) steels are the most common choice for producing ultrafine-grained microstructures by SPD methods [1, 3]. In the present study, the experimental material was low-carbon steel with minimum levels of alloying elements, as indicated by Table 1 showing its chemical composition. The experimental work focused on finding the optimum temperature and surface treatment of specimens to achieve bonding. Multiple ARB cycles were carried out and the resulting microstructure was examined (Fig. 1). Tension tests were conducted and the values of mechanical properties were determined.

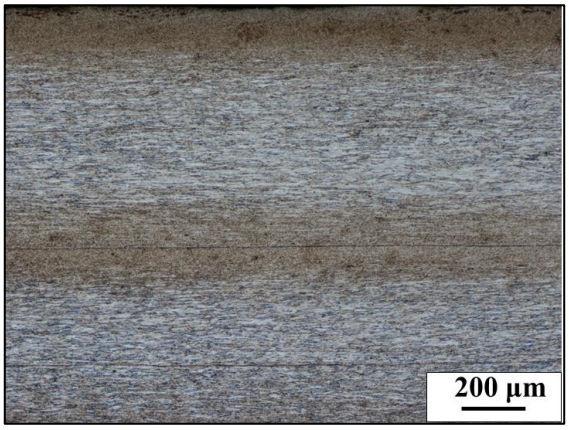

Figure 1. Metal sheet microstructure after two ARB passes

Table 1. Chemical composition of the experimental steel in wt. %

| C | Si | Mn | P | S | Cr | Mo | Cu | Al | B | N | Fe |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0.011** | 0.022 | 0.159 | 0.006 | 0.015 | 0.037 | 0.001 | 0.009 | 0.002 | 0.009 | 0.003 | 99.691 |

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# FAST AND EFFECTIVE PREPARATION OF NANOCRYSTALLINE CELLULOSE FROM LIGNOCELLULOSIC SOURCES

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Herein we report on two optimized procedures for rapid preparation of NCC: by microwave hydrolysis with sulphuric acid and by liquefaction of amorphous part of cellulose in ethylene glycol under acidic catalysis.

Experimental

A suspension of microcrystalline cellulose in water and sulfuric acid was was put into a microwave reactor where it was heated according to the predefined program. The suspension was transferred to plastic centrifuge tube and centrifuged.

The cotton linter was dissolved to the nanocrystalline cellulose residue in glass reactor vessel with attached mixer and condenser with ethylene glycol and methane sulfonic acid catalyst. The product was diluted with 1,4-dioxane and centrifuged. The product is a NCC suspension in 1,4-dioxane.

Results and discussion

Microwave reactor allows good control and repeatable reaction conditions with homogeneous temperature profile and preparation of NCC in shorter reaction times as compared to standard procedure. The average particle sizes of NCC were between 140nm and 1280nm, while yields were between 7% and 78%. The crystallinity index was from 83% to 84%.

The NCC prepared from cotton linter had crystallinity index 92% and the yield of the reaction was more than 67%.

Conclusions

We developed an optimized process of NCC preparation from commercial MCC that allows rapid and repeatable preparation of nanocrystalline cellulose of defined size with high yields. Additional advantage of the process is the ability to fine-tune the particle size by suitable reaction conditions and is enabled by good process control of the microwave synthesis reactor.

Method for preparation of NCC by acid hydrolysis in ethylene glycol is a model procedure for NCC isolation from different natural cellulosic sources such as biomass with high yields and products with high crystallinity index. The main advantage of this method is, that NCC is in a form of a suspension in organic solvent, suitable for further derivatization and functionalization.

# TENSILE AND COMPRESSIVE TESTS OF TEXTILE COMPOSITES AND ITS RESULTS ANALYSIS

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Presented work was focused on experimental investigation of behavior of six types of textile composite subjected to pure tensile, cyclic tensile and compressive loading according to ASTM standards. Each of the type was loaded in directions which formed angles between 0° and 90° with step of 15° with principal material orientations of the weaves. Two types of the weaves were tested (plane and quasi-unidirectional plane weave). Zwick/Roell Z050 test machine was used for the experiments. Specimens were photographed during the test. Photographs were used for subsequent calculation of so called locking angle which form the textile weave prior to the failure. Force-displacement dependencies were measured during tensile tests. Ultimate forces were obtained from compressive tests. Next part of the work was aimed at analyses of experimental data gathered from more than 1000 experiments. Special software was programmed for automatic calculation of averaged dependencies and ultimate forces and displacement. Furthermore, methodology for calculation of locking angle was proposed and tested. Results were used during identification of material parameters of the proposed material model in follow-up research.

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# RELAXOR-LIKE DIELECTRIC PROPERTIES IN SOLUTION DERIVED LEAD-FREE $K_{0.5}Na_{0.5}NbO_3$ – $SrTiO_3$ THIN FILMS

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Requirements for miniaturization of micromechanic and microelectronic components have increased the demand for thin film processing. At present lead-based complex perovskite systems are widely used in the field of ferroelectric ceramics. But, due to the toxicity of lead content, much of the research nowadays is oriented towards lead free materials and potassium sodium niobate with the composition $K_{0.5}Na_{0.5}NbO_3$ or KNN has been considered as one of the promising candidates. Solid solutions of KNN with $SrTiO_3$ (STO) in bulk ceramic form have been reported to exhibit ferroelectric or relaxor-like behaviour, depending on the amount of the two constituent phases.

In this contribution, we report on the study of (1-x)$K_{0.5}Na_{0.5}NbO_3$ –x$SrTiO_3$ or (1-x)KNN –x$STO_3$ thin films, with x varying from 0.025 to 0.25. The about 300 nm thick films were deposited from the acetate-alkoxide-based precursor solutions on Pt(111)/$TiO_2$/$SiO_2$/Si substrates. Upon heating to 750 °C, the formation of perovskite solid solutions was confirmed in all developed films. Increasing STO content decreased the monoclinic distortion, the volume of the unit cell and the degree of preferential (100) orientation in the films. We connect the latter to the differences in the average surface charges of the KNN and STO end-members. The microstructures of KNN-STO films consisted of small, equiaxed grains. The temperature of the dielectric permittivity maximum or $\varepsilon'_{max}$ decreased with the increasing STO content in the films, but the respective $\varepsilon'_{max}$ values were lower than those reported for bulk. Dielectric spectroscopy and polarization vs. electric field dependence revealed the relaxor-like behaviour in the 0.85KNN–0.15STO thin film.

# GALLIUM NANOPARTICLES ON HYDROXYAPATITE

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Creating elemental gallium nanoparticles is a challenging task due to low melting point and negative redox potential of gallium. It has been shown that ultrasonic dispersion of molten gallium enables production of elementary gallium nanoparticles from molten gallium without using surfactants.[1,2] However, with this method, Ga is partly oxidized to GaOOH in aqueous media.[1] Our experiments have revealed that sonication of metallic gallium in pure water and air atmosphere yields mostly GaOOH nanorods. By changing aqueous media to partly aqueous with the addition of acetonitrile, we were able to reduce the GaOOH part of the sample to only an amorphous $Ga(OH)_3$ shell on spherical Ga nanoparticles. The presence of hydroxyapatite enabled separation of the particles, reduced their size and increased the fraction of smaller particles. Moreover, its presence resulted in a nanocomposite material, a composite of hydroxyapatite and amorphous spherical gallium nanoparticles, covered with GaOOH. Most of the Ga particles are smaller than 100 nm, some of them as small as 10 nm. The material was characterized with XRD, SEM, TEM, EDS and FTIR. It may be a potential new anti-bacterial material, since $Ga^{3+}$ ions have antibacterial properties[3, 4] and hydroxyapatite is a bioactive component that will enable normal growth of non-bacterial cells after the antibacterial action.

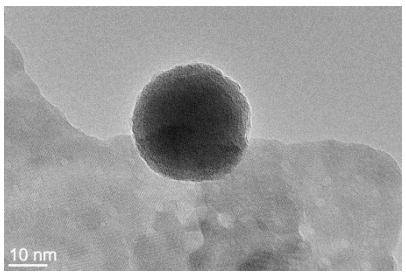


Figure 1: TEM image of a Ga nanoparticle on hydroxyapatite.

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# ESTIMATION OF THERMAL CONTACT CONDUCTANCE BY CHANGING THERMAL CONDUCTIVITY OF INTERFACE LAYER

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Thermal contact conductance is an important parameter that helps us to simulate heat transfer between two bodies and results from simulations can be used in various industrial applications. Usually two bodies with embedded thermocouples are used for estimating thermal contact conductance. One of the bodies is heated up to the required temperature and then is put to the contact with second body. Temperature histories inside bodies are recorded and beck's inverse heat task is used to calculate heat flux, surface temperature and thermal contact conductance from temperature histories of temperature sensors. But, as is shown in this article, embedded thermocouple disturbs temperature field inside body and the condition of constant heat flux at the surface cannot be satisfied. Therefore Beck's algorithm doesn't give us proper results.
New method for estimation of thermal contact conductance, which is based on changing thermal conductivity of interface layer between bodies, is described in this article and results are compared with these from Beck's algorithm.

# DEFORMATION BEHAVIOUR OF NATURAL SHAPED BONE SCAFFOLD

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The proposed paper is aimed at the mechanical testing of artificial bone structure in the form of an enlarged scaffold for application in replacements of trabecular bones [1]. The geometry and morphology of the scaffold is based on a 3D model from X-ray computed micro-tomography of the real trabecular bone. Main motivation of the work is to develop optimized self-degradable bone scaffolds compatible with natural ingrowth of bone tissue. Thus, analysis of deformation behaviour of scaffold with morphology identical to natural bone is the first step in this task.
Model of the enlarged scale bone scaffold was tested using uni-axial compression test. Geometry of the model was based on 3D micro-tomography reconstruction of trabecular bone sample used for comparative mechanical testing [2]. Tomography imaging was performed in resolution sufficient to identify main structural parameters (thickness of the trabeculae, pore sizes and connectivity). Acquired projections were reconstructed to obtain spatial binary image data and model in STL format compatible with 3D printer. The model was upscaled 2 times in order to achieve a favourable ratio between resolution of the μCT scanning and resolution of the 3D printer. Polylactic-acid (PLA) was used as a printing material due to its biocompatibility and self-degradability. Compression tests of scaffold model and real bone were performed using custom uni-axial loading frame and deformation responses of both structures were evaluated and compared.

Acknowledgements
The research was supported by Grant Agency of the Czech Technical University in Prague (project No. SGS12/205/OHK2/3T/16) and by institutional support of RVO: 68378297.

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# LOW-TEMPERATURE EXTRUSION OF TITANIUM

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Extrusion by KOBO method performed via additional cyclic twisting metal guarantees the behaviour throughout the duration of the process conditions of permanent change of the deformation path. As a result, there is the location of plastic flow of metal in the shear bands and above all, generation of dislocation dipoles the "breaking up" leads to the acquisition of the metal strongly overbalance concentration of point defects. "Supersaturation" by point defects changes the physical properties of the metal (reduced viscosity) which favours its superplastic flow. The phenomenon of concentration of point defects to form clusters, leads to a strong increase in the strength of products properties. In particular, titanium wires obtained by KOBO method possess yield strength YS = 560MPa and a tensile strength UTS = 672MPa with a high elongation E = 32%.
In this work alongside results from tensile tests contains the results of the structural observations (optical and TEM) both starting material and after the process of low-temperature extrusion by KOBO method.

# PREPARATION OF ELECTRO-CONDUCTIVE Y-TZP/TIN COMPOSITE WITH REDUCED TiN CONTENT

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A comparative study of Y-TZP/TiN electro-conductive composite preparation by two various synthesis routes has been done; thermal hydrolysis and mixing of commercially available TiN nanopowder with micron-sized Y-TZP. Results reveal that electro-conductive TiN nanoparticles formed by in-situ precipitation of $TiO_2$ on the surface of Y-TZP particles and subsequent nitridation were homogeneously dispersed (Figure 1a) in contrast to mechanically mixed powders (Figure 1b). During the nitridation process the particle size did not change significantly thus percolation concentration remained low (about 16 vol% TiN) and consequently the composites met the requirement (100 – 300 Ωcm)[1] for electrical discharge machining (EDM). Composite prepared by mixing of commercial TiN nanopowder with micron-sized matrix phase Y-TZP did not exhibit homogeneously dispersed TiN nanoparticles. Consequently, in order to obtain required electrical conductivity for EDM, the content of agglomerated electro-conductive particles had to be higher, also resulting in deterioration of mechanical properties. In our research the composites prepared by in-situ precipitation were EDM machinable already below 15 vol% TiN in comparison to Vanmeensel et al.[2] who reported that comparable electrical conductivity of composites prepared by mixing of commercial micron-sized powders was obtained at 33 vol% TiN.

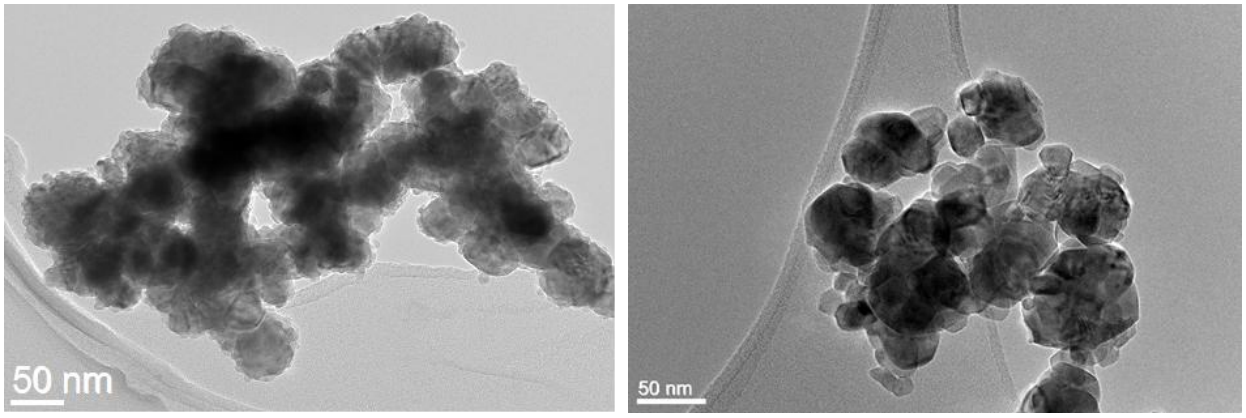


Figure 1: TEM micrographs of a) precipitated TiN nanoparticles on the surface of Y-TZP matrix particles (left) and b) mechanically mixed powders (right).

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# MATHEMATICAL MODELING USING TABU SEARCH APPROACH FOR OPTIMIZING OPERATIONAL CONDITIONS OF OXIDATIVE ORGANIC SOLUBILIZATION AND HYDROLYSIS REACTIONS

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During the last two decades, the photocatalytic oxidative treatment of organic contaminants in various wastewaters has been numerously investigated as an emerging, environmentally friendly, cost-effective method and attracted considerable attention due to increasingly restrictive environmental regulations.

In this study, we have investigated the photocatalytic oxidative hydrolysis and solubilization of organic compounds in aqueous $TiO_2$ (Degussa P25) and modified $TiO_2$ (Au(0 ~ 1.2 wt%)-$TiO_2$(P25)) suspensions in the presence of artificial UV light. The effect of process parameters such as initial organic concentration (25 ~ 100%), photocatalyst loading (0.05 ~ 2 g/L), UV power intensity (0 ~ 36W), solution pH (4 ~ 12) on the photocatalytic hydrolysis/solubilization has been assessed systematically.

Photocatalytic oxidative treatment resulted in the high degree of hydrolysis and solubilization of particulate organics. The highest extent of an increment of soluble organic concentration at the end of operation time of 60 min was 110%. Tabu search, neighbor search based meta-heuristic, which utilizes the characteristic of solution space in order to search the most attractive values was used for calculating the optimal operating conditions. The simulated highest hydrolysis rate constant described by pseudo-first order rate constant was 3.2 $h^{-1}$ under the optimal operating conditions.

Acknowledgments: This work was supported by the Green City Technology Flagship Program funded by the Korea Institute of Science and Technology (KIST-2014-2E25082).

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# DESIGN OF THE LIQUID FLOW APPARATUS WITH USING FEM MODULE

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Thanks to the existing computer simulation tools, the Finite Element Method (in short FEM) combined with Fluid Flow Simulation Module are applied to adjust the rotor's parameters essential for fluid flow systems. Such parameters ought to take into account an impact of the flow conditions on the level of aeration for the flowing water. The FEM is a currently commonly used computer simulation tool for many engineering computations. The development of FEM evolves simultaneously with the progress of the computer techniques. The applied herein computer aided design technology resorts to FEM and Flow Simulation Module used for fluid flow modeling in the systems of biological purification of sewage.

SolidWorks Flow Simulation is a perfect tool for an engineer who wishes to conduct a fluid flow analysis, but is not an expert within fluid simulation. SolidWorks Flow Simulation can be used in a diverse range of applications and is designed to be an extremely flexible software tool. If one strives to develop the machines, by using SolidWorks Flow Simulation during the product development cycle, it can help to build a better product within less time. Flow Simulation is a goal based flow analysis software. One simply instructs the program about the main designer's objectives e.g. maximal velocity in flow, specific pressure drops across examined model etc. and this software package will calculate these required goals and present all computed results to the user after the completion of the analysis. This functionality helps the potential user to obtain a much deeper engineering insight into designs.

This type of modeling-based research enables the adjustment of the efficiency in the designed devices and systems tuned up to the real recipient's demands. Equally, it also allows to decrease the energy consumption for the new innovative technological solutions which in particular meets the current high standard EU requirements .

The paper discusses the adjustment of the rotor construction and its working parameters in modeling processes matters for the determination of the properties and parameters of such devise, which is meant to operate non-stop within the entire interval of the real time and to ascertain to them the most favorable conditions for aeration and turbulence of the flowing fluid.

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# THE THERMAL STABILITY OF SOFT MAGNETIC BULK GLASSY $Fe_{43}Co_{22}Ni_7B_{19}Si_5Nb_4$ ALLOY

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A large number of studies on the development of soft magnetic metallic glasses have been carried out for the subsequent 20 years. It is well recognized that the low glass-forming ability (GFA) of Fe-based alloys has limited the potential of using them as engineering materials. For this reason extensive efforts have been carried out to improve the GFA of metallic materials and understand the mechanism of effects of various factors on the formation, crystallization, thermal stability and property of bulk metallic glass (BMG) [1-3].

In the present paper the thermal stability, magnetic properties and structure of $Fe_{43}Co_{22}Ni_7B_{19}Si_5Nb_4$ bulk amorphous alloy was investigated. The investigated alloy was cast as rods with 1.5; 2.5 and 3.0 mm diameters. Thermal stability associated with the glass transition temperature ($T_g$), crystallization temperature ($T_x$) and supercooled liquid region ($\Delta T_x = T_x - T_g$) was examined by differential scanning calorimetry (DSC). The Curie temperature of investigated glassy rods was determined from results obtained by DSC method. The magnetic properties and microstructure of the rods were examined by the vibrating sample magnetometer (VSM) and by X-ray diffraction (XRD) methods, respectively. The crystallization temperature ($T_x$) and the glass transition temperature ($T_g$) has the value of $T_x$ = 828K, 827 K, 826 K and $T_g$ = 794 K, 790K, 797 K for rods with the diameters of 1.5mm, 2.5 and 3.0mm, respectively. The parameter of $\Delta T_x = T_x - T_g$ as a criterion of the glass forming ability (GFA) of investigated alloy has the value of 34 K, 37 K and 29K for rods with the diameters of 1.5mm, 2.5 and 3.0mm, respectively. The investigated alloys have good soft magnetic properties (e.g. $M_s$ = 1.07 to 1.22 T).

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# INFLUENCE OF COOLING EFFECT OF THE FOUNDRY MOULD ON MICROSTRUCTURE AND THERMO-PHYSICAL PROPERTIES OF CASTINGS MADE OF Al-Si ALLOY

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Mechanical and physical properties of the casting depend mainly on the chemical composition and achieved macro and microstructure of the cast material. This can be affected by the manner of casting and by selection of the foundry mould, when it is possible to use material with different cooling effect. The paper deals with the influence of moulding materials used for the manufacture of disposable moulds on the achieved microstructure and selected thermophysical properties of castings ($\alpha_T$ – length expansion coefficient). Test specimens were obtained by gravity casting of the alloy AlSi10MgMn into the moulds with different cooling effect. By use of different conditions of solidification we prepared material with different microstructure in the as-cast state for experimental evaluation. The obtained properties were compared with the results obtained at use of the most common type of mould – die mould.

# FACILE ROUTE FOR THE SYNTHESIS OF NiO/ZnO NANOCOMPOSITE USED IN GAS SENSORS

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Current years have seen increased interest in the synthesis of p/n metal oxide-based nanocomposites and their great potential in advanced applications, such as optoelectronics, photocatalysis and gas sensors. The superior functional performances of the system combining p-type and n-types semiconducting oxyde in comparison to the corresponding single-phase metal oxides are mainly ascribed to the build-up of an inner electric field at the p/n junction interface.
Hence for our present work, the various ratio of nanocomposite NiO/ZnO was synthetized by a thermal decomposition at different temperature (500°C and 600°C) of a single bath presynthesized precursor. The precursor was first characterized by ICP-AES, FTIR, TG and the nanocomposite obtained was also characterized by DRX, XPS and SEM. Using Sherrer equation we have estimated the size (less than 50 nm) of our nanoparticles. The results show that the method is effectively reliable for the synthesis of pure NiO/ZnO nanocomposite which is a good candidate for gas sensor and photocatalysis application.

# CHARACTERISTICS OF AlTiCrN+DLC COATING DEPOSITED BY HYBRID ARC PVD AND PACVD PROCESS

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Coatings produced by physical vapour deposition are recognised as one of very interesting premium technologies for protection and modification of products surface, due to the existing possibility to synthesis materials with unique physical and chemical properties [1].One of the most effective coatings of this type is the AlTiCrN hard coating. AlTiCrN coatings have been developed for high-temperature wear applications, such as cutting tools or die casting molds due to their unique mechanical properties and oxidation resistance [2]. Low-friction diamond-like layers of the DLC type (diamond-like carbon) play a very important role in a reduction of friction resistance, especially in technical dry friction conditions [3].

Deposited on hot work tool steel substrate coating system composed of AlTiCrN film covered by diamond-like (DLC)-based lubricant, was the subject of the studies. The AlTiCrN and DLC layers were deposited by PVD lateral rotating ARC-cathodes (LARC) and PACVD technology on the X40CrMoV5-1 respectively. This paper provides an analysis of the microstructure, mechanical and tribological properties. HRTEM investigation shows an amorphous character of DLC layer. It was found that tested AlTiCrN layer has nanostructural character with fine crystallites. Basing on the XRD pattern of the AlTiCrN, the occurrence of fcc phase was only observed in the coating, the texture direction <311> is perpendicular to the sample surface. Combined SEM, AES and ToF-SIMS studies confirmed assumed chemical composition and layered structure of coating. The chemical distribution of the elements inside the layers and at the interfaces was analyzed by SEM and AES methods. The atomic concentration of the particular elements of AlTiCrN layer was calculated from the XPS measurements. In sliding dry friction conditions the friction coefficient for the investigated elements is set in the range between 0.03-0.05. The investigated coating reveals high wear resistance. The coating demonstrated a dense cross-sectional morphology as well as good adhesion to the substrate.

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# EVALUATION OF CONTACT STRESS DISTRIBUTION MEASURED BY PIN SENSOR AND PIEZOELECTRIC FORCE TRANSDUCER IN HOT AND COLD ROLLING

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Different approaches have been developed to describe stresses inside of a roll gap during the rolling process, from the simple 1D slab method to complex 3D rolling modelling, solved analytically or numerically. One of the main unknown parameters for all of these rolling models is the relationship between normal and tangential surface stresses on the interface roll and rolled materials. To measure this ratio, "friction," many techniques have developed in different studies. In 2012, a unique series of measurements were taken using two different measuring techniques implemented in one measuring roll – measuring with a pin sensor and a ROLLSURF sensor [1]. In this paper the pin sensor procedure is presented.

Measurements by pin sensor have long history. A basic principle of this technique is the measurement of forces at the top of the sensitive element (pin) which is in contact with a formed material. Strain gauges measure deformation of the pin to determine the forces on the pin. In contrast, a piezoelectric force transducer measures the electric charge on the piezoelectric material which is proportional to the applied forces. A measuring system with a piezoelectric force transducer and pin has a higher structural rigidity compared to strain gauges and better dynamic characteristics of the resultant measuring system. A piezo sensor can be overloaded without damaging it and is well protected against destructive environments. The main disadvantage of a piezo sensor is a loss of electrical charge over time and its higher cost.

This article details a procedure for measured data analysis, a compensation of the crosstalk effect between measured channels by calibration and reduction of electrical charge drift. The influences of the material penetration into the gap around the pin is also described and analyzed.

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# AU NANOPARTICLE SYNTHESIS VIA ULTRASONIC SPRAY PYROLYSIS WITH A SEPARATE EVAPORATION ZONE NN YR

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Some experiments in connection with gold nanoparticle production were conducted in an effort to produce a more accurate model for determining gold nanoparticle synthesis with Ultrasonic Spray Pyrolysis (USP). As previous experiments with gold nanoparticles have yielded nanoparticles of various shapes (spherical, triangular, cylindrical…)[1], a focus on synthesizing only spherical nanoparticles is underway, as a mixture of different shapes is difficult to characterize and utilize. One of the factors for particle formation is droplet evaporation. In an attempt to produce optimal conditions for droplet evaporation with solvent diffusion and precipitation, a separate furnace and separate reaction gas inlets were used. This modification separates the evaporation stage from the reaction stage, compared to a standard USP setup. The temperatures used for evaporation range from 100 to 200°C. A computer numerical simulation was utilized for the evaporation of aerosol droplets and solvent diffusion, to determine the optimal temperature for this stage, ensuring the longest evaporation time available for the given transport tube diameter and length of evaporation zone. A longer evaporation time gives better conditions for diffusion of solvent into the center of the droplet and a higher probability of formation of a spherical particle.

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# A NUMERICAL SIMULATION AS THE SUPPORT FOR MATERIAL TECHNOLOGICAL MODELLING OF DIE FORGINGS PRODUCTION

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The paper describes a numerical simulation and material technological modelling of the current state of forming technology and subsequent free air cooling of selected steel die forgings which are used in the automotive industry. These are often called security parts where a great emphasis is put on reliability and quality. Such a numerical simulation provides information on the material flow, size and deformation rate during molding and temperature conditions during handling, forming and subsequent free air cooling. Material technological modelling allows obtaining the microstructure on the samples corresponding to the selected points on the forging. Combining these two techniques the technology of controlled cooling of steel die forgings, serving as a substitute for heat treatment, will be developed and optimized. It is also possible to optimize the process, in terms of both quality and energy consumption. This technique was applied to the technology of forming of micro-alloyed steel die forgings, especially carbon steel and chrome – molybdenum steel 42CrMoS4 in the environment of the company VIVA a.s. In this paper the results, both numerical as well as physical simulations and their comparison with the real production process are stated.

# DEPTH PROFILING OF MULTILAYERED THIN FILMS ON METALLIC AND GLASS SUBSTRATES

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Diffferent types of multi-layered thin films with potentially advanced optical properties were deposited onto metallic and glass substrates. Films deposited nominally consisted of AlN/Ti/stainless steel on glass substrate, and $TiNO_{x2}/TiNO_{x1}$ on Cu substrate, with total thicknesses of the deposited layers of the order of hundreds of nm.
AES was used to depth profile these multi-layered thin films all the way to the substrate, thus checking their compositions in dependence of depth as well as determining their thicknesses, but also thicknesses of the individual sublayers that thin films consisted of. Highly variable Ti vs. N vs. O atomic ratio inside the layer of the thin film that is supposed to consist of $TiNO_{x2}/TiNO_{x1}$ sublayers, suggests that this layer is indeed not of the homogeneous composition but 2 stoichiometrically distinct sublayers are not readily resolved. It was also found that the top layer of the film on the glass substrate, nominally AlN, actually consisted of Al, N and O.
Shift of the AES peak positions with regard to the metallic state was used for Al, Cu and Ti to obtain information about their chemical state with depth. It was also shown in this way, that Al in Al-N-O type sublayers was oxidized throughout the sublayer.

Keywords: multilayer, thin film, depth profile, AES, peak shift, optical properties

# SELECTIVE EXTRACTION OF Co, Ni AND Cd IN POLYMERIC PVC MEMBRANE CONTAINING ALIQUATE 336 AS CARRIER

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The separation of metals from sulphate and chloride media has been practical interest to the researchers. Polymeric membrane has applications such as separation, enrichment, and recycling. PIMs has many advantages such as harmful chemicals to a minimum, flexible structure and the application [1-3]. PIMs contain the polymer, solvent, carrier and a solution of plasticizer in the film obtained by casting.

In this study cobalt, nickel and cadmium ion extraction has been investigated. Polymeric PVC membrane contains based polymer, which incorporated the commercial extractant Aliquat 336 was used. TBP was used a modifier. 2- nitro phenyl pentyl ether (NPPE) was applied as plasticizer for the preparation of the membranes. The membrane was characterized to obtain information regarding its composition by AFM in Fig.1.


Fig. 1. PVC-Aliquate 336-TBP, AFM images

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# THE PHYSICAL CHEMISTRY OF METAL SURFACES INVOLVED IN CORROSION PROCESSES

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Corrosion (a very costly phenomenon) is caused by the interaction of metals and alloys with their environment, taking place at the material surface.
Recent advances in the understanding of corrosion mechanisms have been achieved by investigating the chemical and electrochemical reactivity of well defined metal surfaces at the nanoscale.
This lecture will focus on recent advances in the understanding of corrosion of metals and alloys at the nanoscale, using a surface science approach. The data that will be reviewed are based on the application of advanced surface analytical techniques, such as STM, STS, XPS, ToF-SIMS, combined with electrochemical measurements, and complemented by DFT modeling.
The following points will be addressed:

- Tools for high resolution characterization of corrosion processes
- The metal-water interface: early stages of interaction studied *in situ* by Electrochemical Scanning Tunneling Microscopy (on Cu, Ag, Ni single crystal surfaces)
- Reactivity of grain boundaries
- Passive films
- Structure sensitive localized dissolution
- Passivity breakdown and pit initiation
- Bacteria/metal interfaces
- Atomistic modeling of corrosion using DFT

# BIODIESEL PRODUCTION USING MINERAL MAGNESIUM OXIDE AS CATALYST. THE ROLE OF PVA AT THE SYNTHESIS OF MgO

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MgO is a common basic catalyst for the biodiesel production and is usually used in mixtures of basic metal oxides like Sr[1]and Li[2] or with KOH and NaOH[3]. In this study, we suggest the biodiesel production using modified mineral MgO which is compared with commercial MgO from commercial nitric magnesium.

The catalysts were synthesized by the sol-gel method in the presence or absence of Poly-vinyl-alcohol, PVA[4]. Briefly, $Mg(NO)_3 \cdot 6H_2O$ was dissolved in $H_2O$ and PVA was added with mole ratio M/PVA=1/5. Then, $NH_3$ was added till pH=10. The resulting gel was continuously stirred for 3 h, aged at room temperature overnight, evaporated at 120$^o$C for 10h and calcined at 600 $^o$C/8 h (MgO-N-PVA). The same process was repeated without PVA (MgO-N). Two more samples were synthesized from mineral MgO which was first dissolved in 37% $HNO_3$ either in the presence (MgO-M-PVA) or absence of PVA(MgO-M). The characterization was made by XRD, $N_2$ porosimetry, SEM and FTIR. The biodiesel production took place in a batch reactor using 10g of rapeseed oil, 0.5g of catalyst and hexane/methanol as solvents at 75$^o$C and atmospheric pressure.

The XRD analysis confirms the structure of MgO, with MgO-M-PVA and MgO-N-PVA samples showing surface area 30 and 11 $m^2$/g whereas the MgO-M and MgO-N 11 and 18 $m^2$/g, respectively. The most active catalysts were MgO-M-PVA and MgO-N-PVA with methylesters yield equal to 91% and 90%. The results are not dependent on the surface area of the catalyst but most probably on the small amount of carbon remained after calcination as FTIR reveals from the characteristic peak at 1500 $cm^{-1}$. To conclude, in this study it is showed that the mineral MgO, can be successfully modified toward a very active catalyst for biodiesel production, providing similar results with the commercially derived MgO. It seemed that the presence of carbon remaining from PVA used enhanced dramatically the catalytic activity.

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# ASSESSMENT OF IMPACT-ECHO METHOD FOR THE MONITORING OF LONG-STANDING FROST RESISTANCE OF CERAMIC TILES

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The aim of this paper is to evaluate the possibility of using the Impact-echo method for monitoring of extremely long term frost resistance of ceramic tiles. The non-destructive testing methods make it possible to sensitively identify the occurrence and development of defects in materials. Impact-echo methods belong to the family of non-destructive testing methods and can be applied in many branches, among others also in civil engineering. To assess the ceramic tile frost resistance, a new measurement method has been developed which is based on using the acoustic properties of the ceramic tiles. Sets of ceramic tiles of the Ia class to EN 14 411 B standard have been analyzed. The ceramic tiles under investigation have been subjected to 500 freeze-thaw-cycle based degradation in compliance with the relevant EN ISO 10545-12 standard. To verify the correctness of the Impact-echo method results, additional physical properties of the ceramic tiles under test have been measured. To analyze the specimen surface condition, we also used Olympus LEXT 3100 confocal scanning microscope. It has been proved that the acoustic method Impact-echo is a sensitive indicator of the structure condition and can be applied to the ceramic cladding element frost resistance and service life prediction assessment.

# IMPROVEMENT OF CASTING OF SPECIAL STEEL WITH WIDE SOLID – LIQUID INTERFACE

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Steelmakers in the last few years are facing to significantly degreasing steel demands caused by the global economic crisis. Positive economic results have been reached mostly by steel factories which have been focused on special steel production with higher product capabilities, such as higher strength grades, steel design for acidic environments, steel for the offshore technology, etc. These steels must keep the mechanical properties, such as the resistance to rapture, compression strength, stress-strain properties etc., in strict limits.

This paper deals with the casting of a special steel (C0.18 Ni0.04 V0.004 N0.003 *w*/%) by EVRAZ VÍTKOVICE STEEL, a.s. The casting of examined steel according to the casting conditions for classic low-carbon steels shows many problems in final quality. The macrostructure laboratory tests of five slab samples show high presence of porosity, centerline segregation and cracks (see. **Fig. 1**).

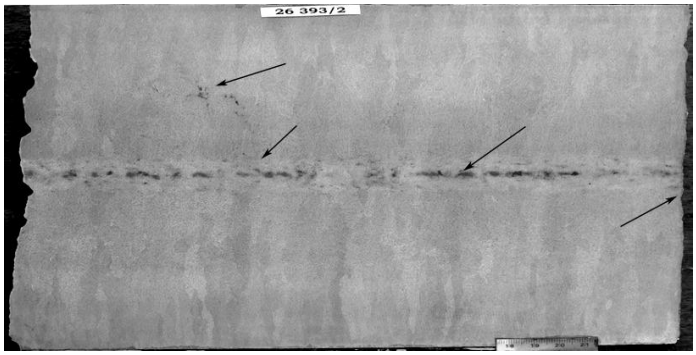


**Fig 1**. Macrostructure laboratory tests

The numerical simulation reveals that the exanimated steel is characterized by the long mushy zone (see. **Fig. 2**) compares with classic low-carbon steels and probably needs a special treatment. The adjustment of process conditions vital for achieving the quality of the special steel grades to be produced is a prerequisite for defect-free production.

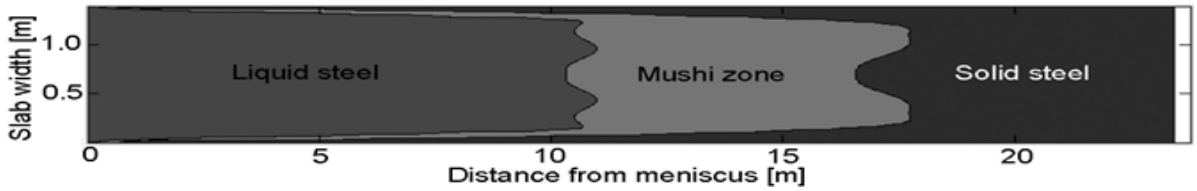


**Fig 2**. Isosolidus, Isoliquidus and mushy zones obtained by the numerical simulation

The way how to get an appropriate casting condition is to use of numerical simulation of continuous casting process and parametric optimization. Our studies suggested new sets of casting parameters as a function of casting speed and pouring temperature.

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# A MESHLESS MODEL OF THERMOMECHANICS DURING DC CASTING OF ALUMINIUM BILLETS

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The deformations of the billet that occur during the DC casting process can have strong impact on quality of the cast product and on the safety of the casting process. Reliable models of thermo-mechanical phenomena, which cause the ingot distortions, are therefore needed. Since a significant improvement in quality can be achieved by optimizing the casting process parameters by using the data provided by thermomechanical models, many numerical models have already been developed. Such models usually take into account three contributions to the strain field: the elastic term, viscoplastic term to model the mushy zone and the thermal expansion term. These models are usually solved by the finite element method [1]. A linear thermoelastic model for nonhomogeneous body is considered. The method used for solving the model is of a novel meshless type. It has already been successfully applied in studies of complex transport phenomena in solidification [2], including macro-segregation with mesosegregates. The solution of the problem is constructed based on collocation on overlapping subdomains by using radial basis functions, specifically multiquadrics. [3]. The local interpolation is first constructed in such a manner that it readily satisfies the boundary conditions and is then used to estimate the differential operators in the governing equation. The obtained coefficients are used to construct a global sparse matrix representing the system of linear equations for the displacement field. Since the method is of meshless type, it has many advantages inherent to this class of methods. The system of equations can easily be constructed and efficiently evaluated by sparse matrix solvers, there is no need to perform expensive polygonization of the domain and the generalization to three dimensional cases is straightforward. The simulations of axisymmetric mechanical problems, associated with low frequency electromagnetic DC casting of billets are presented.

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# SINTERED MATERIALS BASED ON WASTE GLASS

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Glass is plentifully used and due to its specific properties irreplaceable material utilized virtually in all areas of human activity. However consequently production of a significant waste glass quantity, which should be recycled. Although there are relatively integrated systems and advanced technologies for recycling of the products and the extraction of certain desirable chemical elements, thereby obtaining relatively high-quality glass, glass factories or other construction materials producers does not appear interest in these shards or there is only
a partial utilization of the cullet.
These shards are the subject of the research presented in this article. The research was focused on utilization of cullet in the manufacture of sintered materials based on glass. These are commercially produced and used as tiles and pavers. The batch was substituted by waste cullet (recycled container glass – clear and coloured, fluorescent tubes, dark flat glass from demolition of buildings, etc.). Study of the properties was focused on both the physical-mechanical parameters and microstructure of the modified materials. It was found that despite the changes (defects and anomalies) in the microstructure can be achieved satisfactory use properties of the final material, respectively sintered tiling and paving elements.

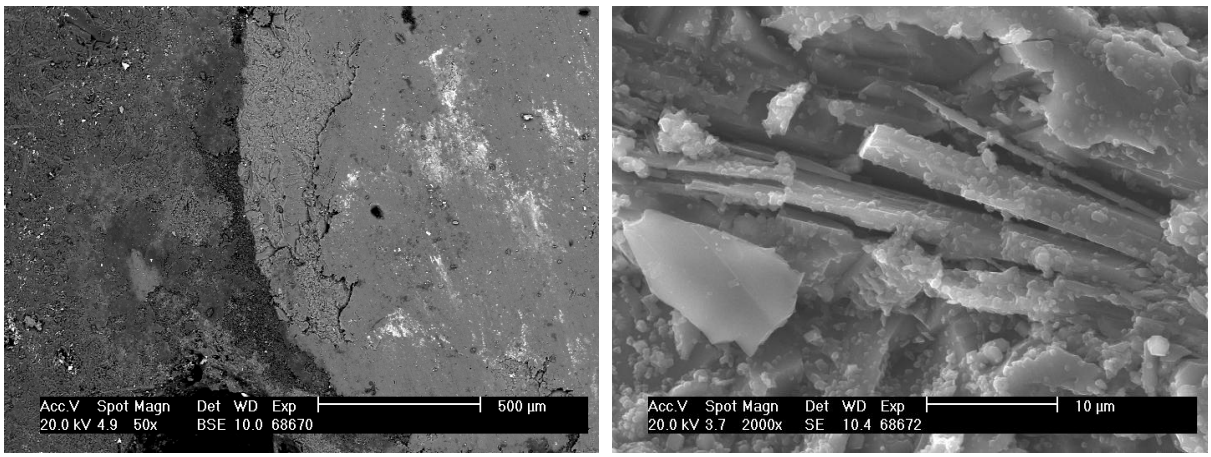


Fig. 1: a) Microstructure of sample based on recycled coloured container glass 50× (left) and b) 2000× (right).

# PHYSICAL METALLURGY AS THE BASIS FOR DEVELOPMENTS IN TOOL STEELS

Invited Lecture at the IFHTSE-Congress in Munich 12.-15. May 2014

by
Rafael Agnelli Mesquita
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Physical metallurgy governs all microstructural changes which take place during heat treatment and therefore determine the final properties of a given metal. Several phenomena con occur, which can be pointed out by five main topics: modification of crystal imperfections in terms of vacancies and dislocations, recrystallization and grain growth, displacive transformations (without diffusion or with limited diffusion), changes in solid solution as well as formation of precipitates. Tool steels are a prominent group of steels when concerning heat treatment, as all those phenomena occur, in higher or lower extent, depending on the steel composition and the heat treatment applied. During this lecture, several examples of physical metallurgy concepts applied to tool steels will be presented, namely: i) Martensite transformation and hardenability in different compositions; ii) ferrite stabilization in low nickel stainless steels; iii) several examples of precipitation hardening of secondary carbides and its effect in mechanical properties; iv) chemical composition homogeneity and the presence of undissolved carbides in heat treatment; v) distribution of primary carbides and the effects in final properties. All these topics will be presented in a microsctructural approach, where the tool steel is treated as a composite, with in-situ formation of hard carbide particles distributed in a hardened metallic matrix.

# BIOPOLYMER NANOSTRUCTURING BASED ON EXCIMER LASER TREATMENT AND THERMAL ANNEALING

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Surface modification of polymers increases potential of their application in highly specialized fields. Polylactide is an extensively researched biodegradable biopolymer which is frequently used in medicine and drug delivery system. Modification of its properties and structuring of surface can lead not only to even more extended medical applications [1].
Aim of this work is construction and characterization of new surface structures on polylactide by method composed of exposure with KrF excimer laser beam and subsequent treatment by thermal annealing. The main focus of investigation was given to the morphological studies and roughness measurements. The changes in the presence of oxygen and carbon in the surface layer were determined by *X*-ray photoelectron spectroscopy (XPS). By applied modification technique were constructed surface layers with wrinkle-like or staminate patterns. Increase and decrease of roughness were determined by used laser parameters. Surface polymer patterns are interesting due to their wide range of possible applications in e.g. tissue engineering or electronics.

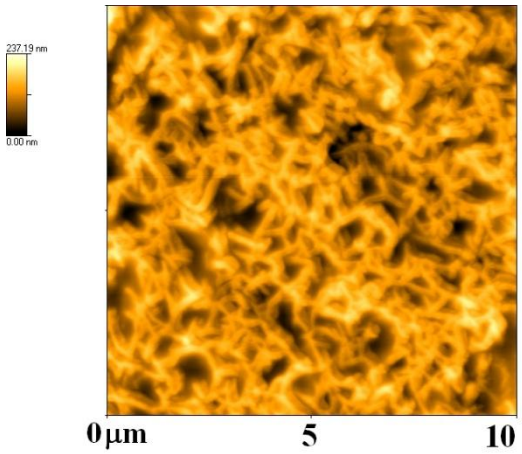


Fig. 1: The surface morphology of polylactide treated by combination of excimer laser and thermal annealing; measured by AFM

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# ENHANCED STABILITY AND ELECTROCHEMICAL PERFORMANCE OF $BaTiO_3/PbO_2$ VIA LAYER BY LAYER ELECTRO-DEPOSITION

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In preparation of $PbO_2$, $BaTiO_3$ have been used as a lower layer of $PbO_2$ toward its activity enhancement through its structural change effect, which is in under submission process, for the first time (no report based on our literature knowledge) from our laboratory. In continuation of the work, stability and enhanced activity aimed to be developed towards industrial application because of its good resistance to corrosion, long lifetime, low cost, and high over potential for oxygen evolution in electrolysis. Herein, thickness of the $BaTiO_3$ (lower layer) and $PbO_2$ (upper layer) will be optimized for its sustainable electrolysis in concern with industrial operations. The same thickness variation study aimed to be correlated for the enhancement in oxidation of mediators. At first step, pretreatment of the Ti electrode and electrodepostion of barium-titanate focused in different conditions like time and current densities. Then, $PbO_2$ electrodepositied in similar, time and current density variation for its thickness and surface structure variation in different deposition bath such as basic and acidic. The electrochemical technique of cyclic voltammetry helps to initial confirmation of $PbO_2$. Further, electrolysis result of all prepared electrodes in sulfuric acid done for their stability in high applied current density. SEM, XRD and cyclic voltammetry results corroborate with the electrolysis for sustainability of the prepared electrode. The electrode that prepared under optimum conditions applied to oxidation of mediators, here Co(II). At the end, a discussion will be made in the $BaTiO_3/PbO_2$ thicknesses on its stability and oxidation effect of mediators.

# A MESHLESS MODEL OF ELECTROMAGNETIC BREAKING FOR CONTINUOUS CASTING OF STEEL

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The application of magnetohydrodynamics in continuous casting of steel enables further improvement of the cast material. The most common applications are the electromagnetic breaking (EMBR) and the electromagnetic stirring (EMS). The former breaks the flow by applying the static magnetic field and thus improves the steel flow pattern, reduces the velocity and the turbulence of the flow, increases cleanliness of the material, improves surface quality and reduces the number of inclusions [1], whereas the later stirs the flow by applying an alternating magnetic field and thus improves the quality of the strand, reduces surface and subsurface defects, enhances solidification and reduces the number of breakouts [2].

In this contribution an EMBR in the continuous casting process is considered. The local radial basis function collocation method (LRBFCM) [3] is used for the solution of coupled turbulent fluid flow, magnetic field, concentration and energy equations. The explicit Euler time stepping scheme and the collocation on multiquadrics radial basis functions on the five-noded overlapping influence domains are used to obtain the solution of partial differential equations. The Abe-Kondoh-Nagano low Reynolds turbulence model [4] is used to describe the turbulent fluid flow, whereas the fractional step method [5] is used to solve the pressure-velocity coupling. The method has been thoroughly tested on several test cases [6-9]

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# THE USE OF MICROMACHINING TO SHAPE THE STRUCTURE AND ELECTRICAL PROPERTIES OF THE FRONT ELECTRODE OF SILICON SOLAR CELL

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The aim of the paper is to study the influence of the front electrode structure produced by the conventional and unconventional technique on electrical properties of silicon solar cells. In the range of the paper will be worked out the investigations of the front electrode produced by a conventional sintering technique in the infrared conveyor furnace, and an unconventional technique of selective laser sintering made from paste based on a silver powder. The investigations of the structure and properties of the front electrodes as well electrical properties obtained silicon solar cells will be performed.

The investigations were done on monocrystalline silicon wafers produced by Deutsche Solar. The basic parameters of these wafers were: conductivity – p type; doped – boron; thickness: 200 ± 20 μm and 330 ± 10 μm; resistivity – 1÷2 Ω·cm and ~1 Ω·cm, area – 25 $cm^2$. During investigations were applied on the front metallization silver pastes, which were consisted of silver powder, silicon dioxide and organic carrier. There was prepared a special test system to evaluate the contact resistance of silver-silicon contact. Front contacts were formed on the surface with the following morphology of the solar cells: textured with deposited antireflection layer and textured without deposited antireflection layer, non-textured with deposited antireflection layer and non-textured without deposited antireflection layer.

In this paper were performed comparative investigations to a convectional and an unconvectional methods The electrical properties of front metallization solar cell were investigated using traditional Transmission Line Model method (TLM). TLM consists in direct current (I) measurement and voltage (U) measurement between any two separate contacts. The topography of monocrystalline silicon wafer after texturization was observed using the atomic force microscope with uncontacted trybe. The medium size of the pyramids was also measured using this microscope. The topography of both surface and cross section of front contacts was observed using both: the scanning electron microscope and the confocal laser scanning microsocope. The microchemical analysis of front contacts was done using the scanning electron microscope equipped with an energy dispersive X-ray (EDS) spectrometer. Phase composition analyses of chosen front contacts were done using the XRD method.

As a result of the paper will be worked out an optimal model structure of the front electrode and the area of its connection with the substrate as a result of giving the best electrical properties of photovoltaic cells. The paper will be worked out theoretically and experimental, the basic investigations will be performed with disposition that as their results will form a wide base of knowledge, which will create the base to solve are already reconditioned and expected in the future problems from a range of solar cells.

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# THE MAGNETIC PROPERTIES AND MICROSTRUCTURE OF BULK AMORPHOUS $Fe_{61}Co_{10}Ti_3Y_6B_{20}$ ALLOY, OBTAINED IN THE FORMS OF RODS AND TUBES

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The 21st century can be called the 'age of miniaturization and proliferation of cutting-edge technology'. Currently, rapid development of subassemblies for electronic devices is on the increase, whilst featuring increasingly smaller physical dimensions. Of particular importance are component parts for miniature motors, targeted at specialist applications. The magnetic material used in micro-motors should have a good coefficient of fulfillment and, of course, excellent magnetic and mechanical parameters. The bulk amorphous alloys include highly promising materials for use in electrical engineering applications [1]. Conventional amorphous alloys, manufactured in the form of a strip, cannot be used for the construction of micro-motors because the strip shape is not suitable for the application.

In this paper, studies of the bulk amorphous alloy: $Fe_{61}Co_{10}Ti_3Y_6B_{20}$ are presented, the samples being fabricated in the form of a rod of diameter 1 mm, and a tube of outer diameter 1 mm. The researched material was obtained using the injection method, whereby the liquid alloy was injected into a copper mould. Using an X-ray diffractometer, scanning electron microscope and computer tomography, the microstructures of these rapidly cooled samples were studied. Based on the obtained results, it was found that both the rod and the tube were fully amorphous. Cross-sections of broken rod and tube were characterized by breakthroughs mixed consisting of smooth, chevron and river pattern character. This shows that there are regions of different ductility distributed throughout the volume of the sample. Three-dimensional images of the investigated materials, obtained from computer tomography, allowed the determination of the contribution of the pores and their size to the total volume of the samples. The investigated alloy is a ferromagnetic material exhibiting good soft magnetic properties, such as: high saturation magnetization, high magnetic permeability, and low value of coercive field. The technique of injecting liquid alloy into a copper mould, combined with the computer tomography studies, can be used to produce toroidal cores, which exhibit highly promising properties for successful application in the construction of electric motors.

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# *MOMORDICA CHARANTIA* MEDIATED GREEN BIOSYNTHESIS OF SILVER NANOPARTICLES

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The synthesis of nanoparticles is in the spotlight in modern nanotechnology. In recent years a number of chemical, physical and biological techniques were applied for the development of metal nano-particles (NP). Biological synthesis of nanoparticles using plant extract is currently under exploitation. Noble metal NP such as silver, gold and platinum are broadly applied in medicinal applications. There is a growing need to develop an eco-friendly method for the synthesis of NP that does not utilize toxic chemicals. In general, NP are prepared by a variety of physical and chemical methods, which are not eco-friendly. Nowadays, green chemistry procedures using various biological systems such as bacteria, fungi, yeast, and plant extract for the synthesis of NP are commonly used[1]. Among them, plant extract based green biosynthesis of metal NP especially gold and silver with controlled physicochemical properties have been reported by many researchers. In this paper, we have reported the green synthesis of silver nanoparticles (AgNPs) by reduction of silver nitrate, using fruit extract of Momordica charantia (bitter melon); commonly found plant in Southeast Asia. The reaction process for the synthesis of AgNPs is simple, cost-effective, rapid, novel and eco-friendly route using fruit extract of bitter melon plant, which acted as a reducing and stabilizing agent simultaneously at room temperature. Bitter melon fruits extract was used as a reducing agent for the development of AgNPs. Properly washed 35g of fresh fruits were added in 175mL ultrapure water in 500mL Erlenmeyer flask and boiled for 10–15min.Whatman filter paper (No. 40) was used for the filtration of boiled material to prepare the aqueous fruit extract, which was used as such for metal NPs synthesis. Aqueous solution (1mM) of silver nitrate was prepared and 50mL of silver metal ion solutions was reduced using 1.8mL of fruits extract at room temperature for 30min. As a result brown–yellow solutions were formed, indicating the formation of AgNPs. Formation of the nano silver was confirmed by surface Plasmon spectra using UV-Vis spectrophotometer and absorbance peak at 440 nm. The effects of reaction conditions such as the fruit extract amount, metal ion concentration and contact time were also studied.

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# LIQUID ALUMINIUM BATTERY

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The share of renewable energy sources in production of electrical energy has been growing. These sources (e.g. wind, sun), however, are not constant, thus more research is dedicated to the storage of larger quantities of electrical energy. One of the ideas for storage of large quantities of electrical energy came out from aluminium industry, where large quantities of electrical energy are used for production of metal (reducing $Al_2O_3$ in metal $Al^0$).
Liquid batteries in general are composed of three liquid layers – the melts, which are separated from each other on the basis of their different densities. The positive electrode placed at the bottom of the cell is a melt of heavier metal with a low melting point (e.g.: Bi, Sn, Pb, Sb). As an electrolyte inorganic salts are used (middle layer). Pure inorganic salts have high melting point, therefore an appropriate combination of different salts are used to decrease the melting temperature, regulating the density of the electrolyte and the ionic conductivity of the electrolyte. The negative electrode is molten Al metal, but metals from the 1st and 2nd group of the periodic system may also be used. The potential between the electrodes appears, due to a reduction of the chemical potential of the active metal (in this case Al) in the alloy (the positive electrode). Liquid battery cells are distinguished for some good properties, such as very large current (up to $1A/cm^2$) and long lifetime. [1]

$$E_{bat.celice} = \frac{RT}{zF} \ln\left[\frac{a_{Al\ (v\,Bi)}}{a_{Al}}\right]$$

Because we come from the aluminium industry, we have decided that the batteries, which are based on similar chemical materials, as used in the electrolysis of aluminium, will be tested. Therefore aluminium metal is used for negative electrode and salts based on cryolite are used for the electrolyte salt. With changes in the composition of the electrolyte and with a variety of metals in the positive electrode, we are trying to assemble a battery cell, which will be stable, have acceptable voltage (0.5 to 1.5 V) and high current (0.1 to 0.2 $A/cm^2$). The properties of battery will be studied with galvanostatic measurements.

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# TRIGGERING PROTEIN ADSORPTION BY CATIONIZATION OF CELLULOSE ULTRATHIN FILMS – CHALLENGES AND APPLICATIONS

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During the past decade, protein adsorption on surfaces has become an important issue in the design of smart materials such as medical implants[1], antifouling materials[2], as well as every-day products. Regarding this, cellulose, the most abundant biopolymer on earth, features some remarkable properties, in particular low unspecific protein adsorption.[3] In case, the cellulosic support is equipped with specific receptors (aptamers, cells, ssDNA,...) it could even serve as a tool for the selective detection of biomolecules such as proteins and DNA as well.[4]

In this contribution we present our recent results on how to tune unspecific protein adsorption (UPA) at the example of fluorescently labeled BSA onto cellulose thin films by a simple cationization procedure. In comparison to unmodified cellulose thin films, adsorption of FITC-BSA on cationically modified surfaces is significantly higher and is largest close to the isoelectric point of FITC-BSA. The total amount of FITC BSA on the surfaces is quantified by combination of QCM-D (wet mass) and MP-SPR (dry mass) data, which yields besides the mass the amount of coupled water as well. Additionally, patterned cationically rendered cellulose films are prepared and loaded with different quantities of fluorescently labeled BSA. A correlation between the amount of deposited protein and the fluorescence intensity is established with lowest detectable concentrations in the pM regime. The presented approach may be applied for in vivo detection systems of unspecific protein adsorption in real systems due to its inherent biocompatibility.

The research leading to these results has received funding from the People Programme (Marie Curie Actions – Career Integration Grants) of the European Union's Seventh Framework Programme (FP7/2007- 2013) under REA grant agreement n°618158 (PhotoPattToCell).

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# CERAMICS MASONRY UNITS INTENDED FOR THE MASONRY RESISTANT TO HIGH HUMIDITY

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The Faculty of Civil Engineering for several years being developed of modern masonry blocks. The aim is to develop masonry units, which exhibit good thermal insulation, mechanical and acoustic properties and reduction of energy intensity in production. Given the ever increasing natural disasters, which affect also landlocked countries, was part of development also focuses on the development of ceramic blocks resistant to high humidity.

High humidity in building construction is one of the worst effects of the building construction. This negative effect causes overall deterioration of the building construction and can lead to its own degradation. Ceramics brick construct are most stressed by high humidity already in the actual construction and after during the use. However, in case of natural disasters in the form of floods, which also occur often in Czech Republic in recent years, has led to a destruction of the building construction and subsequent demolition.

The paper deal with the possibility of preventive hydrophobic ceramic masonry units intended for masonry plinth. This hydrophobization serves as preventing in the case, where fails conventional waterproofing, but also in case of extreme high humidity.

# SYNTHESIS AND STUDY OF CARBON NANOTUBES COATED BY METAL OXIDES AS A COMPOSITE MATERIALS FOR INDUSTRIAL METALLURGY

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Carbon nanotubes (CNTs) have been intensively studied because of their remarkable electronic, mechanical properties and unique one-dimensional (1D) structures. Due to their nanosize, extra-ordinary mechanical strength and thermal stability, carbon nanotubes (CNTs) have been considered as ideal candidates to substitute for the conventional ligating components in multifunctional steel nanocomposites.

Up to now one of main approaches to improve mechanical and adhesive properties of carbon materials is coating CNT by metal oxides. Also such materials are applicable to get a number of new products for electronic industries, catalysis.

There are some ways to prepare coated CNT, like chemical vapor deposition (CVD), sol-gel method or impregnation by metal precursors with next decomposition. We are applied supercritical fluid (SCF) to prepare a coated CNT.

In recent years, supercritical fluids have been widely utilized in material science because of such properties as low viscosity, high diffusivity, near zero surface tension, and strong solvent power for some small molecules. The flexibility of SCFs, in terms of tunable solvation strength and access to high operating temperatures and pressures, enables the synthesis of a variety of nanostructured metal and other materials.

As a fluid a water was used, because this is a simple, low cost and ecologic substance. As a source of metal we used nitrates of metals ($Al(NO_3)_3$, $Cu(NO_3)_2$). The condition of one-step synthesis CNT-composites was changed from 370 – 450 $^oC$, 23 – 30MPa, 0.7 – 0.005 m/l.

CNT-composite materials obtained have been characterized with SEM and HRTEM. It was found the size, morphology and coating of CNT depends on time of reaction, temperature of the synthesis, pressure. Thus the increasing of time reaction and concentration of metal nitrate led to increasing of size metal oxide particles without CNT coating.

# THERMODYNAMIC ANALYSIS OF THE PRECIPITATION OF CARBONITRIDES IN MICROALLOYED STEELS

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Production of mass-products of microalloyed steels with high strength requires proper adjustment of thermomechanical processing conditions to the kinetics of precipitation of MX-type (M – microalloying element, X – interstitial atom) phases in austenite. Understanding the impact of carbonitrides on the processes occurring during hot-working and cooling from the finishing deformation temperature requires the knowledge of the mechanism of their formation and their stability in austenite [1].
The research was carried out on newly elaborated Ti-V and Ti-Nb-V steels assigned for production of forged machine elements with the method of thermomechanical processing.
The analysis of the precipitation of complex carbonitrides with the stechiometric composition of $Ti_xV_{1-x}C_yN_{1-y}$ and $Ti_xNb_vV_{1-x-v}C_yN_{1-y}$ is based on Hillert' and Steffanson's model improved by Adrian [2]. The CarbNit programme was used for calculations of a chemical composition of austenite as well as chemical composition and fraction of carbonitrides.
The effect of austenitizing temperature in a range from 900 to 1200°C on grain size of prior austenite was investigated to verify the analysis. A grain growth corresponds well with a course of a precipitation process, though the limitation of the current model arising from a lack of considering complex carbonitrides and the kinetics of a precipitation process should be taken into account.
The studies provide the basis for proper design of manufacturing process of thermomechanical treatment for high strength forged elements of microalloyed steels.

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# THE ADVANCED SOLIDIFICATION/STABILIZATION METHOD FOR REMEDIATION OF HEAVY METAL CONTAMINATED SOILS

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Areas polluted with heavy metals pose a great threat to the environment. The Old Zinc-works in Celje is the most prominent case of such environmental degradation in Slovenia. Different industrial activities have left behind 17 hectares wide area, where soil contains increased concentrations of zinc, cadmium, lead and other heavy metals.

In-situ immobilization of heavy metals is appropriate approach for remediation of such old burdens in terms of long term stability, environmental acceptance and economic point of view. In the world a solidification/stabilization method is the most popular method for the immobilization of heavy metals. The later consists of mixing the conventional amendments (bentonite clays, zeolites, fly ashes, cements, lime…) with soil for the purpose of limiting the mobility of heavy metals[1]. The newly developed method of solidification/stabilization has improved efficiency of soil remediation due to the use of optimal combination of iron nanoparticles with conventional amendments and geotechnical procedures for in-situ treatment of soil.

Used iron nanoparticles are in a form of maghemite or zero-valent iron (nZVI). The nanosized particles can be effectively dispersed in soil, while their large specific surface area corresponds to their enhanced reactivity. The structure of nZVI is represented by $Fe^0$ core, which is ensuring reducing power and iron oxide shell that fosters free sorption sites. The immobilization process of heavy metals in soil with nZVI is governed by redox reactions, precipitation reactions, and adsorption of heavy metals[2]. Iron oxide nanoparticles employ similar surface processes of chemisorption that immobilize heavy metals[3]. In the case study of remediation of the contaminated soil from Old Zinc-works the conventional amendments clays, fly ashes, zeolites are in combination with iron nanoparticles mixed with the soil. Then the mixture is with appropriate geotechnical procedures built-in in-situ to minimize the environmental impact and to achieve complete immobilization of heavy metals.

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# STRUCTURE AND MECHANICAL PROPERTIES OF AZ91 ALLOY EXTRUDED BY KOBO METHOD WITH LATERAL OUTFLOW

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Magnesium alloy AZ91 belongs to the group of casting materials. Plastic processing of such materials is strongly difficult due to their tendency to cracking. Extrusion of AZ91 alloy was performed using the KOBO method with lateral outflow in order to obtain a wide tape. Good quality tapes are characterized by high strength and ductility properties. The results of the structural test strips referenced to the starting alloy allowed the disclosure of the geometry of its flow during the extrusion process in a complex scheme deformation conditions.

# THERMAL STABILITY OF LATENT HEAT STORAGE MEDIA

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Sensible heat storage is a common way of thermal storage in building structures. When the difference of the initial and the final temperature of the heat storage process is rather small, e.g. up to 5 K, the amount of stored heat is quite limited. This is typical for the temperature in buildings that must be kept in a narrow interval to comply with thermal comfort requirements. The overall heat storage capacity of sensible heat storage materials is proportional to their weight. On the other hand, latent heat storage materials can store large amount of heat, if their temperature changes in the relatively narrow interval around their melting point (Mehling *et* Cabeza, 2008). Materials for latent heat storage can be chosen from organic or inorganic materials with the desired melting temperature (Zalba *et al*.). Since latent heat storage media undergo hundreds or even thousands of phase change cycles during their lifespan the stability of their thermophysical properties with the number of phase change cycles is very important. The lifespan of latent heat storage media needs to be at least 20 years due to the high investment costs. The paper presents the results of the laboratory experiments aimed at the changes of latent heat storage capacity after 10, 100 and 1000 cycles of 5 samples of heat storage media. The heat storage capacity of the media was determined by means of the differential scanning calorimetry (DSC). Because the sample size was relatively small, it was decided to use a thermal incubator (a small climatic chamber) for the cyclical change of the boundary conditions.

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# NUMERICAL SIMULATION OF THE EQUILIBRIUM SEGREGATION OF IMPURITIES ON THE GRAIN BOUNDARIES OF COPPER AND ITS ALLOYS

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Equilibrium segregation (ES) is one of the fundamental mechanisms of the diffusive displacement of atoms to structurally disturbed interphase surfaces, such as: grain boundaries and free surfaces. It's of essential importance in industrial processes of hot plastic working, because it usually involves a loss of deformability or ductility in many metals and alloys due to intercrystalline hot brittleness.
Phenomenological equations of the diffusion, taking into account the time required for the accumulation of the monolayer of the segregating atoms permits to assess the kinetics of the ES phenomenon at the boundaries of the grains and to predict rather accurately the influence of the time and temperature of this process. An alternative way of describing the complex effects of the mechanisms of segregation by means of the phenomenological equations of diffusion is computer modelling of segregation at the boundaries of polycrystalline grains in the atomic scale applying the method of simulating elementary transition of some determine atoms in stable nodal positions of the 2D structure. Adequately repeated simulations of individual transitions of the diffusion permit to assess the resulting segregations in the macroscopic scale.
For the purpose of computer simulation the mathematical model of V. Chapman and G. Faulkner (1, 2) was used, which simulates the migration of additioned or impurity atoms as well as vacancy to the grain boundaries, basing on an analysis of the energy effects of the environment upon the respective elements of the grid, stochastically distributed in the matrix.
The present paper deals with a computer simulation of a vacancy diffusion of sulphur, tin and phosphorus atoms to the boundary of grains of the structure of copper, type (2D), concerning theoretically analyzed model alloys of the type Cu-S, Cu-Sn, Cu-P, as well as Cu-Sn-S. Distinct effects of generating the segregation of sulphur atoms in the monolayer at the grain boundaries have been found and also an enrichment of the grain boundaries with tin atoms. The visualization of the simulation revealed also a possible formation of stationary clusters of vacancies and segregating atoms on the analyzed matrix of the atom structure (2D).

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# THE PREDICTION OF ELASTIC MODULUS OF CHICKEN FEATHER REINFORCED PLA AND THE COMPARISON WITH EXPERIMENTAL RESULTS

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The purpose of this study is to gain the elastic modulus, the key material property, of random discontinuous fibre composites with experiments and micro mechanics models and to compare them. The proposed studies will make it possible to assess the elastic modulus of Chicken Feather Fibre (CFF)/PLA green composites with different CFF mass ratios and to determine the feasibility of micromechanics models for CFF/PLA composites. For this purpose, initially, CFF/PLA composites that have 2%, 5%, 10% chicken feather mass ratio were manufactured by extruder and tensile specimens which are appropriate for ISO 527 standards were formed by injection moulding method. Tensile specimens were tested according to the standards and elastic moduli were calculated using stress-strain curve. Then, with the help of 5 different micro mechanical models, elastic moduli of PLA/CFF composites with different mass rates were calculated and compared with experimental results. The whole results of experimental and models indicated that the presence of chicken feather increased the elastic modulus of all composites as compared to pure PLA. According to the experimental data, the maximum increase in elastic modulus for composites with the presence of CFF was found to be 7%. The comparison between the predictions and test data for PLA/CFF composites shows that the difference between the predicted and measured moduli increases as the fiber mass rate increases above 5%. Maximum error in prediction is about 19% for composite in which chicken feather rate is 10% when the Manera Model is used. The Manera model gives reasonable good predictions at fiber mass rate of about 5%. For the chicken feather mass ratio below 5%, the closest predictions were seen at Christensen and Waals' model that has a maximum error of 3,54%. So Christensen and Waals' model would be appropriate for these kind of composites' elastic modulus predictions. Similarly, it is also possible to use the Pan Model showing a maximum error of 5,06%, for predictions (below 5%) of CFF/PLA composites. Error in the modulus prediction for composite with this mass rate is below 1%.

Keywords: Chicken feather, PLA, green composite, micromechanical models

# SYNTHESIS AND CHARACTERIZATION OF ALKYL-MODIFIED POLY(SODIUM GLUTAMATE)S FOR BIOMEDICAL APPLICATIONS

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The negatively charged, water-soluble, hydrophobically modified poly(sodium glutamate)s, containing different amounts of randomly distributed alkyl grafts, were synthesized. First, poly(γ-benzyl-L-glutamate) was prepared by ring-opening polymerization of the corresponding *N*-carboxyanhydride. Then the benzyl ester groups were partially aminolysed with octylamine. The degree of aminolysis was controlled by changing the mole ratio of octylamine to benzyl glutamate repeat units. The polypeptide degradation during aminolysis was to a large extent prevented by the addition of 2-hydroxypyridine as a bifunctional catalyst. The degree of alkylation was determined by $^{1}$H NMR and the molecular structure by MALDI-TOF MS. After removal of the remaining benzyl groups, the alkyl modified poly(sodium glutamate)s (P(Glu-oa)) were obtained and, together with the oppositely charged *N*,*N*,*N*-trimethyl chitosan, used for the preparation of nanoparticles of recombinant granulocyte colony-stimulating factor (GCSF) protein by polyelectrolyte complexation method. It was observed that, beside electrostatic interaction, the hydrophobic grafts on poly(sodium glutamate)s significantly contribute to the association efficiency with GCSF protein. The addition of *N*,*N*,*N*-trimethyl chitosan solution to the dispersion of GCSF/P(Glu-oa) complexes resulted in formation of well-defined nanoparticles with high association efficiency and high final protein loading.

# THE INFLUENCE OF CARBIDE AND NON-METALLIC INCLUSIONS IN TOOL STEELS SUBSTRATE MATERIALS ON GROWTH OF PVD HARD COATINGS

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In this work we focused our investigation on the influence of inclusions (carbides, oxides, sulfides) in tool steel substrates (ASP30, D2) on the growth of PVD hard coatings. The microstructure of a PM tool steel material ASP30 in the hardened and tempered condition consist of a martensitic matrix with a hard phase consisting of fine VC and (W,Mo)C carbides evenly dispersed in a matrix. The size of the carbide particles is around 1–2 μm. The conventional cold-work tool steel D2 contains a high volume fraction (10–15 %) of coarse (~20 μm) eutectic $Cr_7C_3$ carbides, which are nonuniformly distributed in matrix. The majority of non-metallic inclusions in both types of steels are oxides (e.g. $SiO_2$ and $Al_2O_3$), sulfides (MnS is the most common inclusion found in steel) and silicates. There are also a lot of mixed inclusions.

In this work the substrate surface morphology was followed through the hard coating deposition process (polishing, etching, deposition). On polished steel surface we found some topographical features which appeared at the positions of carbides and non-metallic inclusions. The reason is different removal rates of matrix in comparison with inclusions due to the difference in hardness.

During the ion etching process, which is standard procedure of substrate cleaning before deposition of PVD coatings, the additional morphological features are formed. The reason is a difference in sputtering rate of inclusions and steel matrix. The sputtering rate of molybdenum-tungsten carbide present in ASP30 tool steel is higher than of the matrix, while the sputtering rate of vanadium and chromium carbides is lower. In D2 tool steel the sputtering rate of chromium carbides is much lower than for the matrix. The sputtering rate of MnS inclusions and SiO2 inclusions is higher and lower, respectively, than the matrix. This resulting in a formation of shallow craters and hillocks, which increased the surface roughness for about three times. This could be one of the reasons why ion etching improves the adhesion of hard coatings efficiently due to mechanical anchoring.

All these topographical changes of substrate surface reflected on the coating surface. Due to the shadowing effect they are often magnified through the coating. Thus inclusions in steel are sites at which the PVD growth defects especially pinholes are formed.

The influence of steel inclusions on nanolayer TiAlN/CrN coating growth was studied. We selected typical inclusions and followed it through the sample preparation process (polishing, etching, deposition).

# PREDICTION OF DEFORMATION BEHAVIOR OF PBX SIMULANT IN A AMMUNITION DURING HIGH SPEED CRASH

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This paper is concerned with the prediction of deformation behavior of PBX (Polymer-Bonded eXplosive) simulant during high speed crash. PBX is an energetic material in which small explosive crystals are bonded in a polymer matrix occupying typically 5−10 % by weight. PBX is used in a wide variety of weapon applications ranging from rocket propellants to the main explosive charge in conventional munitions and weapon systems. It is important to characterize the mechanical properties of PBX and to accurately model their response behavior since unexpected external stimuli could cause accidental detonation during manufacturing, transportation or handling. When PBX is applied in a warhead system that undergoes severe dynamic loading conditions during high speed crash, it is significant to investigate the deformation behavior of PBX subjected to dynamic loads in order to guarantee the safety of the warhead system before explosion. PBX in the warhead system undergoes not only localized large deformation with high strain rates induced by direct dynamic loads but also small deformation with low and intermediate strain rates due to stress wave propagation. The strain hardening behavior of PBX at quasi-static states, intermediate and high strain rates should be considered to perform the design of the warhead system since PBX undergoes deformation at a wide range of strain rates irregularly distributed in PBX from quasi-static states to high strain rates. The deformation behavior of PBX and its mechanical characteristic in the warhead were investigated using finite element analysis, which includes the effect of various strain rates.

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# NUMERICAL SIMULATION OF DISSIMILAR WELD JOINT IN SYSWELD SIMULATION SOFTWARE

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Dissimilar metal joints between pipes of ferritic and austenitic steels are widely used in steam generators of power plants. Generators components operating at high temperatures are made of stainless steels and those operating at lower temperatures are made of ferritic steels. The dissimilar metals joints are prone to frequent failures and these failures are generally attributed to one or more of the following causes: (a) difference in mechanical properties across the weld joint and coefficients of thermal expansion of the two types of steels and the resulting creep at the interface, (b) general alloying problems of the two different base metals such as brittle phase formation and dilution, (c) carbon migration from the ferritic steel into the stainless steel, which weakens the HAZ in the ferritic steel, (d) preferential oxidation at the interface, (e) residual stresses present in the weld joints, (f) service conditions and other factors etc.

Dissimilar tube welding were preformed between austenitic and ferritic steel with austenitic weld material. Thermal cycles has been measured during welding by thermocouples. Macrostructure of the weld joint together with thermal cycles has been used to thermal analysis parameters defining in SYSWELD. Material properties of the welded parts were used form SYSWELD database. Mechanical analysis of welding process followed after thermal analysis. Residual stresses and tube deformation after welding were obtained by welding simulation.

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# SEM AND DTA STUDY OF THE DOLOMITE ($MgCa(Co_3)_2$) USED AS FOAMING AGENT

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Characterization and modification of the foaming agent for Al foams production was the main motivation behind the study. Carbonate-type foaming agents release $CO_2$. Temperature region of the gas release is highest for $CaCO_3$ and decreases several tens of centigrade towards $MgCO_3$, which is also optimal temperature region from the technological point of view, with dolomite ($MgCa(CO_3)_2$) being in-between. $CaCO_3$ and $MgCa(CO_3)_2$ have both already been tested as foaming agents in production of the Al foams but never used in the mass production due to its relatively high gas release temperature.
Preliminary tests about influence of mechanical, thermal and chemical treatment of the dolomite onto change of the gas release region temperature were performed. It was found that certain types of chemical treatment decrease this temperature.

# MICROCRACKING AND DEFORMATION PROCESSES IN COMPRESSED Mg ALLOYS MATRIX COMPOSITES INVESTIGATED WITH ACOUSTIC EMISSION METHOD

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Research results on both mechanical and acoustic emission (AE) behavior of Mg-Li and Mg-Al alloys matrix composites (AMC) reinforced with ceramic δ-$Al_2O_3$ or carbon fibers subjected to the channel-die compression at room and elevated temperatures are presented in this paper. The AE measurements at room temperature showed that, the effect of anisotropy of the fibres distribution (random planar distribution) with respect to the compression axis appeared in the most investigated composites, whereas the AE activity at 140 °C revealed a two-range character and the rate of AE events at 140 °C was higher than at room temperature. These effects are discussed in terms of both the differences in thermal expansion between the fibres and the matrix as well as the weakening of the coherency between the fibres and the matrix leading to stronger debonding effects at 140 °C than at room temperature. The spectral analysis of AE signals was performed with the Windowed Fourier Transform method, which served to plot the spectral density of AE signal as a function of frequency. The alominous and corundum ceramics types were also investigated in order to illustrate the enhanced AE, which was related to the different crack paths in the final stages of the sample degradation. The results were also discussed on the basis of SEM images, including the in-situ observations of microcracking as well as the dislocation strain mechanisms and microcracking ones during the channel-die compression of the Mg-Li-Al AMC.

# CONCRETE EARLY AGE MONITORING BY ACOUSTIC EMISSION METHOD AND DETERMINING CHANGE OF ELECTRICAL PROPERTIES

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Concrete is a most popular building *composite material (CM)*. Its long age properties depended on mixture, setting and curing.

When concrete is born, when you place fresh concrete, where you want it to live out its life, it is like a baby – very sensitive and easily ruined. Curing is all of the things that we do to keep our concrete baby happy during the first week or so of its life: maintain the proper temperature (neither too hot nor too cold) and dampness [1]. Acoustic Emission Method and electrical properties measurement technique are applied to monitor early age concrete.

The relationship between acoustic emission activity, temperature and electrical properties, e.g. resistivity and capacity, of concrete at an early age was studied in this research. Chen W. et al. studied the microstructure development of hydrating cement paste at early ages with non-destructive methods including ultrasound P-wave propagation velocity measurement and non-contact electric resistivity tests [2]. There are not many nevertheless references about continuous study of properties during concrete early age are not so many.

Long time monitoring of concrete properties is necessary for determination lifetime and quality. Acoustic Emission Method is proved as very advantageous tool for non-destructive monitoring of structure micro changes during concrete lifetime. Differences detected by acoustic emission between hardened concrete mixtures can determine their properties at age of 28 days strength. Basic concrete property is 28 days compressive strength nevertheless that can change over long time, thus continuous measuring is applicable [3].

The article shows possibility of application mainly Acoustic Emission Method for monitoring concrete mixtures.

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# SYNTHESIS OF Ti-Fe NANOCOMPOSITES FOR ENVIRONMENTAL APPLICATIONS

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We report on the synthesis of anatase ($TiO_2$) particles surface-decorated with zero velent iron nanoparticles (nZVI). $TiO_2$ was synthesized via a sol-gel method and nZVI was subsequently formed, in situ via chemical reduction method. Characterization techniques, such as combination of XRD and Mössbauer spectroscopy, confirmed the purity of anatase phase and indicate that iron exists in the zero valent state (Fig. 1). According TEM images, the iron forms nanoparticles, with a core-shell structure, where core consists entirely of metallic iron being surrounded by an iron oxide shell. The size of the particles is in the range of 300-500 nm and 20-60 nm for $TiO_2$ and nZVI, respectively, as evaluated by SEM. One major point of the Ti-Fe nanocomposite is the well distribution and less agglomeration of nZVI particles over $TiO_2$ surface, representing an important factor for the efficacy of this material in the environmental remediation technologies (nZVI reacts with toxic compounds, e.g. Cr(VI), like an electron donor by a surface mediated reaction). Furthermore, the titanium oxide has been used widely as a great photocatalyst for water treatment. Therefore, the Ti-Fe nanocomposite gains high importance because of the synergetic effect on purification of water.

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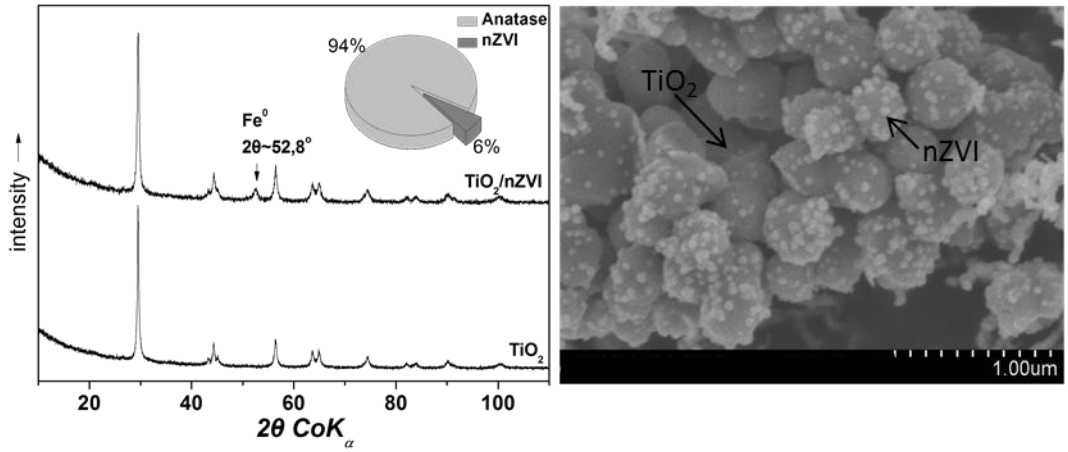


*Fig. 1: XRD pattern and SEM image of the synthesized material*

# AMORPHOUS NANOMETRIC CELLULOSE ULTRA-THIN FILMS - THE STRUCTURAL REARRANGEMENTS INDUCED BY HEAT TREATMENT AND WATER INTERACTION

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Cellulose is the most abundant biopolymer on earth. It is used in papers, textiles, hygienic products, fibers, packaging materials and serves as a support material in chromatography and life science applications. During the last few years, the interest in nano cellulose (e.g. nanocrystals and nanofibers) as a component for hybrid materials increased due to their outstanding and non-linear optical properties. However, the properties of cellulose are strongly determined by its supramolecular structure, which of is highly dependent on the ratio between amorphous and crystalline domains.

In this contribution, we will investigate the consequences of water removal from amorphous cellulose thin films on the supramolecular structure. Our results indicate a structural rearrangement (e.g. heat treatment and hornification) as proven by ATR-IR and GI-SAXS measurements.

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# REMOVAL OF METALS AND NITRATE BY MAGHEMITE NANOSHEETS

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Magnetic maghemite nanoparticles were applied for metals and nitrate removal from drinking water. Nanoparticles were prepared in form of nanosheets by a topotactic transformation of a γ-FeO(OH). The detailed procedure is presented elsewhere [1]. The samples of nanosheets were characterized by X-ray diffractometry (XRD). BET surface areas were determined using Micromeritix Tristar 3020 BET analyser. Two metal-ions, arsenic and chromium, as well as nitrate as inorganic pollutant in water sources were chosen for the study of adsorption isotherms. Working solutions of both metals and nitrate ions were prepared by dilution of standard stock solutions. Calibration curve was constructed for chromium and nitrate in order to determine their concentration spectro-photometrically. Arsenic was determined by colorimetric method.

The XRD spectrum confirmed the formation of maghemite. The magnetization vs. magnetic field curve for the maghemite nanosheets measured at room temperature under an applied magnetic field of 1T does not show any coercivity and reaches 20 emu/g. The lower magnetization value compared to that of the bulk is a consequence of the smaller sizes of the nanostructured domains. The BET surface was determined at 118.8 $m^2/g$ and average pore width 8.6 nm.

The nanosheets exhibit good adsorption capacities and have a potential to be used as an adsorbent for certain metals. Excellent adsorption capacity of As was determined at 30 mg/g. However, the results showed lower adsorption capacity of Cr-ion as reported [2]. Adsorption capacity of nitrate was unsatisfying.

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# THE APPLICATION OF CONTROL – MEASURING APPARATUS AND THE PELTIER MODULES IN THE BULK METALLIC GLASSES PRODUCTION BY PRESSURE CASTING METHOD

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The main goal of the article is description of innovative equipment and presentation test results of Fe-base bulk metallic glasses.
The production of bulk metallic glasses by the pressure casting method for copper molds which used an innovative cooling method are presented in this article. The equipment for casting which using the modern high-frequency induction heater cooperating with control-measuring apparatus, which enables repeatability and maintenance of process parameters is discussed. The semiconductor Peltier modules for cooling of molds are presented. The tests show that the semiconductor Peltier modules are the suitable substitute for water cooling of molds. They enable the casting at zero degrees Celsius of molds. Additionally, the ecological and economic aspects of the introduced new methods are presented. The application of the innovative technology of cooling has an influence on simplification of the equipment construction for casting process, too.
The test results of bulk metallic glasses on iron base obtained by the designed devices are presented in this elaborate. The structure analysis using X-ray examination and microscopic observation was performed. The diffraction pattern and microscopic observation reveal that studied as-cast Fe-Co-B-Si-Nb alloy is in amorphous state. The test results confirmed the amorphous structure of obtained materials.
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Keywords: Metallic Materials; Bulk Metallic Glasses; Peltier modules; Fe-base alloy

# USE OF MATERIAL-TECHNOLOGICAL MODELLING IN DIE FORGING

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In forging, as well as in other industries, new possibilities for ensuring continuous improvement in productivity are being sought. The solution to this problem lies in the optimization of existing technologies or in designing completely new technologies. Interruption of normal operation to verify the optimization steps often represents a significant financial loss. Material-technological modelling is a means to offer a possible solution. It is a method of thermomechanical processing whose result is the use of real material in comparison with FEM simulations. By using material-technological models it is possible to effectively examine the effect of the changes in process parameters based on structural analysis and evaluation of mechanical properties without interfering in the actual production process.
The article describes the design of a complex material-technological model of the real forging process including heat treatment in continuous furnaces. It is a forging from steel C 45, which is produced by the technology of die forming and designed for automotive applications. The material-technological model of this forging was compiled based on the data collected in a real production and data obtained by using FEM simulation. Metallographic analysis was then used to verify the high structural conformity of the model with real forgings. The structure consisted in both cases of ferrite and pearlite. The tensile strengths of the real forging reached 670 MPa with elongation about 28 %. The model-processed material reached a tensile strength of 660 MPa with elongation about 32 %. Based on the achieved results the technology of controlled cooling, which serves as a replacement for the current heat treatment, will be developed and optimized by material-technological modelling.

# USING SIMULATION FOR COMPARING THE RESPONSE OF MATERIALS IN TERMINAL BALLISTICS

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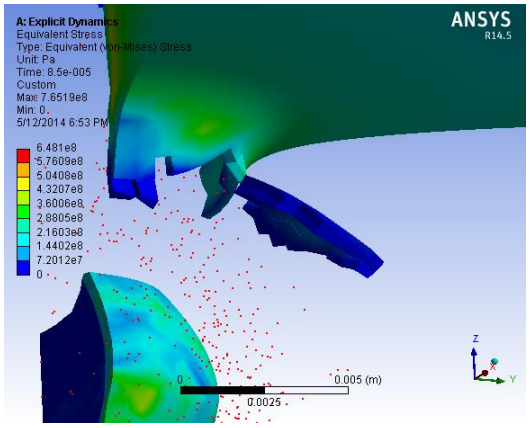
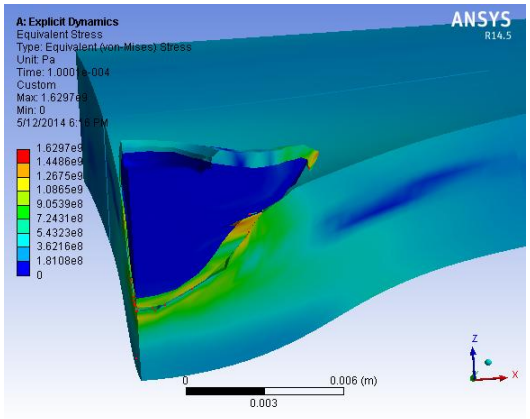
This paper presents a simulation of a bullet impact on a plate, the materials being assigned to a bilinear isotropic hardening model. The model takes into account the yield and fracture limits of both involved materials for the bullet and the plate one. The model was developed with the help of Ansys 14.5. The authors presented the influence of the properties the plate is made of (Fig. 1). Also, theys established a correlation between the evolution of the theoretical maximum von Mises stresses and the stages taking place during the impact (Fig. 2). The projectile has the dimensions of a 32 ACP (7.65×17 mm Browning round).




a) Plate made of aluminum alloy




b) Plate made of steel

Fig. 1. A detail for the deterioration of the plate

## Conclusions

Simulation could be useful for evaluating the safety of an armor, evidencing the particularities of the bullet damages into a plate. The aluminum alloy is penetrated by the bullet, but for the other material, the bullet is stopped into the plate.

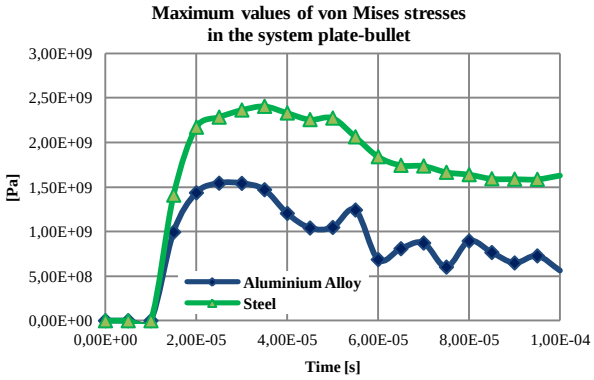



Fig. 2

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# EFFECT OF THERMOMECHANICAL TREATMENT ON THE CORROSION BEHAVIOUR OF HIGH-Mn AUSTENITIC STEEL WITH SILICON AND ALUMINIUM ADDITION

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High-manganese austenitic steels are being developed as the advanced automotive structural material due to their superior combination of strength, ductility, and crashworthiness. Their application to the automotive parts is limited because of low corrosion resistance. During the past decade, there have been a number of reports on the corrosion properties of Fe-Mn-Al-Si alloys. Most investigations have focused on the effect of alloying elements on the corrosion behaviour. It was found that addition of aluminium and chromium improve corrosion resistance of high-manganese steels [1, 2]. Corrosion behaviour of high-Mn austenitic steels depends also on heat treatment applied and plastic deformation. Generally, cold working increases corrosion rate because of deformation twins, which represent regions of different potential from the matrix [3].

The present work concerns the corrosion behaviour of the 27Mn-4Si-2Al type steel microalloyed with Nb and Ti. Supersaturated specimens were compared to the thermomechanically treated specimens. The corrosion resistance was assessed in acidic (0.1M $H_2SO_4$) and chloride-containing (3.5% NaCl) media. Potentiodynamic polarization curves were registered and they were related to corrosion damages identified using light and scanning electron microscopy. The steel exhibited significantly lower corrosion resistance in the acidic solution compared to NaCl medium. It was found that the thermomechanical treatment does not affect the corrosion resistance substantially.

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# RECRYSTALLIZATION BEHAVIOUR OF NICKEL BASED SUPERALLOY

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The thermomechanical processing of nickel base superalloy is the way to considerably influence the grain size. As uniform coarse grain size increases the creep strength and crack growth resistance. In the work, the processing to achieve uniform recrystallized grain structure with variation of thermo-mechanical parameters is investigated.

The MoNiCr alloy is determined for modern conceptions of nuclear reactors in which molten fluoride salts are used in the primary and/or secondary circuit as coolants. It represents a material alternative with high corrosion resistance in the area of fluoride salts and it has very good creep properties in the temperature range of 650 – 750 °C as well.

The manufacture of vessels and fittings from MoNiCr alloy requires managing the technology of forming of this high-alloyed material. The key moment seems to be forming of cast state of the material to the state of cast recrystallized microstructure with a homogenous fine grain. Particular stress condition is besides temperature very important at hot forming. Nickel alloys are able to accept a significantly higher deformation level if compression stress prevails.

Forming with compression state of stress increases probability that material will without failure reach such a level of deformation which causes recovery and recrystallization processes. Particular deformation process was carried out on physical simulator. Preceding cold deformation essentially accelerates the recrystallization process of a deformed cast structure.

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# IMPROVED PROPERTIES OF H11 TOOL STEEL THROUGH OPTIMIZED VACUUM HEAT TREATMENT AND SURFACE ENGINEERING

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Tools and dies used in different sectors of forming industry are exposed to very demanding contact conditions, including elevated temperatures, high contact pressures and abrasive flow of work material. Thus tool surface is subjected to complex combination of thermal, mechanical, chemical and tribological loads, which lead to thermal and mechanical cracking, plastic deformation and wear of the tool. As the market, especially automotive industry focus toward the use of new light-weight high-strength materials, which are more and more difficult to form, also requirements on tool properties including fracture toughness and wear resistance, are becoming more demanding. One way of improving wear resistance of tools, already very successfully proven in cutting tool operations is application of hard wear resistant coatings. However, beside complex shape of forming tools, which makes them very difficult to coat and high tendency of commercial hard coatings to galling, limited load-carrying capacity of tool steels greatly restricts the use of hard coatings in forming applications. Load-carrying capacity can be simply improved by increasing substrate hardness, but in majority of forming applications fracture toughness and resistance to crack initiation and propagation are equally important as wear resistance. Vacuum heat treatment allows optimization of the tool steel micro-structure, which then results in required tool steel properties, particularly in respect of higher fracture toughness while maintaining or even increasing hardness.

The aim of the current research work was to investigate the effect of changes in chemical composition and heat treatment conditions on properties of hot work tool steel and to improve its fatigue and wear properties through proper surface engineering. Investigation was performed on H11 type hot work tool steels subjected to different combinations of vacuum heat treatment, plasma nitriding and PACVD coating deposition. Effect of austenitizing and tempering temperature on fracture toughness and hard-ness of the investigated hot work tool steels was performed on the non-standard circumferentially notched and fatigue pre-cracked uncoated tensile specimens. Load-carrying capacity, on the other hand was determined on TiCN coated cylindrical specimens subjected to progressively loading dry sliding conditions in load scanning test rig and results correlated to the substrate vacuum heat treatment conditions. Finally, wear and galling resistance against carbon drop-forging steel were investigated and results compared for coated and uncoated hot work tool steel subjected to different vacuum heat treatment conditions. At the conference results for different vacuum heat treatment parameters and surface engineering combinations will be presented and results correlated to chemical composition, microstructure and properties obtained.

Keywords: tool steel, vacuum heat treatment, fracture toughness, load-carrying capacity, wear, galling

# IMPLICIT NUMERICAL MULTIDIMENSIONAL HEAT CONDUCTION ALGORITHM PARALLELIZATION AND ACCELERATION ON GRAPHICAL CARD

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Analytical solutions are much less computationally intensive than numerical ones and moreover they are more accurate because they do not contain numerical errors. However, they can describe only small group of simple heat conduction problems. The numerical simulation of heat conduction is often used as it is able to describe complex problems, but computational time is much longer especially for unsteady multidimensional models with temperature dependent material properties. The computational time becomes even longer when the models are used for inverse calculations where thousands of direct heat conduction calculation can be required. After discretization using the implicit scheme the heat conduction problem can be described by set of linear equations $\mathbf{A}.\mathbf{T}=\mathbf{B}$ for constant material properties where **T** are the unknown temperatures in the model and **A** is huge sparse square matrix for big models. The **A** matrix has dimensions N.N where N is the number of nodes in the whole model. For example 3D model with 100 nodes in each dimension has **A** matrix $10^6$ times $10^6$ consisting of $10^{12}$ values. To calculate vector **T** it is necessary to store this huge matrix in computer memory and calculate inverse matrix $\mathbf{A}^{-1}$. Even more, for temperature dependent model the calculation must be iterated because the matrix **A** and vector **B** is changing with better estimation of final vector **T**. However, there exists different approach often called line-by-line method which needs much smaller computer memory but the computation procedure is strictly serial. It means no parallel computation can be done which is strictly required when graphic card is used for acceleration of computation. This method uses the principle of heat flux superposition. The paper describes multidimensional numerical model of unsteady heat conduction based on line-by-line method and modification of this method for highly parallel computation. The computational model can handle all three types of boundary conditions including radiation as well as temperature dependent material properties and heat generation. Enormous speed up is shown for the modified line-by-line method accelerated on graphic card and the computational times are compared with the original line-by-line method for various mesh dimensions.

# CHARACTERISTICS OF DYE-SENSITIZED SOLAR CELLS WITH CARBON NANOMATERIALS

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Dye-sensitized photovoltaic cells consisting of a layer structure have been a topic developed in the world for twenty years and they form a new development trend of photovoltaics. One of the examined aspects of their application is building-integrated photovoltaics. Dye-sensitized photovoltaic cells DSSC were developed by Michael Grätzel and Brian O'Regan in 1991 and have been intensively examined ever since [1,2]. Because of their low production costs, easy transfer, relatively high efficiency of photon conversion to the current and an easy production technology, dye-sensitized cells may be an alternative to silicon cells. Basically, a dye-sensitized photovoltaic cell consists of 5 elements: mechanical base covered with a layer of transparent conductive oxides TCO, semiconductor film, e.g. $TiO_2$, dye absorbed on the semiconductor's surface, electrolyte including a redox carrier, counter electrode suitable to regenerate a redox carrier, such as e.g. platinum [3].
As part of this work was performed dye-sensitized solar cells. First, the glass with transparent conductive oxides was thoroughly cleaned. Then, the glass with TCO was coated with a layer of $TiO_2$ using the doctor blade technique, and fired in a furnace at 450°C. The plate prepared in this way was sensitized in ruthenium based dye. The counter electrode was obtained by applying on the glass with TCO carbon nanomaterials include graphite and carbon nanotubes. Photoanode and counter electrode were combined and between them was injected redox electrolyte.
This paper provides an analysis of the microstructure, electrical and optical properties of nanostructural coatings with carbon nanoelements of the integrated dye-sensitized photovoltaic cells.

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# INCIPIENT PLASTICITY OF (1,1,19) VICINAL SURFACES OF COPPER AND NICKEL

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Steps are a common occurrence on surfaces of metallic materials, yet their influence on the mechanical response of materials has largely been ignored. Vicinal surfaces consist of terraces divided by equidistant steps. The relaxation of the surface produces a complex elastic field, extending several layers into the bulk of the material.

The incipient plasticity of the (1,1,19) vicinal surfaces of copper and nickel was studied by molecular dynamics. Uniaxial tensile and compressive stresses were applied in the direction perpendicular to that of the steps with the strain rate of 2.5 % $ps^{-1}$ at the temperature of 10 K. In addition, the mechanical response of the vicinal surfaces was compared to that of the nominal (0,0,1) surfaces of both materials.

The surfaces are softer than the bulk for both materials and plastically deform at lower strains. The presence of steps influences the nucleation of defects, so that they reflect the periodicity of the surface.

# OPTIMISATION OF PREPARATION OF POLYSTYRENE PATTERNS FOR THE LOST FOAM TECHNOLOGY

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The article describes the manufacture and use of the polystyrene pattern for the foundry LOST FOAM method. In this technology the polystyrene pattern covered with protective coating remains in the mould and during casting it evaporates. This process plays a key role for the final quality of the casting. Some patterns cannot be cut from a single block, or prepared by foaming in a special mould. It is afterwards necessary to glue individual parts of the pattern perfectly together.
Experimental part of this paper emphasises particularly the selection of suitable adhesive to be used for assembly of the pattern as such and also of the gating system. Suitable adhesive must not impede the flow of metal, it must not generate too much flue gas when burning or otherwise negatively affect the process of manufacture of the casting. We tested and used for creation of test evaporable patterns several types of adhesives. The castings produced with use of these patterns were subjected to visual and mechanical tests. The aim of the work was to compare the complexity of work with different types of adhesives, quality and strength of glued joints on the PS pattern, visual quality of the final casting, and ultimately also the strength of metal in the areas of bonded joints.

# KINETICS OF SMALL IMPURITIES GRAIN BOUNDARIES SEGREGATIONS FORMATION IN COLD-ROLLED DEEP DRAWING 08C-Al AND IF-STEELS DURING POST-DEFORMATION ANNEALING

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Heating of steel above 150–250°C increases the mobility of impurities atoms. Excessive free energy of grain boundaries and interfaces stimulates their enrichment by surfactant impurities. This phenolmenon is known as equilibrium grain boundary segregation (GBS). GBS can either strengthen (C, N, B – interstitials) or weaken (P, S – substitutions) cohesion grains. Hence investigation of dangerous temperature-time intervals (kinetics) of small impurities (C, N, P, S) GBS is very important for optimization of post–deformation annealing schemes for cold–rolled deep drawing 08C-Al and IF steels. Fine-grain structure of these steels with clean grain boundaries guarantees its high plasticity.

Thermodynamic properties of samples surface and interfaces are identical. So, segregation phenomena in steels can be easily modelled by measuring of surface chemical composition of samples during annealing at constant temperature. Surface chemical composition of samples was measured by Auger electron spectroscopy (AES). Kinetics of GBS formation for C, N, P and S was determined by series of isothermal expositions of specimens in the spectrometer work chamber at temperatures 250°C – 650°C. Than C-curves of GBS for each detected impurity were calculated. Time–temperature intervals of preference GB enrichment by C, N, P, S were determined for 08C-Al steel with various reduction ratio and for IF–steels with various concentration of micro-alloying elements. It was found that cold rolling of 08C-Al steel with reduction ratio from 48% to 80% dramatically increases the preferential carbon GBS temperature from 350 °C up to 450 °C. Due to the necessity of carbon deattachement from Cottrell atmospheres with annealing of dislocations. Influence of IF–steel microalloying by Al, Nb and Ti on concurrence multicomponent GBS of interstitial and substitution impurities is demonstrated in the report. The trace concentrations of C and N in solid solution sufficiently affects on enrichment of the grain boundaries by P and S.

Investigation of small impurities mobility is a key to understanding of strength and plasticity formation during post-deformation heat treatment of deep-drawing steels.

# STUDY OF THERMAL AND MOISTURE TRANSPORT IN THE STRUCTURE OF INSULATING MATERIALS BASED ON NATURAL FIBERS

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Given the ever increasing need for insulation materials and also with regard to the general need for sustainable use of natural resources are at the Faculty of Civil Engineering in Brno for many years developed fibrous insulation materials based on fibers originating from agriculture (hemp fiber, flax fiber, waste textile fibers, sheep wool, etc). These materials are highly progressive building materials with a low carbon footprint and low Primary energy input PEI. Experimental testing was in previous research works found that these materials exhibit comparable properties to synthetic insulating materials available on the market. However, from the viewpoint of thermal insulating properties of these materials based on natural fibers exhibit different thermal and moisture behavior as a result of different structures insulation while also a low thermal conductivity natural fibers, for example, compared with fibers of glass or stone.

The paper describes the results of research focused on the study of the propagation of heat and moisture in the structure of insulating materials based on plant and animal fibers. Specifically, there were hemp fibers and wool. Further results are presented study the effect of fiber thickness and the density of developed materials for their thermal insulation properties.

# MANAGEMENT OF TECHNOLOGY IN HEAT TREATMENT

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The problem of developing a methodology of technology management relates directly to the cognitive problem that pervades contemporary specialists in the field of materials engineering in the area of production processes of the quality management and management sciences. This problem is of special importance in processes which include heat treatment. A problem of establishing the requirements that should be fulfilled by the function of technology today in order to be considered for the faculty of science in the theory of materials engineering and the theory of production engineering (management) is becoming an actual issue [1,2].
The requirements of ISO 9001 became insufficient to demonstrate the advantage of organization to ensure a sufficiently high level of quality in the field of automotive market, as evidenced by the development of the technical specification ISO/TS 16949 and consecutively in the area of heat treatment processes of the standard CQI-9 Heat Treat System Assessment, prepared by AIAG – Automotive Industry Action Group. Standard CQI-9 is a supplement for the requirements with a view to enabling co-operation, development and promotion of new developments in the automotive industry, organizations implementing heat treatment processes [2].
The implementation of research concerns the impact of the management on the quality of products in the bath nitriding. The results indicated a correlation between the way of the control and the results of the heat treatment process using the methodology of technology management and the requirements of the specification CQI-9. It has been shown the validity of the application of developed requirements aimed at shaping the heat treatment processes.

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# EFFECT OF AGGREGATE TYPE ON THE PROPERTIES OF ALKALI-ACTIVATED SLAG SUBJECTED TO HIGH TEMPERATURES

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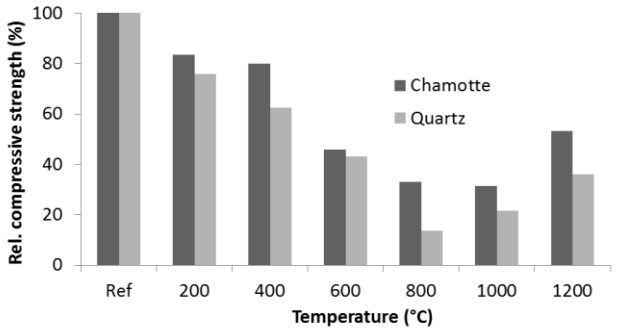
High temperatures present a risk of destruction for most silicate based construction materials. Although these materials are not flammable, they lose their properties due to a thermal decomposition. In contrast to ordinary Portland cement based materials, alkali-activated slag exhibits better thermal stability when exposed to temperatures up to 1200 °C.[1-3] Due to its different porosity it is less susceptible to spalling.[4] However, the properties of composites after high temperature treatment depend also on the stability of aggregates. The effect of two different types of aggregate (quartz and chamotte) on the residual mechanical properties and microstructure of alkali-activated slag mortars exposed to 200–1200 °C is presented in this study.

The results showed an improved mechanical performance of thermally stable chamotte aggregate at temperatures above 600 °C. Quartz is transformed at 573 °C to high quartz causing volume instability and consequently a strength deterioration. Although chamotte also contains some quartz phase, the reaction of mullite with alkalis from the matrix leads to the formation of albite and anorthite which makes the material tougher, and thus, compensating the negative effect of quartz.

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# FLAME RESISTANCE AND MECHANICAL PROPERTIES OF COMPOSITES BASED ON NEW ADVANCED RESIN SYSTEM FR 4/12

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Composite materials used in transport industry and also in other sectors, must meet certain degree of flame resistance. For this purpose, commonly used flame-retardants are based on halogen compounds in liquid state or aluminum hydroxide in solid state. Solid flame-retardants have a negative effect on processing and mechanical properties. Especially low viscosity and rapid wettability of fibers is very important especially in RTM process.

Therefore, a new advanced matrix system based on phosphorus flame-retardants was developed. Flame resistance and mechanical properties of composite materials produced from new resin system were tested. Also processing parameters and tests are is described in the article. When composite and sandwich structures are used in train applications, they have to fulfill different requirements. The first (or main) requirement is fire safety. In addition to fire safety of these materials it's required relatively high mechanical properties, dimensional and thermal stability and health safety. For example french standard NF F01 – 281- Fibre reinforced plastic in railway rolling stock required minimum strength of reinforced plastics up to 150 MPa bending strength, while maintaining self-extinguishing properties according to another french standard NF F 16-101. Given that we are talking mainly about facing applications, products made of these materials must clearly meet the criteria for high visual quality.

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# SINTERING-TEMPERATURE-RELATED AGEING OF ALUMINA- OR/AND SILICA-DOPED 3Y-TZP

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The lifetime of 3-mol%-yttria-doped tetragonal (t) zirconia 3Y-TZP ceramic, which is becoming a prevalent biomaterial in dentistry, is controlled by its fracture toughness and susceptibility to low-temperature degradation (LTD), i.e. ageing [1]. In our previous work we have shown that the ageing resistance of dental 3Y-TZP ceramic sintered at 1450°C or below can be improved by small amounts (□0.3 wt. %) alumina and silica additions, without reducing the fracture toughness of the material. However, many commercial dental zirconia ceramics are sintered at higher temperatures than 1450 °C, which may substantially alter the phase relations and thereby related ageing resistance of alumina and/or silica co-doped 3Y-TZP.

In the present work we report on the influence of sintering temperature on the LTD of alumina or/and silica-doped 3Y-TZP. Materials, sintered at temperatures ranging from 1400 °C to 1600 °C, were subjected to *in vitro* ageing in distilled water at 134 °C for 24 h. In agreement with our previous results, alumina or silica-doped materials sintered at 1450°C or below showed the same ageing properties. After sintering at temperatures >1500 °C silica-doped 3Y-TZP revealed lower LTD resistance, while the susceptibility to ageing of alumina/silica co-doped 3Y-TZP was still substantially decreased. In order to get a better insight in the temperature–dependent phase relations influencing LTD, the following diffusion-coupled experiments were conducted, in which alumina-free and alumina-doped 3Y-TZP powders were mixed with a larger amount of $SiO_2$, pressed into pellets and sintered under different conditions, i.e., at 1450 °C for 4 and 8 h, and at 1550 °C for 4 h. After sintering at 1450 °C for 4 h no reaction was observed, regardless of the presence of alumina in 3Y-TZP. However, after sintering at this temperature for a longer period of time, or at yet higher temperatures, the yttria-rich precipitates were found within the glassy phase in 3Y-TZP/$SiO_2$, reflecting the lower phase stability of silica-doped 3Y-TZP, especially when sintered at higher temperatures. In contrast, no reactions took place in alumina/3Y-TZP/$SiO_2$ system, contributing to high LTD resistance of co-doped material even when it sintered at temperatures > 1500 °C.

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# SWASTIKA SHAPE PATCH STRUCTURE ANTENNA ON A LOW COST POLYMER RESIN COMPOSITE MATERIAL FOR WIRELESS APPLICATIONS

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In this invention, a compact simple structure modified Swastika shape patch multiband antenna on a substrate of available low cost polymer resin composite material is designed for Wireless Applications applications. The substrate material consists of an epoxy matrix reinforced by woven glass. This composition of epoxy resin and fiber glass varies in thickness and is direction dependent. One of the attractive properties of polymer resin composites is that they can be shaped and reshaped repeatedly without losing their material properties [1]. Due to lower manufacturing cost, ease of fabrication, design flexibility and market availability of the proposed material, it has become popular for use as a substrate in patch antenna design. The composition ratio of the material is 60 % fiber glass and 40 % epoxy resin. The designed microstrip line fed compact antenna consisting of a swastika shape patch with extra slot and wide slotted ground with four extra slots is presented in detail. The five rectangular slots in the patch radiator change the patch of the surface current. Furthermore, the slots and slits in the ground plane are also expanding the surface current. Thus, two resonant modes are excited and the dimensions of the slots and slits have an important role on matching performance of the proposed antenna. The patch radiator with microstrip line feed is printed on one side of the epoxy resin polymer substrate and slotted ground plane with slits is printed on the other side of the same substrate. The proposed swastika shape antenna was designed and analysed by using a finite element method based simulator HFSS and fabricated on a low cost FR4 (polymer resin composite material) printed circuit board. The effect of the different substrate materials on the reflection coefficients of the proposed antennas were also analysed. It can be clearly seen that the proposed antenna provides a wider band-width and acceptable return loss value compared to other reported materials. The experimental and numerical results exhibits that the antenna has an impedance bandwidth with -10 dB return loss at 2.28-3.94 GHz and 5.05-6.17 GHz which can cover both the Wi-Fi and WiMAX bands. Also, a stable monopole like radiation pattern and an average antenna gain of 4.25 dBi and 3.65 dBi across the operating band have been achieved. The radiation efficiency, input impedance, and current distri-bution of the proposed antenna were also investigated.Recently, the rapid development of wireless communication systems, the multiple band antenna with simple structure, compact size, higher performance, low cost, and easy integration with the circuit has been needed extensively. Details of the materials structure and proposed designed are investigated and discussed.

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# MODELLING AND SIMULATION OF SOLIDIFICATION PROCESSES: PAST, PRESENT, FUTURE

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The purpose of the paper is to make an overview on solidification modelling since the roots in Eighteen century until now. The talk is divided into advances in physical concepts such as discovery of latent heat, nucleation, instabilities, dendrites and eutectics, advances in formulations and numerical methods, verification and validation of the models. Special attention is paid to the evolution of models that predict the defects such as macrosegregation, cracks, porosity and hot tearing. Modern multi-physics and multiscale models are reviewed and the goals of primary contemporary research directions are discussed. The paper is dedicated to scientist and engineers, interested in basic information on the discussed quickly evolving and technologically important research field.

# COMPOSITES OF CARBON NANOTUBES WITH METALS AND METAL OXIDES: SYNTHESIS, STRUCTURES AND CHARACTERIZATION TECHNIQUES

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Structured carbon nanomaterials (CNM) can be considered as a class of the unique objects that combines advanced surface, outstanding mechanical properties, chemical inertness, high electrical conductivity and thermal stability, as well as the possibility of chemical modification. These facts open up huge prospects for their practical use either in complicated industrial applications (manufacturing of electronic devices, systems for energy storage, generation and conversion) or in well developed areas: catalyst industry, metallurgy, polymers and building materials spheres. For most of these applications strong interactions between the tubular structure and the matrix are require.

The fist point to provide strong chemical bonding is carboxylation, e.g. formation of carboxyl groups on the CNM surface for further ensure of interactions due to them. For these purpose the treatment by strong mineral acids, e.g. $HNO_3$, is most effective. For conic carbon nanotubes the carboxylation degree can reach up to 13%, for cylindrical ones – 5%, carbon shells – 20% without material degradation. After that metal oxides can be precipitated on the surface of material. If necessary, hydrazine, $LiBH_4$ or gaseous hydrogen can be applied to form metal nanoparticles on the surface. The big disadvantage of this approach is hampered control of oxide/carbon ratio, while most of applications, including introduction to metals and alloys, needs disagglomerated samples of nanotubes uniformly covered by oxides or metals. To reach this several approaches can be utilized. First one is mostly suitable for nanotubes and fibers and resides in preliminary oxidative conversion of the surface by reaction of carbon with CaO under small oxygen content in inert gas. This will increase the metal oxide loading up to 4 times without agglomeration. Another way is precipitation of metal oxides or metals under strong ultrasonication from carbonyls or acetylacetonates in viscous solvent, like decaline. The last approach is the use of supercritical media – $CO_2$ or water. It leads to obtaining of CNM decorated by metals or metal oxides with minimal agglomeration.

HRTEM equipped with EDX or EELS spectrometers, SEM, XPS and XRD were found to be the powerful techniques for characterization of such composited, consisted of discrete nanoparticles with 5-15 nm size stabilized on structured carbon surface. The materials obtained could be introduced to metals and alloys by vacuum casting or spark plasma sintering (SPS).

# INFLUENCE OF HEAT TREATMENT AND $K_{IC}$/HRC RATIO ON THE DYNAMIC WEAR PROPERTIES OF COATED HIGH SPEED STEEL

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Precision punching is constantly faced with demands for greater productivity and lower costs, which on the one hand require better sustainability of punching tools and on the other hand the use of cheaper tool materials, elimination of additional processes and cleaning of the products. Another aspect which is becoming increasingly important is ecological aspect, and requires complete elimination of environmentally damaging lubricants. To achieve these objectives, it is necessary to utilize less expensive base materials in combination with a surface modification providing adequate strength and self-lubricating properties.

Despite intensive development of new materials, hard coatings and surface modification techniques in the process of punching tools, the most commonly used material remains tungsten carbide. In addition to requirements for increased toughness and ductility of tools, limited resource and a very high price of tungsten carbide, need to reduce lubricants in the punching process is one of the main reasons for replacement of tungsten carbide cobalt. The successful application of high-speed steel combined with the tool surface modification techniques has been known from the field of cutting tools. Unfortunately, the tools for punching are exposed to a much more complex stress state during the high impact dynamic loadings, which modified surfaces must withstand without damage or failure.

The growing operation performance requirements of mechanical systems require the use of new advanced materials and surface technologies to enhance the efficiency of mechanical systems and simultaneously reduce energy consumption. Efficiency of mechanical systems can be improved by reducing friction and wear in tribological contact, which can be achieved by changing the shapes of elements, use of hard protective coatings, improving surface roughness and surface topography. While the possibility of changing the geometry is very limited and linked to their function in the system, the use of hard protective coatings on machine parts and dynamically loaded forming tools is still in initial stage of development due to the load carrying capacity limitations and problems of compatibility with the existing lubricants.

The aim of this work was to determine the impact of various heat treatments on the KIc/HRc ratio and subsequently on the wear properties of coated high-speed steel under dynamic impact loading. High-speed steel K890, which was used as a substrate material, was vacuum heat treated under six different conditions with the aim to modify hardness, fracture toughness and ductility of the high-speed steel. After heat treatment all specimens were coated with very common PVD TiAlN monolayer coating with a thickness of about 2 μm. Rockwell-C adhesion test was used to determine the influence of substrate properties on the coating adhesion. On the other hand, in order to evaluate impact failure of the coating Ball-on-plate impact fatigue test was designed and used, with the tungsten carbide ball ($\phi$32 mm) being used as an impacting counterpart. After the test, wear of the coating was measured and evaluated. Fractured regions and microstructures of the steel were analysed and compared with the results. It was found that hardness and improvement in the fracture toughness have significant influence on the adhesion and impact failure life of the coated high-speed steel.

# NEW MIXED METAL COORDINATION POLYMERS BY METALLOLIGAND SYNTHETIC APPROACH. RESULTS WITH $Cu(2,4\text{-}HPdc)_2(H_2O)_2$

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Coordination polymers or MOFs have experienced a rapid emerge in the last two decades. This materials have shown interesting properties for applications as gas adsorption and catalysis, among others. The presence in the structure of these materials of incompletely coordinated metal cations, also known as unsaturated metal centres (UMC), greatly favors catalysis as well as adsorption, since direct interactions between metal and substrates can be easily established. The use of metalloligands as linkers for the construction of MOFs is a promising approach to obtain unsaturated metal sites[1]. Combining them with a second metal, which acts as framework node, mixed metal coordination polymers can be obtained in a 'two-step self-assembly' synthesis.

In order to obtain copper(II) UMCs as Lewis acid sites, a metalloligand with pyridine-2,4-dicarboxylic acid (2,4-$H_2$Pdc) have been used, bis(pyridine-2,4-dicarboxylato) copper(II) dihydrate ($Cu(2,4\text{-}HPdc)_2(H_2O)_2$)[2]. This metalloligand has been used with different metals of the 1st transition series, such as Mn(II), Fe(II) and Fe(III), Co(II), Ni(II), Cu(II)and Zn(II), and with Na(I). Different crystal structures were obtained with the different metals(Fig. 1), but with a common feature, the presence of the metalloligand as introduced in the synthesis.

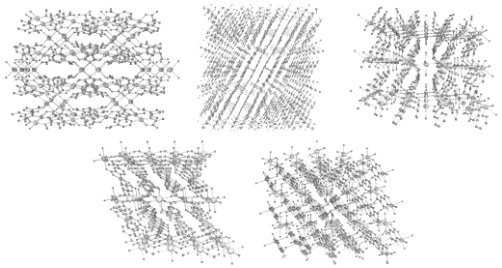

**Fig. 1.** Crystal structures of various of the coordination polymers obtained with $Cu(2,4\text{-}HPdc)_2(H_2O)_2$ metalloligand.

Copper(II) UMCs were obtained for NaCu(2,4-HPdc)(2,4-Pdc) compound, which has been tested as catalyst in cyanosilylation reactions of aldehydes.

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# IMPACT OF Al-RICH SECONDARY PHASES ON HIGH-TEMPERATURE STABILITY OF Al-DOPED ZnO THERMOELECTRIC MATERIALS

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The advantage of oxide thermoelectric materials over heavy metallic alloy thermoelectric materials based on elements Bi, Sb, Te, and Ge is their expected ability to operate at high temperatures, low cost, and non-toxicity. However, in the high temperature regime, oxygen (non-) stoichiometry of certain oxide thermoelectric materials can be affected, this changes the defect structure and, consequently, lowers the efficiency of the material.[1] Among oxide thermoelectric materials, Al-doped ZnO based materials show relatively good properties[2], but their thermal stability under air atmosphere is questionable because materials eventually lose electrical conductance when exposed to air at high temperatures. We investigated the impact of the microstructure on the reduction of electrical conductivity in Al-doped ZnO. Microstructural analysis showed that at various nominal dopant concentrations the secondary phase occurs in two forms: as intergranular Al-rich phase or an Al-spinel phase. We have found that the microstructure, containing the intergranular Al-rich phase (Fig. 1), effects high-temperature transport properties, which could have influence on the thermal stability of the material.

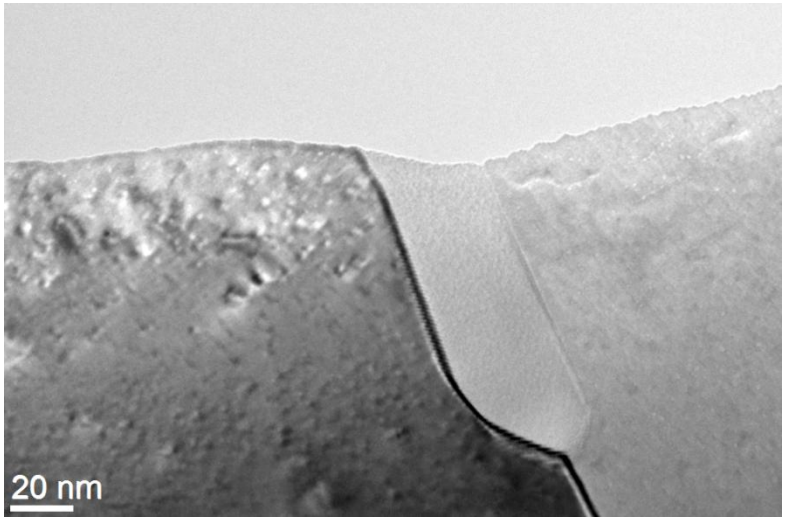


Figure 1: TEM image of intergranular Al-rich phase in ZnO matrix

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# BORON DOPED CARBON NANOTUBES: THERMAL ANALYSIS AND RAMAN SPECTROSCOPY STUDY

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The development of the synthetic techniques for the boron doped carbon nanotubes (B-CNTs) is of great importance since unique semiconducting properties and structural characteristics. Determination of fundamental conditions of their synthesis is also of great interest for thermodynamics of nanomaterials synthetic procedures.

The experiments on Raman spectroscopy were carried out using Horiba Jobin Yvon LabRam HR800UV, equipped with 514.5 nm argon gas laser and Olympus optical microscope system. The thermal analysis investigations were performed using simultaneous thermal analyzer NETSCH STA 449 PC LUXX connected in-line with quadrupole mass-spectrometer NETSCH QMS 403 Aoelos under 20 ml/min gas flow thru the furnace and $10^{o}$/min heating rate. The morphological characteristics of the B-CNT synthesized were studied by scanning electron microscopy using JEOL JSM-6490 LV equipped with JEOL EDX spectral analysis system.

Synthesis of CNT was carried by hydrocarbons pyrolysis apparatus by passing of vapours of precursor mixture over modified by Co and Mo oxides MgO support. The mixture contained benzene and boron-containing compound with B-O bonds and without it. Purification of products from metals and their oxides was performed by boiling in 10% solution of hydrochloric acid for 4 hours under ultrasonication. After that material was washed with distilled water until neutral pH, and then dried under 120°C.

The results obtained show that the properties of B-CNT synthesized are greatly depend on the temperature of process, type of precursor and the nature of metal catalyst:

under increasing of temperature of synthesis with the use of Fe- and Ni-catalysts the increasing of the diameter of B-CNT obtained is observed. When using Co-catalyst the formation of carbon partly disordered nanofibers is observed;

analyzing the samples synthesized with various content of catalyst it was noted that the increase of metal percentage in the support leads to increase in interval of combustion temperatures, caused by bigger disordering in structure of B-CNT. The level of disordering from Raman spectroscopy data was estimated from the relations of $I_D/I_G$ and of $I_{G'}/I_G$ bands in vibration spectrum.

# DESIGN, FABRICATION AND MEASUREMENT OF A NEW SNG METAMATERIAL

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Metamaterials are naturally unavailable artificial materials that may exhibit some exotic electromagnetic property, such as the ability to exhibit negative values of permittivity (ε) and permeability(μ) simultaneously in a certain frequency range. A metamaterial with either epsilon (ε) or Mu(μ) negative is called 'Single Negative (SNG)' metamaterials. A metamaterial with both epsilon (ε) and Mu(μ) negative is called 'Double Negative (DNG)' metamaterials. Due to these exotic electromagnetic properties of metamaterials, it can be applied in many important applications like, directional antenna design, electromagnetic cloaking, SAR reduction etc. [1-3]. This paper presents a design, fabrication and measurements of a SNG metamaterial unit cell. The transmission co-efficient of this metamaterial shows resonance at a certain frequency in the C-band microwave frequency range. It also exhibits positive permittivity and negative permeability at that frequency which is the characteristics of a SNG metamaterial. In this design the two separate split square resonators of copper have been joined by a metal link on a FR-4 substrate material to form H-shape unit structure. A commercially available CST Microwave Studio simulation software has been used to get the reflection and transmission parameters of this unit cell. The perfect electric and perfect magnetic boundary condition has been used for the simulation. The design is then fabricated for 8×8 unit cells on a 240×240mm$^2$ FR-4 substrate material for measurement. The measurement is done in a semi anechoic chamber environment. The measured result shows good conformity with the simulated result. All the effective medium parameters for the design are calculated using NRW-method.

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# EFFECT OF SUPERPLASTICIZER ADMIXTURE ON MECHANICAL FRACTURE PARAMETERS OF CONCRETE

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Project of the Grant Agency of the Czech Republic "Assessment and Prediction of the Concrete Cover Layers Durability" deals with the study of problems of concrete cover layers durability and contributes to development of the knowledge in the field of durability assessment and evaluation. Project is aimed especially at the determination of the transport characteristics of the concrete cover layers determined by the water and gas permeability methods. These so-called "durability parameters" are completed especially with the fracture parameters (e.g. effective fracture toughness and specific fracture energy) and basic physical and mechanical properties of fresh and hardened concrete.

In this paper, authors are focused attention on mechanical fracture parameters obtained from three-point bending tests on concrete specimens with a central edge notch. Tests were conducted on four sets of specimens differing in the material. Concrete of specimens was different in dosage of Portland cement CEM I 42.5 R (305 or 355 kg/m$^3$) and superplasticizer (none or in amount 0.25 % of weight of cement). The consistency of fresh concrete was the same for all mixtures. Three specimens in each set were tested at the age of 28 days. Increasing the dosage of cement and superplasticizer admixture influences the mechanical fracture properties of concrete in both positive and negative ways. It follows that it is proper to monitor not only effect of superplasticizer admixture on compressive strength values[1, 2] but also focused attention on fracture parameter values. For example resistance to stable and unstable crack propagation, which is evidently connected with durability of material, can be quantified using "double-*K*" fracture model[3].

This outcome has been achieved with the financial support of the Czech Science Foundation, project GA CR 13-18870S within the AdMaS project − Advanced Materials, Structures and Technologies Centre − Reg. No. CZ.1.05/2.1.00/03.0097.

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# EFFECTS OF THERMAL GRADIENT ON THE FORMATION OF MICRO POROSITY DURING ONE DIMENSIONAL SOLIDIFICATION OF A356 ALUMINIUM ALLOY

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One of the most influential parameters on the formation of interdendritic shrinkage porosity is the thermal gradient which affects the mush zone distance and solidus velocity. A modified Bridgeman type furnace which is shown in Fig.1 has been specially designed to solidified aluminium alloys one dimensionally under different temperature gradient. The furnace has four different zones which are thermally synchronized by means of a PLC control. Thermal gradient during solidification of A356 aluminium alloy was set different values ranging from 0.1 °C/cm to 1.0 °C/cm for the castings. After cooled down to room temperature, each casting was sectioned through the vertical axis and the amount of micro porosity was measured.

The aim of this study is to determine the minimum threshold value of the thermal gradient for microporosity formation in A360 cast aluminium alloy. This work is an ongoing study, detail of the results and conclusions will be provided within the main text and at the presentation during the conference.

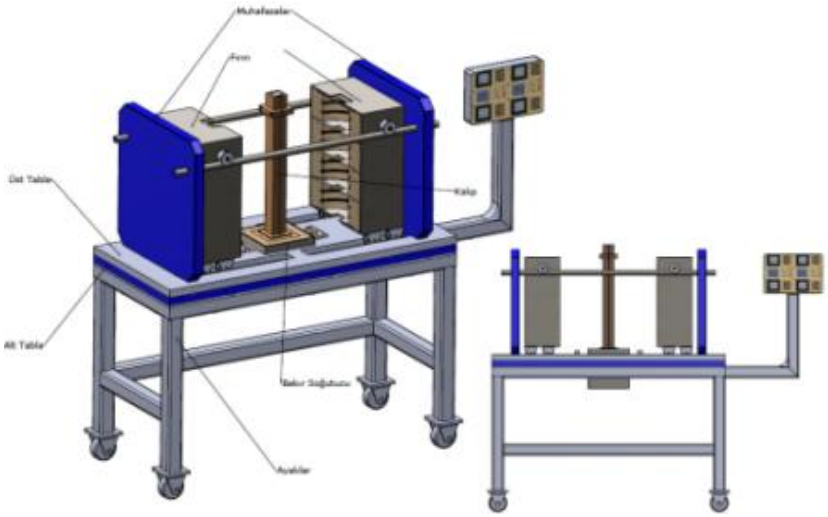

Fig.1 Drawings of unidirectional solidification furnace for controlled thermal gradient.

# OPTIMIZATION OF OPERATING CONDITIONS IN A LABORATORY SOFC TESTING DEVICE

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Solid oxide fuel cells (SOFCs) are devices that convert chemical energy into electrical energy. They are assembled from three solid components, which, in principle, differ in thermal expansion coefficients. These differences may cause residual stresses during operation and consequently lead to physical damage of the cell. From this perspective, the reliability of operating SOFC is seriously dependant on thermal stress built inside the multi-layer structure. In this work some operating conditions in SOFC based on SDC electrolyte, LSM cathode and Ni-SDC anode have been investigated both experimentally and theoretically. Theoretical analysis of the residual stresses and temperature profiles inside an operating cell was modelled with the finite elements method. The results of the mathematical modelling during warm-up, steady-state or cool-down periods were used to optimize the cell geometry, thickness of individual cell layers and also to determine the most appropriate operating cell conditions. In order to experimentally confirm some theoretical calculations, a new SOFC testing system was developed, which enabled relatively easy assembling or dismantle and also quick changes of operating conditions (temperature, atmospheres).
Based on the modelling results, optimization of operating conditions was proposed in order to reduce the thermal stresses built into the materials.
Keywords: SOFC, modelling, temperature gradient, thermal stress, optimization

# THE EFFECTS OF CARBIDES DISTRIBUTION ON CREEP RATE OF THE CREEP RESISTANT STEEL X20CrMoV12.1

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X20CrMoV12.1 is one of the steels that are often used in power plants for steam pipes due to its excellent combination of high-temperature strength, toughness and creep strength. These properties are achieved with heat treatment which consists of austenitizing, quenching and high temperature tempering. The microstructure of such steels consists of highly tempered martensite with finely dispersed carbide particles along boundaries and sub-boundaries of ex-austenitic grains and in their interior. During steel exploitation the working conditions often reach temperatures up to 600 °C or more. Therefore, the particles change their chemical and phase composition as well as their size and distribution.

The aim of this work was to investigate the influence of the tempering time on the change of particles distribution and to determine the effect of particles distribution, spacing and their size on accelerated creep rate.

It was found out that by short tempering of steel stringers of cementite particles are formed at great number of ferrite grain boundaries and sub-boundaries. By longer tempering, the content of chromium in particles increases up to 20 % Cr and $M_{23}C_6$ starts to nucleate.

The number of stringers decreases by longer tempering time parallel to particles coarsening because of grain boundary particles dissolution and lateral diffusion of chromium. By sufficient tempering time, almost all particles stringers are dissolved and the uniform distribution of particles in ferrite matrix is obtained.

Stringers of particles decrease steel creep rate. The steel creep rate increases gradually with decreasing number of stringers. Below a critical number of stringers, it increases much faster by growth of average size and spacing of particles.

# STRUCTURE AND PROPERIES O CARBURISED SURFACE LAYER ON 35CRSIMN5-5-4 STEEL AFER NANOSTRUCTURIZATION TREATMENT

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The aim of the paper was to investigate the properties of the carbide-free nanobainitic structure obtained by austempering heat treatment in the surface layer of the carburized 35CrSiMn5-5-4 steel.. During vacuum carburizing the surface layer of steel was enriched with carbon above 0.6 % wt. Steel samples were subsequently austenitized, quenched to two different temperatures: 260°C and 320 °C, and annealed at these temperatures for a time necessary to complete the bainitic transformation. For comparison one set carbonized samples was subjected to the conventional heat treatment: martensitic quenching and low tempering. The microstructural characterisation of steel after different heat treatments was performed by the use of scanning (SEM) and transmission (TEM) electron microscopes. TEM techniques: bright field, dark field and the diffraction patterns analyses combined with stereological measurement methods were used to determine the volume fraction and dimensions of the observed phases in the surface layers and in the core of the samples. Microhardness and wear resistance of three kinds of steel samples were investigated: the two subjected to austempering treatment at different temperature and the other subjected to a conventional treatment. It was shown, that the carbide free nanobainitic structure containing increased amount of retained austenite displays higher wear resistance of than the tempered martensite. The results confirm that austempering treatment can be a competitive method in comparison to a conventional heat treatment for steels after carburization process.

# DETECTION OF MOISTURE TRANSPORT IN THE POROUS MATERIAL VIA MATHEMATICAL METHOD

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The excessive moisture has an adverse effect on the building materials structure and this can lead to the degradation of building constructions. Most standard construction materials are characterized of porous structure. Under certain conditions, water fills the pores within the structure of building material. This work is based on models of moisture transport in accordance physical laws models (KRISCHER, KIESSL). The aim of the work is to obtain the parameters of distribution of moisture for calculation capillary conductivity coefficient for practical using by means of non destructive method. The developed software is applicable for analysis of potential flow and moisture distribution in the porous material. The calculation of the coefficient of capillary conductivity and its dependence is based on the moisture curves in 3D in non-stationary state of wetting, determined by non-destructive method, see Fig. 1, using experimentally assembled aparatus.

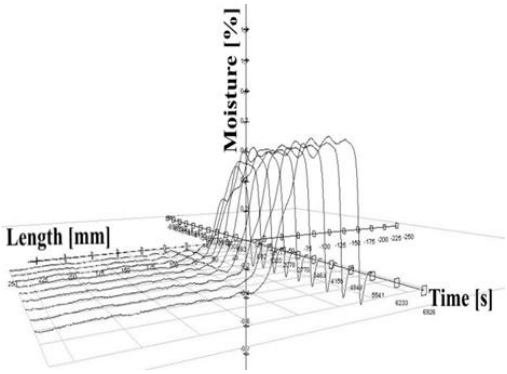


Fig. 1 Three-dimensional distributions of moisture in the porous material

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# AUTOMATIC ANALYSIS OF NONMETALLIC INCLUSIONS IN STEEL USING FE-SEM

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Field emission scanning electron microscope (FE-SEM) is a very powerful tool for a wide range of different material characterization applications. The aim of the following work is the introduction of automatic analysis of non-metallic inclusions in steel using FE-SEM, into the regular industrial practice.

Different types of inclusions can be found in the liquid steel. In general, we distinguish exogenous (slag entrapment, refractory material, re-oxidation products) and endogenous inclusion types.

For the production of chemically clean steel, detail knowledge of the inclusion types and the origin of their formation in relation to individual steelmaking process step, is crucial. The developed SEM technique of automatic analysis of inclusions enables to follow the development of non-metallic inclusions during various industrial production steps and to evaluate the influence of different steel producing processes on the steel cleanliness. For each analysis the area of 9 $mm^2$ is scanned and all the inclusions larger than 1 μm are detected automatically and analysed using the EDX detector. A large quantity of different data for each inclusion type (number, chemical composition, size, surface area,..) enables to get a measurable view of the steel cleanliness level. The unique classification to different inclusion type's classes enables correct automatic inclusion identification even when the inclusion size is as small as ~1 μm, or when the background of the matrix is much featured.

The presented method of automatic analysis is very suitable for industrial steelmaking process optimization, i.e. quality problems identification during the steel production; or study of various parameters affecting the cleanliness of steel.

# FRACTURE PROPERTIES OF PLAIN AND STEEL-POLYPROPYLENE FIBER REINFORCED HIGH PERFORMANCE CONCRETE

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High performance concrete (HPC) is a material more frequently used in the building industry due to its durability. Fibres are added to the matrix as reinforcement to control cracking and to increase ductility [1]. Fibre concrete research has been conducted for over fifty years, and still the future directions for its development are being set [2, 3]. One of the recent concept is hybridization of fibres, the optimum combination of several kinds of them with different properties to create a complex composite with a very high resistance to cracking in a wide range of crack width [4]. The aim of this article is to establish the fracture properties of HPC containing two widely used types of fibers. The experimental investigation consisted of test on cubes, cylinders and notched prismatic specimens made from plain HPC and fiber HPC with variable content ranging from 0.25 to 1% of steel or/and polypropylene fibers. Extensive data on compressive, splitting and flexural tensile behavior, modulus of elasticity and fracture energy were recorded and analyzed. A typical experimental set up, load-deflection and load-CMOD curves of the FRHPC specimen are shown in Fig. 1.

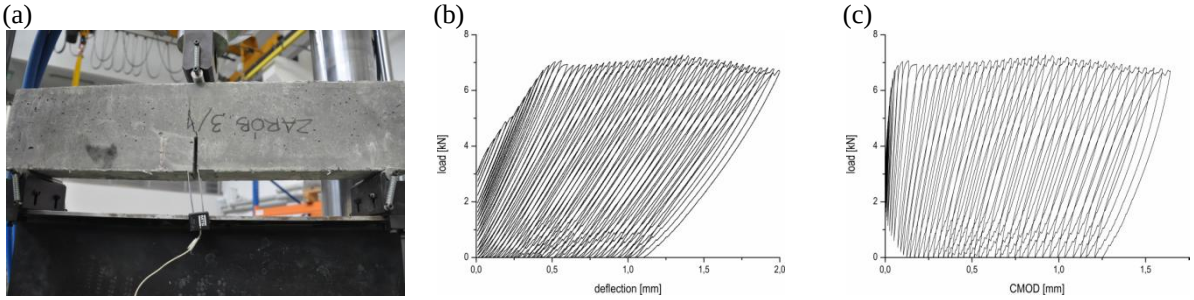


Fig. 1. Three point bending test of FRHPC notched prismatic specimen: (a) experimental set up, (b) load-deflection curve, (c) load-CMOD curve

The present results obtained from investigations have shown that hybrid fibers contribute immensely to the structural stability of HPC elements.

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# PREPARATION OF A POROUS CERAMICS MATERIAL BASED ON $CaZrO_3$

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Zirconate materials with the perovskite structure are under consideration in many engineering fields. Due to their potential applications as mechanical filters or coatings working in the high temperature and corrosive environment, it is interesting to obtain porous materials on calcium zirconate ($CaZrO_3$) base.The most important $CaZrO_3$ properties are: high melting point (2345°C), good thermal shock resistance, high dielectric constant, high electrical conductivity and excellent corrosion resistance against alkali oxides and components of portland cement clinker.

The present study was devoted to an investigation of synthesis conditions of high porous $CaZrO_3$. Porous ceramics based on $CaZrO_3$ with SnO addition were prepared by pressureless sintering. The study presents an influence of the type of starting materials and firing procedures on the microstructure of the $CaZrO_3$ materials. Two different firing procedure were applied. The samples were obtained from $CaCO_3$ or CaO and $ZrO_2$. SnO was added in amount of 2% by weight. The prepared materials were investigated in terms of phase composition by XRD. Their microstructure was analyzed using the SEM/EDS and mercury porosimetry methods. It was found that using calcium carbonate in the one-step firing process at 1650°C with 10h soaking time is possible to obtain the porous zirconate ceramics with porosity exceeds 40%. During firing the solid solution containing Sn ions in $CaZrO_3$ was formed. It was stated that these ions played significant role in porous microstructure formation. The final material was composed with about 90% of $CaZrO_3$ and 10% $ZrO_2$.

**Acknowledgement**
The work was partially supported by the grant no. INNOTECH-K2/IN2/16/181920/NCBR/13

# SIMULATANEOUS ANTIMICROBIAL AND ANTICOAGULANT SURFACES ON THE BASIS OF POLYSACCHARIDES AND NANOPARTICLES

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In this contribution, we will present our recent results in the preparation and rational design of silver and gold nanoparticles encapsulated in an anticoagulant, hemocompatible polysaccharide, 6-O-chitosan sulfate shell.[1,2]

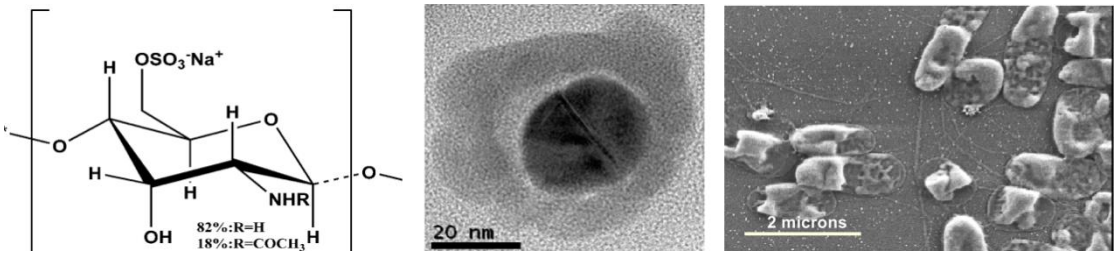


**Figure 1.** Molecular Structure of S-Chi (left), synthesized core shell particles (middle) and SEM images of dead E. Coli bacteria on the modified surfaces (right).

The synthesis of the nanoparticles does not require any organic solvent nor any reduction/stabilization agent. The nanoparticles are immobilized onto different kinds of surfaces and the amount of deposited material is quantified using a quartz crystal microbalance with dissipation (QCM-D). All surfaces are highly antimicrobial towards the chosen test organism *E.coli* MG 1655 [R1-16] as proven by live/dead assays using fluorescence staining and scanning electron microscopy. In addition, the anticoagulant behavior of the surfaces towards blood plasma was elucidated using a QCM-D. In comparison to the unmodified substrates, the total coagulation time as well as the thrombin formation time and fibrin clotting time of surfaces modified with nanoparticles are significantly increased.

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# METALLIC BIOMATERIALS

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The biomaterials are used for over 4000 years in medicine but it is now only 150 years that we are researching the interactions between the host tissue and materials. The main groups of biomaterials are metals, ceramics and polymers. Metals have excellent strength and are used as load-bearing materials; ceramics are hard but brittle and are often used in dentistry, while polymers are quite soft composite materials. Problems with biomaterials appear in aggressive environments and the consequences are corrosion, wear, fatigue and release of toxic ions into the human body. To reduce the failure of a biomaterial, a passive layer should be deposited on its surface. This is achieved by oxidation process where the oxide layer forms on the surface and protects the bulk material from further degradation. Oxidation kinetics of metals obeys three different laws depending on the temperature of oxidation: linear, parabolic and logarithmic law. Logarithmic law usually represents oxidation in thin layer regime at low temperatures. In parabolic law, the oxide growth occurs with a continuing decreasing oxidation rate. Linear law appears when rate of oxidation remains constant with time.

**Keywords:** Biomaterials, Biocompatible metals, Failure of metallic biomaterials, Oxidation kinetics

# THE DISSOLUTION OF Zr IN Al-Mg-Si MELTS

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This work studies the dissolution of Zr in the Al-Mg-Si melts, its interactions with Al-Ti-B master alloys, and the effect of all these additions on the as-cast microstructure. Zr was added in different concentrations by using AlZr10 master alloy while Ti and B were added in different concentrations by using several Al-Ti-B grain refiners. The dissolution temperatures of Zr in the Al-Mg-Si alloy were calculated by using Thermo-Calc software. After solidification, the combined effects of Zr, Ti, B, dissolution temperatures, and contact times on the grain sizes, degree of segregation, and the characterristics of intermetallic phase were determined by using light microscopy, electron microscopy, and energy dispersive X-ray spectroscopy. The focus was given to the study of microstructure evolution during solidification, especially to the study of the "co-poisoning" effect that arises from reactions between Al-Zr and Al-Ti-B master alloys, and measures for reducing this undesirable effect.
Keywords: Al-Mg-Si alloy, Al-Zr master alloy, Al-Ti-B grain refiner, microstructure

# THE EFFECT OF ELEVATED TEMPERATURE ON THE UNIAXIAL TENSILE BEHAVIOUR AND THE DISTRIBUTION OF DEFORMATION GRADIENT OF AN FE-SI ALLOY

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Electrical steels magnetic properties are very sensitive to plastic deformation. To understand the magnetic property deterioration with stress, uniaxial deformation testing is mainly used[1].
The aim of the present study is to investigate the influence of temperature of temper-rolling on the deformation distribution and dislocation density of non-oriented electrical steel with relatively high Si-content.
In order to study the effect of elevated temperature on the uniaxial tensile behaviour of selected non-oriented electrical steel hot-tensile tests were carried out in temperature range from 150 °C to 250 °C. Samples from both, the rolling and the transverse direction of 0.5 mm thick, fully processed products were used. Tensile tests of materials at room temperature were used for comparison.
Moreover, the investigation of the deformation gradient in materials in selected temperature range through cross-sections using uniaxial deformation testing was also performed by complementary investigation using a combination of SEM/EBSD characterization and a nanoindentation method.

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# CONTROL ON SOFT REDUCTION OF CONTINUOUS CASTING SLAB BY THERMAL MODEL

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Internal quality cast steel slabs to the radial continuous casting significantly affects the setting of support rollers[1]. The steel passes through support rolls cools from 1400 °C to a temperature of 600 °C, therefore, leads to shrinkage of the material, which must respect the reduction setting profile. Figure 1 is a comparison of the density of steel at temperature for four typical carbon steel. In the temperature range 500 – 1400 °C shows different courses density. When setting reduction profile by means of rollers fixed to be a compromise for all the cast steel. During operation of the continuous casting rolls wear occurs, so this effect must respect reduction setting profile by means of rollers. For optimal setting of support rollers respects these compromises is used the 3D thermal model[2].
This reduction setting can not be optimized to ensure the production of slabs without internal defects. New the machine for continuous casting (caster) of steel are fitted with so-called soft reduction ie the managing system operated rollers position control, which allows you to set reduction profile for each particular steel, including respect for wear in cylinders. The control system is bound on on-line 3D thermal model[3].

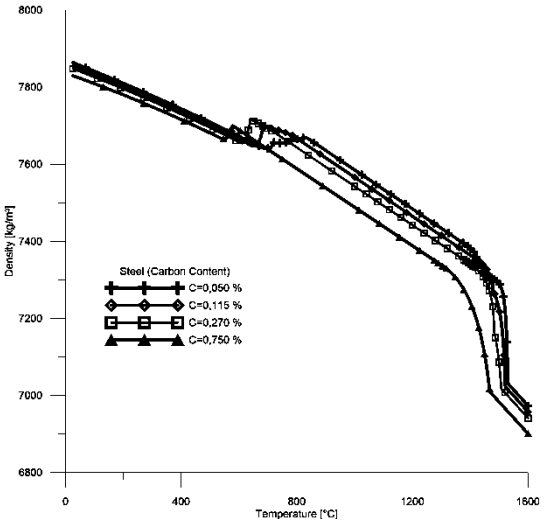


**Figure 1:** The dependence of the density of steel at a temperature

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# REPAIR TECHNIQUES OF DISSIMILAR METAL WELDS BETWEEN STAINLESS AND PLAIN CARBON STEEL

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Dissimilar metal welds are common to all industries and their service performance is often crucial for the function of welded part. Improper selection of filler material for welding dissimilar joints between austenitic stainless steel and plain carbon steel lead to several problems, which can all results in weld failure. From known practice, there were cases where instead of recommended filler material from group of stainless steel, carbon steel filler material was selected for welding. Due to martensite grain structure of the weld, hardness limit is exceeded. Formation of hard weld with low ductility accompanied by the diffusion of hydrogen, always present serious risk of cracking. Due to these reasons, welded joints need to be repaired to achieve suitable weld mechanical properties and quality. Emphasizing possibilities and limitations imposed by unsuitable weld, base, and filler metal metallurgy, some methods of repair, involving weld removal or weld overlay, are more in detail described in the presented paper.

# PREPARATION OF AMORPHOUS SILICA FROM RICE HUSK ASH

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In the present time processing of rice husk to produce amorphous silica of varying degree of purity and dispersion is an actual task. Resulting $SiO_2$ is used in tire production, construction industry and others areas. Both rice hull ash and $SiO_2$ are the effective additives for smelting metal ore allowing lowering melting temperatures. At the same time heat which is produced during burning of rice husk can be converted into electricity.

As established in present work, rice husk ash contains from 20 to 55 wt.% Si and 25-50 wt.% carbon as well as small amounts of Na, K, Ca, Mg, Al, Fe and S. Thus rice husk ash could be considered an alternate source of $SiO_2$.

Basing on TG/DSK analysis data we proposed the ways of chemical activation of rice husk ash in order to isolate $SiO_2$ and developed scheme of effective heat treatment ($570^oC$ in a stream of air or 850°C in a muffle furnace). Under these heat treatment conditions major part of the sample (up to 95 wt.%) of $SiO_2$ had surface area ~8 $m^2/g$. To remove the metals of first and second groups, as well as Al and Fe we proposed to perform washing of rice husk ash with solutions of hydrochloric acid or nitric acid. However, repeated extraction of mineral acids may be more effective. After washing the product of heat treatment of rice husk ash Fe remained in the sample as an insoluble iron silicate.

Alternative methods for chemical activation of rice husk ash, namely alkaline treatment (sintering with KOH or $Na_2CO_3$, followed by dissolving in hydrochloric acid) and chlorination (in presence of excess of carbon), lead to a product of higher purity (up to 100 wt.% $SiO_2$) and also allow varying morphological characteristics of product in wide range. $SiO_2$ obtained from alkaline treatment of rice husk ash had S~370-385 $m^2/g$.

# NEW CONSOLIDANTS BASED ON SOLUBLE CALCIUM COMPOUNDS

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The main goal of restoration procedures is to preserve functional, visual and structural integrity of monuments, emphasizing the overall aim of original material perseverance. Consolidation of inorganic materials such as stone, render and brick has long tradition in conservation science. In order to achieve good chemical, physical and aesthetic compatibility between consolidants and historic materials, a range of consolidants of different chemical composition are needed.
For the consolidation of carbonate materials, CaCO3 forming consolidants are preferable. Diluted suspensions of Ca(OH)2 nanoparticles in different alcohols are usually used for consolidation of limestone and other low-porosity carbonate materials. The disadvantage of nanolime consolidants is low penetration depth and the whitening effect of coloured surfaces.
CaCO3 forming consolidants based on soluble calcium compounds have been developed in the scope of HEROMAT1 project. They have excellent penetration capability, very good consolidation efficiency with small effect on pore structure and no whitening effect. For the characterization of the consolidation efficiency of new consolidants different methods were used, such as: infrared spectroscopy (FT-IR), scanning electron microscopy (FE-SEM), DRMS (»drilling resistance measurement system«), indicator method for penetration depth determination, colorimetry, etc.

Acknowledgments
The EU project HEROMAT - Protection of Cultural Heritage Object with Multifunctional Advanced Materials- (FP7, NMP3-2011-282992) is acknowledged for financial support.

1. www.heromat.com.

# CONTROLLED HEATING IN VACUUM AND INERTIAL ATMOSPHERE FOR HIGH TEMPERATURE STUDIES

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One of the problems researchers in the field of metallic materials encounter is the problem of in-situ studies involving annealing at high temperatures. Many processes, such as recrystallization, phase transformations, segregation and grain growth require temperatures above 800 C and even much higher. To study such processes, vacuum environment would be preferable, due to limited oxidation and contamination, along with the possibility to perform in situ studies in characterization systems requiring vacuum (such as SEM, XPS, AES etc). However, the heat transfer from the heating element to the specimen in vacuum is possible only through radiation, which is not very efficient. This leads to a difference in the temperatures between the specimen and the heating element.

To overcome this problem we have constructed a dedicated heating system for metallic specimens that consists of a simple stub-like heater with W coil and can be operated in vacuum or protective Ar atmosphere. The temperatures that can be reached are in the range of 800 C for heating in vacuum, and exceeding 1100 C for heating in pure Ar atmosphere, which protects the surface from oxidation and contamination, but also ensures optimal heat distribution and an efficient heat transfer. We have mounted thermocouples on the heating element and the specimen itself, so the temperatures and the differences in the temperatures could be monitored at all times. The specimens can be removed from the vacuum chamber after the annealing procedure, and quasi in situ studies can be performed.

In this contribution, we will show the construction of the heating system and also give examples of the studies that have utilized such chamber, such as observing the transformation of carbides in high speed steel (in this case, Ar protective atmosphere was used to ensure temperatures of 1100 C) and dewetting of thin gold film on silicon substrates, where the temperatures were around 500 C and were reached in vacuum.

# THE INFLUENCE OF IRON POWDER PARTICLES MORPHOLOGY ON ITS ABILITY FOR AUTOMATIC DIE COMPACTION

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Abstract: Fe and steel based powder metallurgy (P/M) products, such as steel gears, spurs, locking mechanisms, porous filters, sliding bearings, as well as other machine parts and structural elements, are mainly produced with so called conventional sintering technology. It is the most efficient technology for the mass production of small complex functional and structural parts, and therefore the most convenient and popular among all of P/M technologies. The most important end-user of sintered parts is automotive industry. But, small complex sintered parts can be frequently used also in furniture and household industry, precise mechanics, articles for recreation and sports. Fine iron based powder mixture or prealloyed powder is firstly automatic die compacted (ADC) into final shape of product with mechanical or hydraulic press and then sintered in a protective atmosphere at approximately $1100^0$C. Metal powder mixture must have appropriate technological properties given by the particle morphology enabling fast and reliable die compaction process. The most important are high tap density, good powder flowability and low compressibility. All this gives to green compacts appropriate final shape with smooth surface, relatively high and uniform green density, as well as green strength without flaws and cracks. In the case of very small two- ore more-heights products; for example gears with low module it is very difficult to obtain uniform green density at acceptable compaction pressures. Often small cracks are formed at height crossings and big differences in green density appear in smaller or thinner regions. In the frame of our investigation we analysed the influence of the selected prealloyed iron powder (Distaloy AB, Höganäs, Sweden) morphology and its technological properties on automatic die compaction, as well as sintering process in the case of small two-level gear dimensions of 5/40-7/10×7 mm with module $m$=0.5. Original iron powder was sieved and three different powder particle fractions were compacted and compared considering ADC and sintering process. It was found out that the selection of finer powder as proposed could not contribute to the improvement of the overall ADC process, as well as better green compact. In the present conference contribution the results of our investigations will be presented.

Keywords: Fe-based alloy powders, morphology and microstructure, automatic die compaction, sintering

# AN IMPROVED MECHANO-HYDROTHERMAL METHOD TO SYNTHETIZE CaAl-LAYERED DOUBLE HYDROXIDES

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The mechano-hydrothermal technique is an especially new method in the literature concerning the syntheses of Mg(II)Al(III)-layered double hydroxides (Mg(II)Al(III)-LDHs) [1, 2]. In our work, we took advantage of the effect of ultrasound (cavitation phenomenon) in liquid media in order to enhance the efficiency of mechano-hydrothermal synthesis of Ca(II)Al(III)-LDH and to intercalate anions of fluorine-containing organic compounds among the layers of LDHs.

The pristine and modified LDHs were prepared by the combination of mechanochemistry and sonochemistry. In the first step, the starting materials were mechanically activated in a mixer mill; then, the aqueous media was added to the mixture and immersed into a thermostated (25 °C) ultrasonic bath. The effect of parameters on the preparation were explored and identified by X-ray diffractometry (XRD), scanning electron microscopy (SEM), thermogravimetric analysis (TGA), energy dispersive X-ray fluorescence (EDX) and infrared (IR) spectroscopies.

The main method was the XRD for fast checking of the effects of the parameters, like ultrasound treatment and pre-milling time interval, and the concentration of $OH^-$ in the aqueous media. Finally, the ultrasonic stirring was compared to the simple mechanical one to investigate its benefits. For the pristine and intercalated LDHs the infrared and thermogravimetric measurements verified the formation of the LDH structure, and also the success of intercalation. In the SEM images, the laminated forms of the LDHs were observable, and the elemental maps from SEM−EDX measurements gave additional proofs for the successful preparation of LDHs as well as the intercalation.

In conclusion, a novel technique, the mechano-hydrothermal method was improved and used in the fast synthesis of Ca(II)Al(III)-LDHs. Furthermore, this method seems to be an effective way to intercalate the anionic forms of organic compounds into LDHs.

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# COMPARISON OF CORROSION RESISTANCE OF COMMERCIAL TITANIUM GRADE 2 AND TITANIUM ALLOY Ti6Al4V, AND THE SAME MATERIALS WHICH WERE PRODUCED BY INNOVATIVE INJECTION METHOD

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The main drawback of the utility of all materials used in industry and medicine is the fact that they are subject to wear and tear, which is manifested in a decrease in mechanical and physic-chemical properties. A major challenge of materials science is to produce materials that will be characterized by the relevant mechanical properties together with high resistance to corrosion. Whereas these inconveniences, an analysis were carried out, which will characterize corrosion resistance of several materials from the group of titanium alloys. Currently used is a lot of technology which allow obtain better corrosion resistance for example: application of coatings, changes in chemical composition, production a layer by thermal treatment.

In this article will examine commercial materials and same materials produced by injection method. This method allows modify the structure of layer and the whole range of the material – in this way it is possible to obtain amorphous structure. Studies will determine the impact of amorphous structure on corrosion resistance with suitable mechanical properties. All tests were performed in order to select the best material for biomedical applications.

The first step was preparative commercial materials, and produced amorphous materials which same chemical composition as commercial materials. After the analysis of structure X-Ray diffraction was carried out of all the materials. In second step were corrosion study carried out in Ringer's liquid and in 0.9% solution of sodium chloride (multi-electrolyte liquid). In the final step all collected data on each of the materials were compared, what allowed to select the most attractive material in terms of corrosion resistance for biomedical application.

# METHYL ORANGE REMOVAL USING COMMERCIALLY PRODUCED ZnO NANOPOWDER

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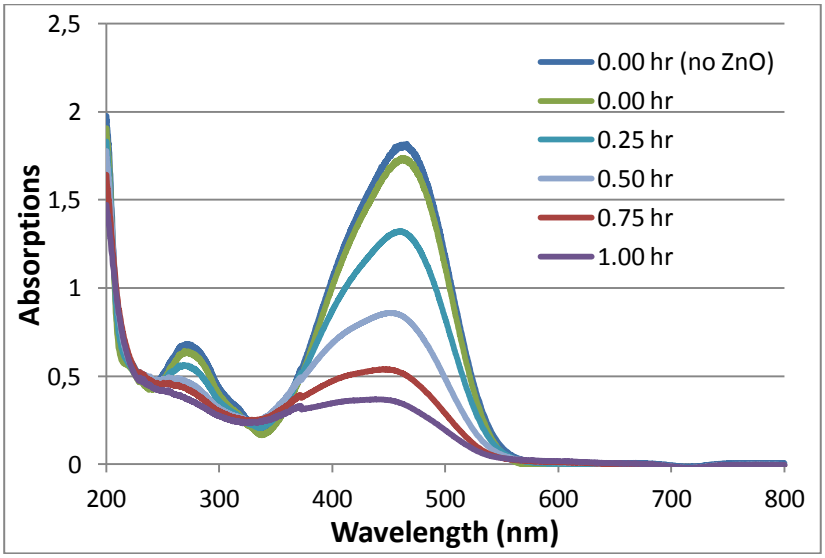
This work aims to investigate the performance of the commercially produced ZnO nanopowder in the removal of methyl orange (MO), an anionic/azo dye, from aqueous solutions[1]. The studied parameters were the irradiation time, initial dye concentration and the catalyst loading. The ZnO nanopowder was characterized by the field emission scanning electron microscopy (FESEM), energy dispersive X-ray spectroscopy (EDX) and X-ray diffraction (XRD). The FESEM measurement for the microstructures of ZnO nanopowder shows various shapes from spherical to rod-like shapes and they were fairly monodispersed. The degradation result shows a significant degradation of the organic dye in the presence of the ZnO nanopowder even without the irradiation by the UV light. The degradation was significantly increased when they were irradiated with the UV light. In addition, for the same irradiation time, the photodegradation of the organic dye was increased as the ZnO loading increases. The results indicate that by employing the commercialized ZnO nanopowder, significant removal of methyl orange dye from the wastewater was observed.

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# MICROSTRUCTURE OF SLAGS IN SECONDARY STEELMAKING

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Slags used in secondary steelmaking are not mainly formed during the melting of the charge and/or oxidation of alloying elements, but instead by addition of slag formers like lime and bauxite, beside the oxidation of reduction agents like silicon and aluminum. Secondary steelmaking slags protect the steel melt from atmospheric oxidation, act as a trap for non-metallic inclusions and, because they have high slag basicity levels, are appropriate for desulfurization of steel melt. The chemical composition of representative secondary slags that are not used for vacuum refining is typically around 30 – 65 % CaO, 10 – 25 % $SiO_2$, 10 – 25 % $Al_2O_3$, 5 – 20 % MgO, 1 – 3 % of S and about 1 % of other components. Secondary steelmaking slags usually contain dicalcium silicate ($2CaOSiO_2$), mayenite ($12CaO.7Al_2O_3$), magnesium oxide (MgO) and calcium sulfides (CaS) that precipitate during cooling.

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

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

# THE UNTRADITIONAL NON-DESTRUCTIVE TESTING DURING THE HARDENING OF ALKALI-ACTIVATED SLAG

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This paper reports the results of measurements during hardening and drying of specimens of alkali activated slag mortars. Alkali activated slag is a material having a great potential to be used in practice. The main drawback of this material is a high level of autogenous and especially drying shrinkage, which causes a deterioration of the mechanical properties [1]. The aim of this paper is introduce the effect of method and time curing on the microstructure of alkali activated slag mortars. An understanding of microstructure–performance relationships is the key to true understanding of material behaviours. The results obtained in the laboratory are useful to understand the various stages of micro-cracking activity during the hardening process in quasi-brittle materials such as alkali activated slag mortars and extend them for field applications. Non-destructive acoustic analysis methods.

Impact-echo method as a traditional and the Acoustic Emission Method as non-traditional method for civil engineering, were used for experiment. The principle of the Impact-echo method is based on analysing an elastic-impulse-induced mechanical wave [2]. Acoustic emission is the term for the noise emitted by material and structures when they are subjected to stress [3]. Types of stresses can be mechanical, thermal or chemical. Ultrasound Testing and Loss in Weight were used as complementary methods of the tested samples.

**Acknowledgements**

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# DUPLEX AND SUPERDUPLEX STAINLESS STEELS IMPACT TOUGHNESS INVESTIGATIONS

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The work presents research results of the influence of heat treatments and resulting changes in microstructure on impact toughness of commercial 2205 duplex stainless steel and higher alloy superduplex 2507 grade. Duplex stainless steels are very attractive constructional materials for service in aggressive environments. Such steels offer several advantages over the common austenitic stainless steels [1, 2]. Both steels were submitted to ageing treatments in the temperature range of 500-900°C with exposure times 6 minutes, 1 hour and 10 hours. Light microscope examinations, hardness measurements and impact toughness tests were performed in order to reveal microstructure and changes in mechanical properties (Fig. 1).

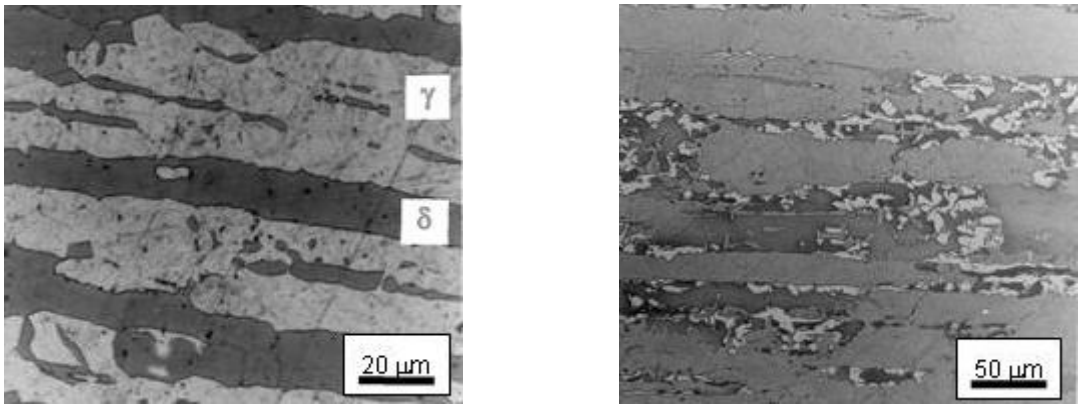


Fig. 1. Microstructure of 2205 duplex stainless steel (a) and σ-phase transformation after ageing at 900 °C for 1 hour

Performed tests have shown the negative effect of precipitates, mainly sigma phase, on the plasticity of duplex 2205 and superduplex 2507 stainless steels. Short time heating in the temperature range 500-700°C could be acceptable.

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# SYNTHESIS OF Ni-Al-Mg AND Ti-Al-Mg ON NI AND Ti SUBSTRATE BY ELECTRO SPARK ALLOYING

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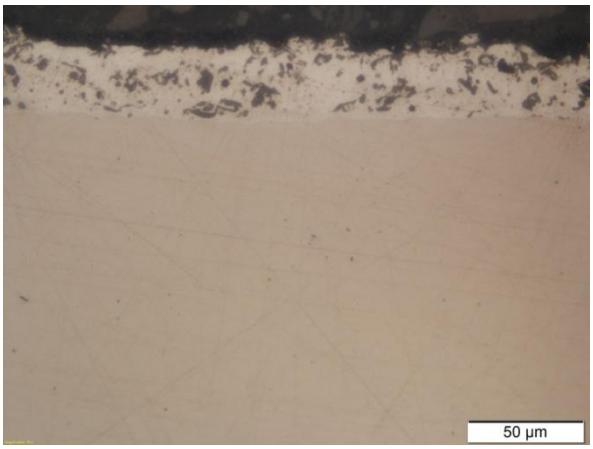
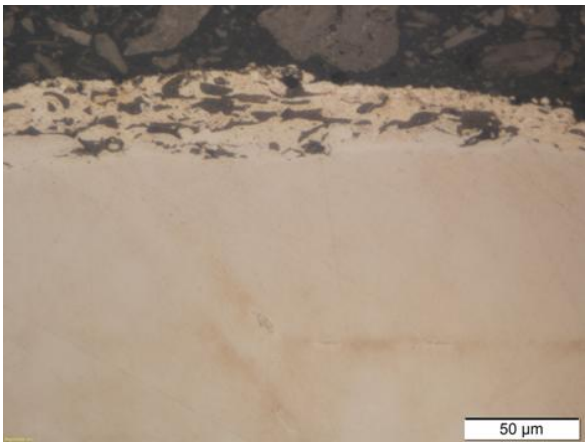
Electro spark alloying (ESA) is suitable method[1-3] for production of thin layer on the metallic substrate for reduction of wear, improvement of corrosion resistance or for prolongation of life time of substrate or tool. With application of different electrodes is possible in situ synthesis of aluminides and other alloys on the metallic substrate surface. The aim was to study the influence of short intensive current pulses on transport of mass from AlMg5 electrode, on microstructure and composition of the layer that can serve as corrosion or trybological protection of the surface of Ni or Ti substrate. Presented are results of metallographic evaluation of Ni-Al-Mg and Ti-Al-Mg layers on Ni or Ti substrate and EDS analysis of in situ formed phases as well as the distribution of elements in the layer. Application of electro spark alloying with AlMg5 electrode, for in situ synthesis of aluminides on Ni or Ti substrate, revealed the formation of Ni-Al-Mg and Ti-Al-Mg non stechiometric alloys.



Cross section of Ni-Al-Mg layer



Cross section of Ti-Al-Mg layer

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# COMPOSITE MATERIAL PRINTED ANTENNA FOR MULTI-STANDARD MOBILE WIRELESS APPLICATION

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This paper presents a printed multi-standard wireless antenna fabricated on cost effective composite material to cover GSM 1800, UMTS (1.92-2.17 GHZ), LTE band 40 (2.3-2.4 GHZ) and WLAN (5.1-5.35 GHZ) frequency bands. A crescent shaped multiband monopole antenna for mobile wireless application in [1]. U-shaped compact antenna with coupling feed was proposed for multi-band mobile handset application [2]. The reported antenna is incorporated with two distinct monopole radiators with meander-line type ground plane. The wireless mobile antenna can be conveniently simulated by commercially available EM simulation software (We use CST Microwave Studio) using the finite difference time-domain (FDTD) method. The parametric analysis of the antenna geometry has been demonstrated and the specific absorption rate (SAR) with the human head model has also been analyzed. The wireless handset antenna has performed better antenna performance, like impedance bandwidth, antenna gain, radiation pattern and radiation efficiency are obtained over operating bands. The experimental results validate the simulated one. The proposed antenna has escorted with various attractive features and the overall performances of the proposed antenna make it worthy of the mobile cellular application.

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# THE INFLUENCE OF THE COOLING RATE ON RESIDUAL STRESS OF 1050 STEEL

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The effect of the cooling rate on residual stress and mechanical properties of the AISI 1050 Steel were investigated in this study. Three specimens taken from AISI 1050 steel were annealed at 850 $^{o}$C for 1.5 hours in order to ensure the steel specimens completely transform to austenite. Then, one of these steels was air-cooled, the second was rapidly cooled in water and the other one was cooled in oil. After the cooling process, the hardness of the specimens was measured to understand the effect of cooling conditions on the hardness. The steel which was cooled in water has the biggest hardness value. Different residual stress values were obtained related to the cooling rate. The residual stress measurement was performed by X-ray diffraction (XRD) method. In addition to that, scanning electron microscope (SEM) was used to analyze the microstructure of specimens. The results show that, hardness measurement and cooling rate has significant influence on residual stress. The residual stress of material was changed with increasing cooling rate.
Key words: Cooling rate, residual stres, SEM, XRD

# ABRASIVE WEAR PERFORMANCE OF PTA AND HVOF OVERLAY COATINGS AFTER HEAT TREATMENT

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In many years Mining and Oil-pump sectors have been faced challenging wear resistant materials requirements. Their equipments and tools were used to move or to eject dirt, rocks, minerals and elements found within the ground, subjecting the steel parts to extremely abrasive conditions. In mining sector have been quite a lot of wear-induced losses and maintenance cost. Constantly in search of new wear resistant materials and coatings continue.

High velocity oxy fuel (HVOF) spraying is a common family of hard facing techniques, which, compared to other processes (like welding and overlay techniques), are characterized by flexibility in coating material choice, low substrate thermal input and virtually no substrate dissolution. An other alternative method for wear resistant overlay application is a Plasma Transferred Arc (PTA) overlay hard facing. The structure of the plasma transferred arc (PTA) overlay is a high proportion (up to 30 to 45%) of hard primary $M_7C_3$ chromium carbides in a eutectic matrix. The overlay wear performance depends on the number of layers, process parameters, cooling process and substrate. Operating temperature is restricted by the overlay chemical composition. The life time of the wearplates are decreased at elevated temperature (higher than 450 $^oC$).

In this study the abrasive wear resistance of the HVOF cermet based composite coatings and PTA overlay hardfacing coatings were compared in three-body abrasive wear condition using a dry sand rubber wheel abrasion test rig based on ASTM G65 in different test conditions. Tests are applied before and after heat treated state at 750 $^oC$/12 h, wear performances were compared and characterized of their microstructures. Heat treatment of the coatings significantly improved the wear resistance under the test conditions. This is result of the improved inter-splat cohesion. The as-sprayed coatings are in metastable state, therefore when they are exposed to elevated temperature, the microstructural and compositional transformations occurred. The otherwise wear resistance of the PTA overlays reduced as a result of decarburization. The wear resistance of heat treated HVOF carbide based coatings 3 times higher than heat treated PTA overlays.

Keywords: HVOF coatings, PTA overlays, Abrasive wear, heat treatment effect

# ON THE IMPACT FAILURE MECHANISMS IN AN ARMOR MATERIAL CONSISTING OF SILICON CARBIDE AND TEMPERED STEEL LAYERS

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In this work the armor, containing silicon carbide and tempered steel (34CrNiMo6) layers, was tested using armor piercing projectile to get knowledge on the macro and micro failure mechanisms in the components. The silicon carbide tiles, produced by cold pressing and sintering operations, had a density of 3.12 g/cm$^3$. Meantime the steel plates were quenched in an oil bath after the austenitization at 860 °C and then tempered at 400 °C in a controlled atmosphere to get adequate strength and toughness. The hardness of the silicon carbide tile and tempered steel plate were measured to be ~ 2483 HV and 46 HRC respectively. After the impact tests applied with the armor piercing projectile, the samples were examined at both macro and micro levels. Although the SiC front layer with a thickness of 8.5 mm in the composite armor improved the ballistic protection, some microstructural changes were recorded in the tempered steel layer due to the effect of shock waves.

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# EFFECT OF MODIFYING X210CR12 STEEL STOCK STRUCTURE USING HIGH PRESSURE TORSION ON RESULTING STRUCTURE AFTER MINI-THIXOFORMING

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Thixoforming is a technology that offers possibilities for processing otherwise difficult to form materials. Forming takes place in the temperature range between the solidus and liquidus, usually in a single molding step. This means that the structural components can exist in the structure after processing in an arrangement that would not be achievable by conventional methods. The article includes a description of the changes to the input material microstructure processed by mini-thixoforming technology, which is an alternative method of thixoforming for processing small volumes of materials. In the experiment, X210Cr12 tool steel was used in two modified input states. The first semi-stock was soft annealed with ferritic-carbidic microstructure and primary chromium carbides with ferritic grain size approx. 10 microns. In the second case, this first stock was modified by SPD method, by HPT (high pressure torsion) specifically. The structure after this treatment also consists of ferritic-carbidic microstructure, however the grain size was refined from the original approx. 10 μm to values below 0.5 micron. There was also defragmentation of large primary chromium carbides in the matrix. The semi-solid state processing of both semi-stocks was performed under the same conditions. The obtained structures were analyzed by light and scanning electron microscopy including EBSD and REM with high magnification. Hardness testing was used to compare mechanical properties. In both cases the structure of the modified semi-stocks consisted of polygonal austenite distributed in a eutectic network after mini-thixoforming. The size of polygonal formations of austenite stayed at 10-13 micron size in the soft-annealing state, while 5-6 microns was measured for the state prepared by HPT.

# ELECTRICAL PROPERTIES OF POLYACRYLONITRILE-HEXYL METHACRYLATE COPOLYMERS

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Solid polymer electrolytes (SPEs) or gel polymer electrolytes (GPEs) have great interest for Li-ion batteries because of their high energy densities and safe usage. Several researchers have focused on to find the optimal combination of host polymer (polyethylene oxide (PEO), poly(methyl methacrylate) (PMMA), polyvinylidene fluoride (PVDF), polyvinyl chloride (PVC) and polyacrylonitrile (PAN), etc.) and dopant salt (lithium perchlorate, lithium tetrafluoroborate, lithium hexafluorophosphate, etc.). Chong et. al. studied PAN based solid polymer electrolyte consisting lithium tetrafluoroborate ($LiBF_4$)[1]. Chen-Yang et. al. prepared a series of composite polymer electrolytes based on PAN, $LiClO_4$ and montmorillonite[2]. Polyacrylonitrile–methyl methacrylate P(AN–MMA) copolymer[3] and PAN/PMMA polymer blend[4] electrolytes were prepared and evaluated for Li-ion battery applications.
In this study, poly(acrylonitrile-co-hexylmethacrylate), P(AN-HMA) copolymers from 92/8 to 84/16 molar ratios were synthesized by emulsion polymerization technique. The structural characterization is done by FTIR and $^1$H-NMR spectroscopy and thermal analyses are performed by thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). By incorporating the HMA segments into the PAN films, the brittleness of the films was reduced. After various amounts of $LiClO_4$ salt loading into copolymer films, the dielectric properties of these films at different frequencies were investigated. The copolymers with higher HMA and salt content showed the higher ac-conductivity.

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# EFFECT OF UV RADIATION AND ENVIRONMENTAL AGING ON ABRASIVE WEAR AND MECHANICAL PROPERTIES OF A CARBON BLACK FILLED ACRYLONITRILE BUTADIENE RUBBER

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Nitrile butadiene rubber (NBR) is an well-known widely used engineering elastomer because its chemical resistance, but in some applications NBR components must to work under abrasive loads[1]. Wear behavior of elastomeric compounds has been extensively studied[2], but relationship between wear resistance and mechanical properties is not completely understood as result of the complex viscoelastic response of rubbers[3]. Abrasive wear mechanisms and compressive properties of as-received, environmental-aged and UV-aged carbon black reinforced NBR rubber were examined in this study. Uniaxial compression, compression-set and abrasion tests were carried out, and Shore A hardness was measured for all experimental setups. Wear mechanisms at abraded surfaces were identified by scanning electron microscopy (SEM) analysis. Results show that both environmental aging and UV-aging decreased elastic modulus, but environmental aging increased it. No differences between volume losses were found, because of data dispersion during abrasive tests. A direct relationship between elastic modulus and wear resistance or hardness was not found. Waviness and crater formation were the predominant wear mechanisms, but some differences between morphology of worn surfaces were identified. A discussion on the synergism of NBR degradation when aged and its wear resistance is presented.

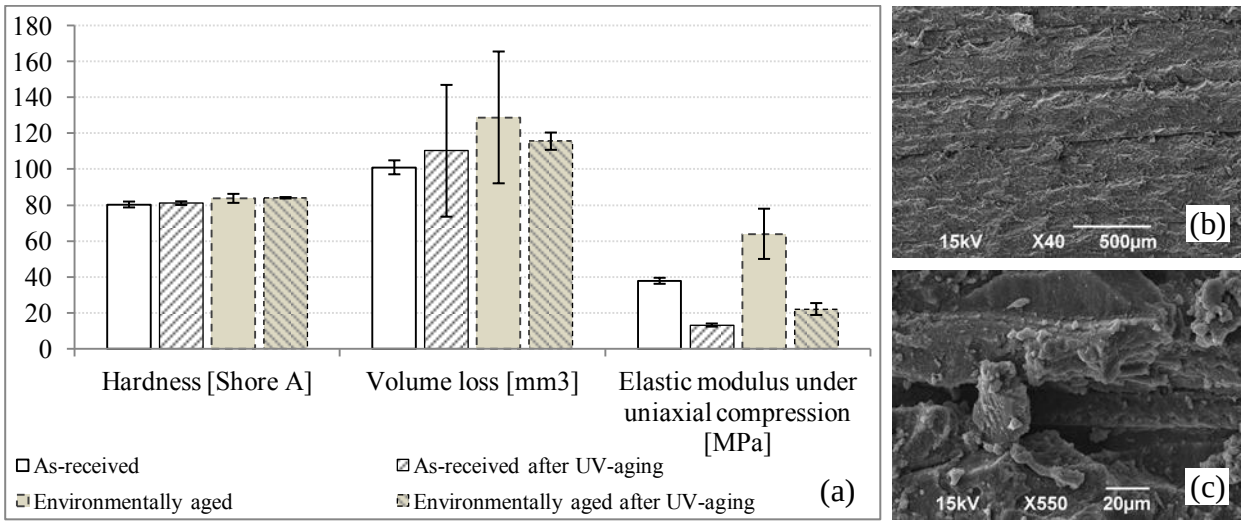


Figure 1. (a) Hardness, volume loss and E values. (b) and (c): SEM of worn surfaces

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# NUMERICAL SIMULATION OF COMPACTION PROCESS OF SINTERED DOUBLE HEIGHT GEARS

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Sintering is a manufacturing process of powder components that is based on atomic diffusion of powder materials. These mechanical components, especially gears, are widely used in numerous fields of mechanical engineering, because they can be made in near net shape objects with minimal or none machining after sintering. Equipment for sintering is quite expensive and for that reason, sintering process of manufacturing different components is economic for larger production series.

Process of sintering can be divided into multiple steps of which one of the most important is compaction process. When the powder is being compacted, in mechanically or hydraulically operated presses, density distribution is changing.

Density magnitude and density distribution within the component have a great impact on mechanical properties of a finished product, so it is crucial, that the achieved density after compaction process is closest to 100% of theoretical density of material as possible and that the density distribution is uniform. To achieve higher density and uniform density distribution throughout the whole component after compaction process, press worker must have a great deal of experience to optimize the compaction parameters (movement of the press components) just right.

When optimizing compaction parameters from experience, there is a great chance that the damages to the press tools can occur. To avoid high costs of tool damages and time spent optimizing compaction parameters on a press, numerical simulations can be applied to resolve these situations. Using numerical simulation in ABAQUS with the build-in Drucker-Prager Cap model, it is possible to eliminate "*trial and error"* process and optimize press compaction parameters numerically, thus saving time and money. Results of this kind of simulation will show local density distribution over the entire model. By optimizing movement of punches in numerical simulation, simulation can be restarted again and again with different compaction parameters and this way the results of final density distribution can be compared. When results of numerical simulation are satisfactory, then the compaction parameters can be transferred on to the press.

# TEMPERATURE MEASUREMENTS – DISTURBANCES INTRODUCED WITH MEASURING PROBE, SOME EXAMPLES

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Measuring techniques often introduce, change or modify state of the observed system: e.g. pipe flow measurements using orifice, voltage measurement of high impedance voltage source, temperature measurement of liquid nitrogen submerged steel using thermocouples. The above mentioned measuring techniques more or less modify the system which is to be measured. In fact, by coupling measuring devices to the measured system, the measured system is changed and measured values are biased. Two examples of temperature measurements, where high disturbances are introduced to the measured system by measuring probe, are presented. The below measurements were done by authors or found/observed by third parties performing measurements.

The first example is measuring temperature in screw M16X160 during heat treatment to 890°C in continuous furnace, where the temperature is measured by ceramic isolated thermocouple wires of 0.75mm diameter. The borehole depth in screw neck is 80mm. Main disturbance introduced here is removal of measured screw mass (borehole). The measured sample mass/initial sample mass is ≈0.93.

Next example is measuring transient temperature of tool die, when submerged into liquid nitrogen from room temperature. For this experiment a 15.2 kg heavy tool die transient temperature profile was measured using ø1.5mm inconel shielded thermocouple was used, the borehole depth was 35mm. The borehole/thermocouple contact was sealed by PTFE. The length of thermocouple submerged to liquid nitrogen was 150mm. The steady-state measured temperature of tool die at measured point was -170°C. By coiling thermocouple to increase length of submerged part of thermocouple to about 1500mm, steady-state measured temperature appears to be -194°C. In this case, source of disturbance was heat conducted through the thermocouple to the submerged tool die. The surprisingly huge influence of tiny thermocouple to the tool die temperature is the gas-phase nitrogen on the tool die surface. It acts as thermal insulator against surrounding liquid nitrogen phase, since nitrogen in gas-phase has very low heat capacity and low thermal conductivity.

# CATALYTIC AND SENSOR PROPERTIES OF $Co_3O_4$ PREPARED BY COMBUSTION SYNTHESIS ROUTE

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Cobalt oxide, $Co_3O_4$, has shown great potentials for various practical applications due to excellent electronic, magnetic and redox properties. Its high catalytic activity in combustion of CO is well known for a longer period. However, this material has also drawn some research interest as a p-type metal oxide gas sensor. A powerful strategy to improve both catalytic and sensor performance is the utilization of a nanocrystalline powder with a high surface to volume ratio. Thus, a strong interaction between the surrounding gas and the material is enabled.

The nanocrystalline $Co_3O_4$ powder was synthesised by the nitrate-glycine combustion route. The glycine/metal ion ratio was adjusted to provide stoichiometric or fuel-lean conditions of the redox reaction. The auto-ignition of gels with the evolution of large amounts of gases was occurred at approximately 180 °C, and the process was spontaneously underwent to a smouldering combustion and formation of a voluminous powder. According to the X-ray diffraction analysis the phase-pure $Co_3O_4$ was obtained only when the precursor powder was prepared from the 50% fuel-lean redox reaction. The field emission scanning electron micrographs revealed the spongy aspect of the calcined powder, where small primary particles formed the agglomerates.

For the screen-printing, the $Co_3O_4$ powder was mixed with the organic binder to achieve a viscous paste suitable for printing. The paste was screen printed onto $Al_2O_3$ substrates with interdigitated Pt electrodes for read-out of the resistance and a Pt heater for operation at well controlled temperatures, and fired at 400 °C in air. The catalytic conversion of the $Co_3O_4$ powder and the sensor signal of the corresponding sensors were checked under different concentrations of the reducing test gases. The excellent catalytic activity of the $Co_3O_4$ powder was confirmed. The sensor signal was the best to ethanol at the operating temperature of 150 °C, which was found to be 100 °C lower than for comercial $SnO_2$ sensors.

# BIODEGRADABLE METALS

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Metallic biomaterials have been used in bone and joint replacements, fractured bone fixation devices, stents, dental implants, etc., for a long time. The advantage of metals over polymers or ceramics is in higher strength, toughness and established processing technologies. The most important metallic biomaterials in the current use are stainless steels (SUS 316L), titanium alloys (Ti, Ti-6Al-4V, Ti-6Al-7Nb), cobalt alloys (Co-Cr-Mo), superelastic Ni-Ti, noble metal alloys (Au, Pd, dental amalgams – Hg-Ag-Cu-Sn). All these kinds of materials show a high corrosion resistance in human body fluids and, therefore, are considered as bio-inert materials.

Besides the bio-inert materials, biodegradable materials have attracted a great attention. Biodegradable materials progressively corrode and degrade in the body environment to produce non-toxic, non-allergic and non-carcinogenic compounds which are readily excreted by the human body. Biodegradable materials can be used for implants whose functions in the human body are only temporary, like fixation devices (screws, plates) of fractured bones and stents. Polymeric biodegradable materials (for example poly-lactic acid – PLA) are commonly used at present, but their disadvantages are low mechanical strength and hardness. For this reason, biodegradable metals and metallic alloys have been extensively investigated during last decades.

Biodegradable metals should have a good biocompatibility to the human body tissues. This basic requirement limits the number of possible candidates to three metals, magnesium, zinc and iron. In the present paper, mechanical, structural and corrosion characteristics of Mg-, Zn- and Fe-based alloys, as promising biodegradable implant materials, are compared. Advantages and disadvantages of the three kinds of alloys are demonstrated.

# PRODUCTION OF SHAPED SEMI-PRODUCTS FROM AHS STEELS BY INTERNAL PRESSURE

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The continuous development of industry leads to the need for an ever increasing quality of parts with excellent mechanical properties and appreciable dimensional complexity, which together with low weight, saves operating costs and increases operational reliability. The increasingly dynamically evolving automotive industry is becoming dominant in meeting these requirements. Given these facts it is necessary to develop new ways and technologies by which these requirements can be achieved. One possible way could be the processing of low alloyed high strength steels with modern procedures of heat treatment. One of these procedures is the Q-P process, which allows high tensile strength of about 2000 MPa to be achieved and elongation exceeding 10 %. Sufficiently high value of elongation is concurrently a prerequisite and in some applications a requirement for reliable operation. Unconventional methods, which are used to obtain blanks with dimensional complexity, can be combined with the Q-P process to create parts with excellent mechanical properties and complex shapes.
This paper is focused on application of a combination of internal high pressure forming, hot stamping and Q-P processing to obtain a functional product with high values of mechanical properties and complex shape, whose fabrication is not possible by conventional methods of production or is much too expensive. The aim of the experimental programme was post-processing of thin-walled hollow blanks through the designed production chain, from which commercially useful products were fabricated by gradual optimization. Blanks were first austenitized in a furnace at a chosen temperature and then they were moulded by internal pressure in a closed die, thus they were quenched below Ms. Quenching temperature was controlled by the proposed calibration times. In order to determine the influence of heat treatment on the microstructure evolution and mechanical properties the blanks were processed in three different ways after removing from the die. In the first case the blanks were directly cooled down by air. In the second case the blanks were reheated immediately after removing from the die to a partitioning temperature (Q-P process), where the isothermal holding time was carried out. In the third case tempering after air cooling below Ms was carried out.
The structure of obtained products predominantly consisted of martensite with a low amount of bainite. This structure provided high tensile strength that at no point fell below the value of 1950 MPa while retaining excellent elongation values of around 15%.

# THE APPLICATION OF ACTIVATING FLUXES IN THE MANUFACTURE OF MEDIUM PRESSURE PIPELINES

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In the manufacture of medium pressure pipelines (≤100 bar) the TIG (WIG) welding process is traditionally used. Thanks to its technological advantages, the use of ATIG process is specially recommended for welding of high-alloy austenite steels of thickness more than 3mm. Thickness of the pipe wall more than 3mm, in conventional TIG process of welding demands tilting of the edges of joints, which in the ATIG processes is not the case.
In this paper it is presented the use of ATIG welding process in manufacture of the pipeline No100 (Np81) in Hydropower Bajina Bašta (Republic of Serbia). Used material is corrosion resistant – steel 316L. Dimensions of the pipes are Ø108x4 mm.
Highly-dispersive mixture – activating fluxes for the class of austenite high-alloy steels are used for welding. With the free contraction process it is obtained necessary reinforcement in the weld metal. All the tests carried out have confirmed the high quality of welded joints and their reliability.

# MICROSTRUCTURAL CHANGES OF FINE-GRAINED CONCRETE EXPOSED TO SULFATE ATTACK

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Durability of concrete has become a very relevant issue in construction projects over the last decades. Sulfate attack is one of the major threats for durability of concrete constructions and it becomes a major destructor in sewage collection systems where concrete sewer pipes are exposed to sulfates. The sulfates originate from waste water as well as from biogenic activity of bacteria – *microbiologically induced concrete corrosion* (*MICC)* [1]. During this process the pH of the surface of concrete sewer pipes is reduced and it may lead to steel depassivation and results in the corrosion of this steel reinforcement. Formation of ettringite ($AF_t$) from gypsum (forming by reaction of sulfate anion with calcium hydroxide) and $C_3A$ via monosulfate ($AF_m$), according to eq. (1), is the main chemical reaction of sulfate attack on concrete.

$$C\bar{S}H_2 + C_3A + 10\,H \rightarrow C_4ASH_{12} \xrightarrow{2\,C\bar{S}H_2 + 16\,H} C_6A\bar{S}_3H_{32} \quad (1)$$

gypsum monosulfate ettringite

Ettringite and gypsum have considerably larger volume than initial compounds, which leads to increased pressure. Thus, the interactions of sulfate ions with the cement matrix result in disruption of the concrete and significant loss of mechanical strength and mass, and it leads to reduction of service life of sewage pipes made from concrete [2-3].

This paper is focused on the sulfate attack on fine-grained concrete where the effect of six months contact of 0.5% sulfuric acid, simulating MICC, on microstructural changes of various types of concrete has been investigated. The changes of microstructure were determined by mercury intrusion porosimetry and scanning electron microscope. The largest microstructural changes occurred in samples made from Portland cement and cement with the addition of metakaolin and ground limestone. Concrete containing blast furnace slag, fly ash and also samples made from sulfate resistant cement were more resistive to sulfate treatment. By the mapping of the element distribution on the surface of longitudinal section of each samples, the presence of thickness rich in sulfur, iron and aluminum was proved.

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# PHYSICOCHEMICAL PROPERTIES OF Ti67 ALLOY AFTER EO AND STEAM STERILIZATION

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Techniques of surface modification play a significant role in forming physical and chemical properties of titanium and its alloys [1]. Among many techniques of layers application, chemical and electrochemical methods are particularly interesting as it enables to control the process of deposition of thin layers of the material and modification of their properties through the change of reagents and parameters of deposition process. A special advantage their methods brings is the possibility to obtain layers that offer perfect coating for geometrically complex surfaces [2]. Apart from improved haemocompatibility, a significant issue related to creation of the layers is also proper set of physicochemical properties. Therefore, the study comprised tests of physicochemical properties of oxide layers deposited on the surface samples taken from Ti-6Al-7Nb alloy. Samples were subject to various surface modifications, namely: grinding, electrolytic polishing, $SiO_2$ layer was applied with application of sol-gel method and $TiO_2$ by means of anodic oxide and medical sterilisation methods (EO and steam). Corrosion resistance tests were performed on the ground of registered anodic polarisation curves and Stern method. Electrochemical Impedance Spectroscopy was also used in order to evaluate phenolmena taking place on the surface of the tested alloys. As a part of evaluation of mechanical properties of surface layers created in such a way, hardness tests and tests of adhesion of those layers to metallic substrate were made. Measurements of instrumental hardness were made with Oliver&Phar method, whereas adhesion of the layers to the substrate was measured by means of scratch test. Suggestion of proper surface treatment variants is perspective significance and will help to develop technological conditions with specified parameters of oxide coating creation on the surface of metallic implants.

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# CORROSION RESISTANCE OF NANOBAINITE OBTAINED IN CARBURIZED LAYER OF 38CRALMO6-10 STEEL

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Steels with a microstructure consisted of nanobainitic ferrite in a carbon-enriched retained austenite matrix may be potentially used in a variety of industrial applications due to good combinations of strength, toughness and ductility. It has been revealed in a numerous studies that nanobainitic structure obtained in surface layers of carburized steels has advantageous properties as compared to the conventional tempered martensite, for example it displays significantly better wear resistance. In this study, corrosion resistance of a carburized 38CrAlMo6-10 steel after different heat treatments was compared. Samples of investigated steel were vacuum carburized and subsequently austenitized and austempered at two different temperatures close to the temperature Ms of the surface layer. Another part of the carburized samples was conventionally quenched and tempered. The obtained microstructures of carburized layers were examined using light microscope (LM) and on transmission electron microscope (TEM). TEM observations revealed that after austempering the carburized layer are composed of a nano-sized bainite plates separated by thin films of retained austenite. Corrosion resistance tests were performed through polarization of steel samples in Na2SO4 environment with pH 4 and 7. The corrosion resistance of both kinds of samples were compared and discussed.

# *POST MORTEM* STUDY OF THE REFRACTORY ZIRCONIA METERING NOZZLE EXPOSED TO CORROSIVE EFFECT OF THE MOLTEN STEEL AND SLAG, CD

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Partially stabilized $ZrO_2$ materials are widely used as refractories owing to their high refractoriness, high corrosion resistance and good thermal shock resistance. Due to these various properties, zirconium oxides have been used as metering nozzles in the continuous casting of steel.
This paper presents a comprehensive study on the phase composition and microstructure changes of sintered Mg-stabilized zirconia metering nozzle exposed to corrosive effect of the molten steel and slag after working for 30 hours in tundish for continuous casting process.
The chemical and phase compositions of both as-delivered and corroded materials were investigated by X-Ray Fluorescence (XRF) and X-Ray Diffraction (XRD), respectively. The microstructure was observed using a scanning electron microscope (SEM) coupled with an energy dispersive x-ray system (EDS).
On macroscopic observation of the corroded material, cracks and two zones were distinguished in respect of colour. A dark zone was strongly corroded by molten steel and slag (the hot zone refractory material) while the light zone remain unccorroded.
The XRD analysis showed that the dark layer was richer in stabilized $ZrO_2$ than the light layer. Moreover, during the corrosion process, liquid steel infiltrated the zirconia material with was confirmed by the SEM investigation.

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# STUDY OF NONLINEAR OPTICAL PROPERTIES OF SILVER NANOPARTICLES EMBEDED IN GLASS

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Transparent dielectrics with embedded silver nanoparticles are characterized by strong optical non-linearities and very fast response times which are the basis of their numerous applications in photonics. The unique properties of these noble metal nanoparticles (NPs) originate from the localized surface plasmon resonance (LSPR) occurring in the spectral range of 400 – 460 nm. The LSPR strongly depends on the size, shape and concentration of metallic NPs as well as on the properties of embedding medium.

In our experiment, the composite glasses with Ag NPs are prepared first introducing silver ions during ion-exchange process by immersing soda-lime glass slides into a molten bath of 10mol% AgNO3: NaNO3 at a temperature of 400°C. Then, the ion-exchanged samples are annealed or irradiated by a nanosecond laser pulses which makes Ag ions to be reduced into atoms which migrate and aggregate into nanoparticles. Moreover, using the on-line optical extinction measurements and exploiting the LSPR we study the evolution of NPs parameters (their average size and concentration). As a result we managed to identify characteristic phases of the NPs growth which strongly depend on the temperature of annealing or the wavelength and power of the laser pulses.

The samples are first characterized by UV-VIS absorption spectroscopy and then using the Z-scan technique. Both nonlinear absorption and refraction are determined from the open and closed Z-scan measurements, respectively. In our measurements we used femtosecond laser pulses at 780 nm in order to attenuate linear absorption but also to avoid thermal effects commonly occurring when nanosecond pulses are applied.

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# ELECTRICAL AND OPTICAL PROPERTIES OF ZNO NANOROD ARRAYS PREPARED COMBINING ELECTROPHORETIC DEPOSITION AND HYDROTHERMAL GROWTH

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There is a wide variety of methods available for the preparation of 1 and 2D ZnO nanostructures, which are generally divided into two main groups: vapour phase methods and chemical or solution-based methods [1]. From these two groups, chemical solution processes, and more specifically hydrothermal growth (HG), stands out as a powerful low-energy consumption route to successfully control the crystallization engineering of ZnO, in contrast to evaporative methods, which usually require expensive experimental equipment and rigorous experimental conditions. HG growth allows large scale production of nanostructures at low temperatures in a simple, cost effective way, enabling a relative control of the obtained morphology and nanostructure size at the same time. HG requires ZnO seed layer to facilitate the heterogeneous growth of the ZnO nanorods (NRs). In most cases seed layers are prepared by spin coating, sol gel or magnetron sputtering [2]. In this work we propose the use of electrophoretic deposition (EPD) of ZnO nanoparticles as seeding method for the preparation of ZnO films, and their subsequent growth into ZnO NRs under hydrothermal conditions. The use of EPD as seeding procedure allows the obtaining of homogeneous, well oriented ZnO thin films in a simple, low cost, reproducible way. The work was supported by EU COST Action TD1105 – project LD14111 of the Ministry of Education CR.

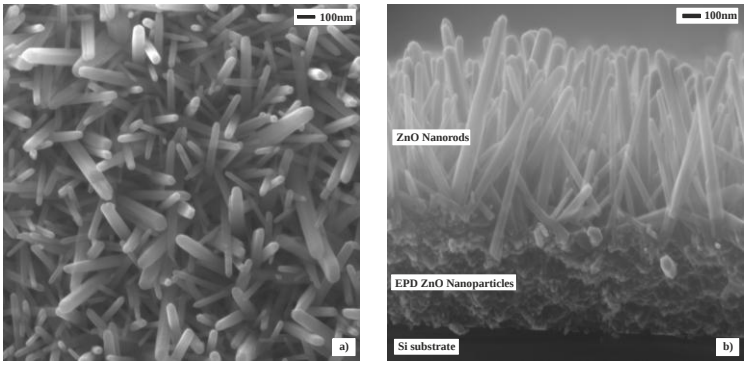


Figure 1: SEM images of ZnO NRs grown on seed layer prepared by ectrophoretic deposition of ZnO nanoparticles. (a) top view and (b) cross section.

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# THE EFFECT OF CURRENT ON THE PRODUCTION OF NITI INTERMETALLIC VIA ELECTRIC CURRENT ACTIVATED SINTERING

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In this study, it was investigated fabrication of in situ intermetallic NiTi composites from powder mixture containing 50wt% titanium powder (%99,5 purity less than 44 µm)-50wt% nickel powder (%99,9 purity, 3-7 µm). Powder mixtures without a small amount of aluminum were compressed uniaxially under 170 MPa of pressure and sintered at 1000-1300-1600 A current for 15 minutes in a steel mould using electric current activated sintering method. Phases in samples were analyzed by XRD and their hardness was measured by Vickers hardness tester (approximately 650 HV±100). Scanning electron microscopes (EDS) investigations showed that microstructures of samples were consisting of different phases such as; Ni, Ti, NiTi, $Ni_2T_3$, $NiTi_2$, $Ni_3Ti$, $TiO_2$ according to current parameter. Also there was a trace amount of aluminium oxide in the sintered body. XRD analyses also supported the results.
Key Words: NiTi intermetallics, Electric Current Activated Sintering, Characterization

# USE OF SEMI-SOLID PROCESSING (MINI-THIXOFORMING) TO PRODUCE AL REINFORCED METALLIC GLASS COMPOSITES

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Mini-thixoforming provides complicated shapes to be produced very effectively. This is a novel technique for semi-solid processing. It is used to produce net shape components of aluminium, magnesium and copper alloys, or metal matrix composites for high performance applications. The microstructure cannot be produced by other techniques are also ensured. In this study, metallic glass composites have been produced by a combination powder metallurgy and processing of material in semi-solid state. Before producing the composites, metallic glass materials were characterized by differential thermal analysis-thermogravimetry (DTA-TG), X-ray diffraction (XRD), scanning electron microscopy-energy dispersive spectroscopy (SEM-EDX), light microscope and micro-hardness test machine. The powder mixture consisting of aluminum + metallic glass powders has been compacted into the steel container. They have been mechanically compressed before heating to semi-solid state to get better compaction. Homogenous Al powders reinforced metallic glass composites have been obtained subsequent to semi-solid process. Characterization of the structures was carried out by DTA-TG, XRD, SEM-EDX, light microscope and micro-hardness test machine. The one step short heating process was investigated to see being able to be formed of metal – metallic glass compact composites from powder material consisted of aluminum and metallic glasses in semi-solid state.

# FABRICATION OF NANOSTRUCTURE FE-DOPED ZNO THIN FILMS FOR ISOPROPYL ALCOHOL SENSORS

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The volatile organic compound (VOC) has been used for many applications in human life for long time. Isopropyl alcohol (IPA) is one kind of VOC most commonly found domestically as rubbing alcohol for numerous household and commercial products [1]. IPA is a colorless and flammable which can irritate mouth and throat when inhaling to the human. Repeated high exposure can cause headache, dizziness, confusion, loss of coordination, and even death. The monitoring sensor of IPA would be an important matter in term of safety and health protections. This paper reports fabrications of isopropyl alcohol sensor based on metal oxide nanostructure thin films. The nanostructure of thin films would yield higher surface area for absorptions to the targeted gas so it can increase the sensing performance of the sensor [2]. The nanostructure thin films based on ZnO decorated with Fe have been successfully synthesized using chemical bath deposition technique. The thin films structure has been investigated using several characterizations technique including X-ray diffractions (XRD), scanning electrons microscopy (SEM), and energy disperse spectroscopy (EDS). The SEM records have been confirmed that the thin films have thin sheet nano pattern indicating larger surface area compared to the bulk structure. The EDS also have been detected that the Fe compound still exist after fabrications process of the sensor. The resulting high surface area of nanosheet Fe doped ZnO then constructed as a sensitive sensor layer for isopropyl alcohol sensor. The sensing characterizations systems have been performed to investigate the optimum operation temperature as well as the best amount of Fe doped for isopropyl alcohol sensor. The Fe-doped ZnO thin film sensor shows reversible response to isopropyl alcohol (IPA) gas at various temperature from 100 ℃ to 300 ℃. The optimum sensor sensitivity is yielded at 275 ℃ of working temperature. The sensors have optimum sensitivity at 0.5% of Fe amount introduced to the ZnO nanostructure thin films. The sensors also have good selectivity for IPA vapor compared to ethanol and acetone.

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# SYNTHESIS AND APPLICATION OF NOVEL POLYMER CARRIERS FOR DELIVERY OF ACTIVE PHARMACEUTICAL INGREDIENTS

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In this presentation the synthesis, characterization and application of novel non-toxic, biodegradable and biocompatible polymer drug carriers of different architecture based on various combinations of chitosan, synthetic polypeptides and dendritic polymers will be presented, i.e. poly(ester-amide) dendrimers synthesized from $AB_2$ adduct of 2,2-bis(hydroxymethyl) propanoic acid and glycine, alkyl-modified poly(sodium glutamates) synthesized by ring-opening polymerization of *N*-carboxyanhydrides and subsequent hydrophobic post-polymerization modification and chitosan-*graft*-poly(sodium-L-glutamate), prepared by grafting polypeptide grafts from chitosan backbone.
Our goal was to prepare drug delivery systems with improved properties for delivery of poorly water-soluble low molecular-weight active pharmaceutical ingredients in the form of solid dispersions or for oral delivery of high molecular-weight protein/peptide drugs (biopharmaceuticals) in the form of nanoparticles, prepared by polyelectrolyte complexation method.

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# MICROSTRUCTURAL CHANGES OF OCR12 TOOL STEEL MODIFIED BY RARE EARTH ELEMENTS

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Tool steels are widely used for the manufacture of cutting tools, dies and molds. They are generally characterized by high wear resistance. The OCR12 steel belongs to the group of cold work steels, which are not resistant to softening at elevated temperatures and are used in applications not involving prolonged or repeated heating. Such applications include woodworking, stamping and pressing tools.
The wear resistance of tool steels is strongly dependent on the amount, shape, distribution and type of the carbides present in the microstructure. Thus, it is essential to study the carbides in the material and to develop methods to control their properties. The initial carbide network influences the hot processing and microstructural evolution. Large carbide network is difficult to break down and is therefore, undesirable.
We have attempted to modify the cast microstructure of the OCR12 steel by addition of rare earth (RE) elements. The as-received OCR 12 steel was remelted and 0,26 wt.% rare earth elements in the form of mischmetal were added to the melt. The effect of rare earth elements on the microstructure and morphology of the eutectic carbides in OCR12 tool steel was investigated. It is expected that eutectic carbide morphology changes significantly when steel is modulated with RE, favoring a more homogeneous distribution of the carbide network. The microstructure of RE modified and non-modified samples was investigated by optical and scanning electron microscope (SEM). In this contribution, we will present the differences in microstructures between modified and original steels.
Keywords: tool steel, rare earth elements, carbides network, steel modiffication

# STRATEGIES TOWARD SEQUENTIAL POLYMERIZATION OF DIFFERENT TYPES OF HETEROCYCLIC MONOMERS USING ORGANIC CATALYSTS

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Ring-opening polymerizations (ROP) of epoxides and cyclic esters/carbonates share the common feature of proceeding through alkoxide/hydroxyl end groups, but one-pot sequential polymerization of such different types of monomers has been a major challenge as the active species that work for one can either be inactive or lead to uncontrolled polymerization for the other, especially in the case of conventional metal-based initiating/catalytic systems.

The development of organocatalytic polymerization techniques has offered new opportunities for the fulfillment of such synthetic tasks. Recently, we have found that controlled sequential polymerization can be performed leading to well-defined block copolymers provided the organic catalysts are adequately chosen and finely tuned to the monomers to polymerize. For example, the use of a mild phosphazene base[1] enables the sequential ROP of ethylene oxide, *ε*-caprolactone and L-lactide to generate the corresponding triblock terpolymer (Figure 1a),[2] and a "catalyst switch" strategy (a successive use of a strong phosphazene base and an acid catalyst) enables the one-pot synthesis of well-defined block copolymers based on various polyethers, polyesters and polycarbonates with 2, 3 or 4 block types (Figure 1b).[3,4]

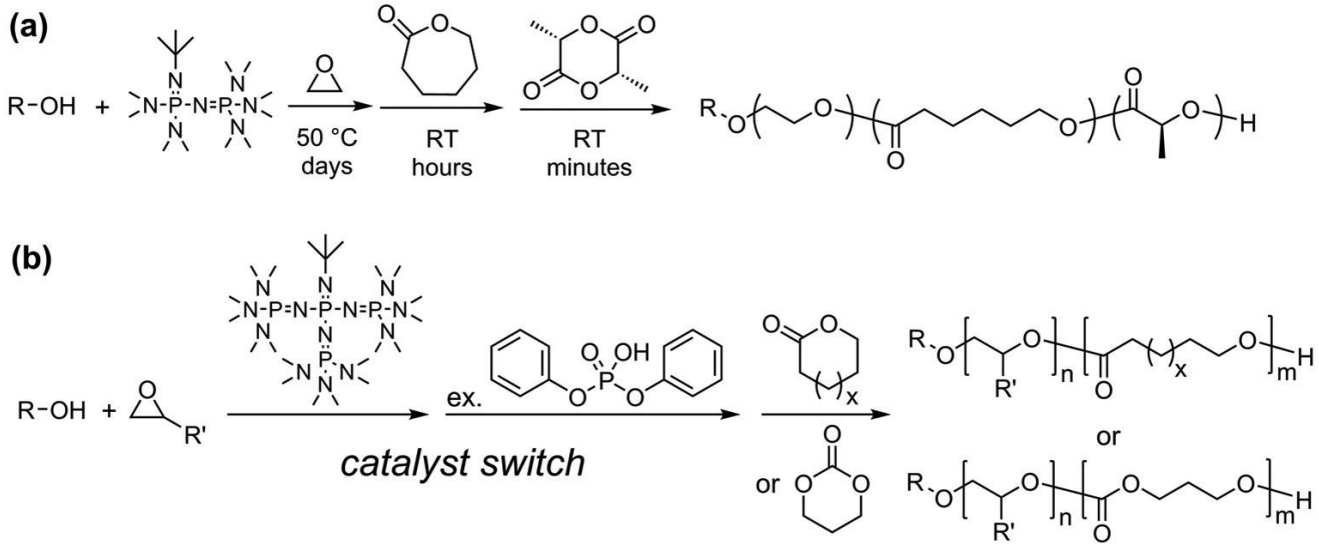


**Figure 1**. Sequential organocatalytic polymerization of different types of heterocyclic monomers using (a) a mild phosphazene base and (b) a "catalyst switch" strategy.

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# LOW-ENERGY ION BEAM INDUCED SURFACE ENGINEERING: FROM SELF-ORGANIZED NANOSTRUCTURES TO ULTRA-SMOOTH SURFACES

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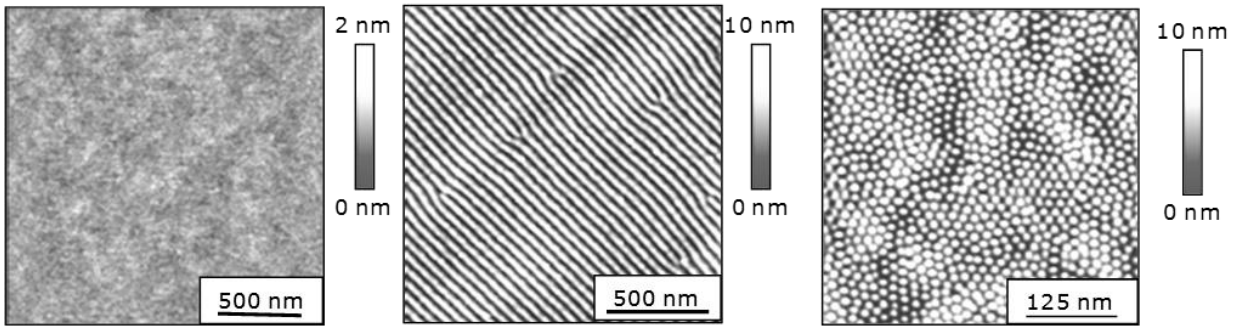
The fabrication of regular nanostructures on the nanometer length scale builds the basis for many technological applications in variety of fields, from optics to optoelectronics, to biological optics, to templates for the deposition of functional thin films, and to data storage industry. One effective method is the low-energy ion beam erosion of solid surfaces that is a widespread technique used in many surface processing applications. For particular sputtering conditions, due to self-organization processes, the surface erosion process can lead into well ordered nanostructures on the surface like ripples or dots. This self-organized pattern formation is related to a surface instability between curvature dependent sputtering that roughens the surface and smoothing by different surface relaxation mechanisms.




In this talk the current status of self-organized pattern formation and surface smoothing by low-energy ion beam erosion is summarized. In detail it will be shown that a multitude of patterns can evolve on the surface with a periodicity from 30 nm to 100 nm.[1] Furthermore a successful combination of conventional lithographically nanostructuring techniques with the ion induced self-organization processes that leads to hierarchical nanostructuring will be presented.
If the evolution of the surface topography is dominated by relaxation mechanisms surface smoothing can occur.[2] Especially, it will be demonstrated that ion beam assisted smoothing is suitable also for the polishing of technological relevant surfaces down to 0.1 nm rms roughness level showing a great promise for large-area surface processing, which is essential for many advanced optical applications.

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# ANALYSIS OF VANADIUM INFLUENCE TO AlSi10MgMn ALLOY WITH HIGH IRON LEVEL

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Removing of the impurities from aluminium alloys increases final cost of the castings. The most common impurity in Al-Si based alloys is iron. High iron level in the aluminium alloys leads to formation of intermetallic phases due to its low solubility in solid aluminium and aluminium alloys. Intermetallic phase $Al_5FeSi$ is most frequent phase in cast Al-Si alloys. This phase is also considered to have most detrimental effect to mechanical properties and castability of the alloys. Deleterious effect of $Al_5FeSi$ phase to mechanical properties is related to its platelet like morphology that reduces ductility of alloy. Porosity of the final casting is also influenced by iron-based intermetallic phases which can also affects alloy's ductility.

When Fe is present in excess of specified levels, various methods have been advocated to reduce its harmful influence. Adding of some chemical elements (iron correctors) to alloy is the most common method of iron influence elimination. Elements such Co, Mn, Cr, Mo, Ni and V has been reported to have significant influence to improving alloy properties.

Elimination of detrimental iron effect is mainly required in secondary (recycled) aluminium alloys. Processing of aluminium scrap causes increasing of iron content that has to be reduced in some way. High iron level in AlSi10MgMn has a significant influence at the amount exceeding 0.7 wt. %. Alloy contains significant levels of Mg and Mn which leads to formation of significant number of script-like phases next-to platelet-like phase $Al_5FeSi$. Further increasing of alloy properties might be achieved by using elements improving mechanical properties of Al-Si alloys. Vanadium belongs to the group of elements which can favourably affect mechanical properties of Al-Si alloy even in small amount. Presented article describes vanadium influence to mechanical and foundry properties of AlSi10MgMn alloy with high iron content. Microstructure of the alloy is also reviewed.

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# HIGH CHROMIUM CREEP RESISTANT STEELS – THE NEW CONCEPT OF DISJUNCTIVE MATRIX STATIONARY CREEP

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The microstructure of high chromium creep resistant steels consists of ferrite matrix with carbide and carbonitride precipitates which presents obstacles to the dislocation movement and increase the creep resistance of steel. Creep deformation of steel proceeds with glide and climb of mobile dislocations at stresses few times lower than the steel yield stress. Different theoretical and semi-empirical equations for creep rate calculation are available in the literature which tries to explain creep process. Theoretical equations include physical and material constants and parameters related to steel microstructure while on the other hand empirical equations are based on experimental creep rate and tensile properties at elevated temperature and the microstructure is considered with a suited constant.
In this contribution a new concept of interaction process between mobile dislocations and precipitates during creep deformation is proposed and presented. New concept proposes the explanation how the precipitates in the steel matrix affect the stress used for gliding and stress used for climbing of mobile dislocations. The ferrite matrix of steel consists of a great number of polyhedric grains with different lattice orientations compared to direction of applied creep stress. Applied creep stress is transferred trough the precipitates to the matrix in particle disjunctive matrix. The transferred stress consists of glide and climb components of stress with magnitude related to the of angles of applied creep stress – matrix grain glide direction ($\alpha$), stress transfer edge ($\beta$) and matrix grain glide plane ($\gamma$). By determined relations of angles $\alpha$ and $\gamma$, the glide stress is diminished for up to $10^4$ times compared to applied creep stress and even much more than the climb stress. Since the creep specimen behaves as a solid body, the creep rate is equal in all matrix grains, where it is governed by precipitates with the lowest disjunctive matrix glide stress. Unshearable precipitates in the microstructure cut the mobile dislocation line in segments and are overcame by climbing of segments orthogonal to lattice glide plane. In the particle conjunctive matrix, the dislocation length decreases with consumption of energy for glide and climb, while, in particle disjunctive matrix, additional greater energy is consumed for lengthening of mobile dislocation line segments.
Applying the Hornbogens creep rate equation modified with the addition of the parameter ($\lambda$-$d$) where $d$ is the average particle size and $\lambda$ is the average particle spacing and constant representing the increase of stress, stress exponent $n$ from 2 to 3.65, the difference between the calculated creep rates and experimentally obtained was lower than 10 % confirming the modification as acceptable and the decrease of glide stress agrees reasonably well with the stress exponent $n$ = 3.65.