

**1. MEDNARODNA KONFERENCA O MATERIALIH
IN TEHNOLOGIJAH POD POKROVITELJSTVOM
FEMS IN IUVSTA**

13.–15. oktober 2008, Portorož, Slovenija

**1st INTERNATIONAL CONFERENCE ON MATERIALS
AND TECHNOLOGY SPONSORED BY
FEMS AND IUVSTA**

13–15 October 2008, Portorož, Slovenia

**PROGRAM IN KNJIGA POVZETKOV
PROGRAM AND BOOK OF ABSTRACTS**

**UREDNIK / EDITOR
MONIKA JENKO**

INŠTITUT ZA KOVINSKE MATERIALE IN TEHNOLOGIJE, LJUBLJANA

**1. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH POD
POKROVITELJSTVOM FEMS IN IUUSTA / 1st INTERNATIONAL CONFERENCE ON MATE-
RIALS AND TECHNOLOGY SPONSORED BY FEMS AND IUUSTA**

Program in knjiga povzetkov / Program and book of abstracts

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Lepi pot 11, Ljubljana, Slovenija*

Za založnika *Monika Jenko*

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d. o. o., Štore*

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Legenda – Legend:

KM	Kovinski materiali – Metallic materials
AM	Anorganski materiali – Inorganic materials
P	Polimeri – Polymers
VT	Vakuumska tehnika – Vacuum technique
NN	Nanomateriali in nanotehnologije – Nanomaterials and nanotechnology
RP	Raziskovalna politika – Research policy
VO	Varstvo okolja – Environmental protection
VP	Vabljena predavanja – Invited papers
GP	Govorni prispevki – Oral
MR	Mladi raziskovalci – Young scientists

**1. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH
 POD POKROVITELJSTVOM FEMS IN IUUSTA, 13. – 15. OKTOBER 2008
 1ST INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY
 SPONSORED BY FEMS AND IUUSTA, 13–15 OCTOBER, 2008
 PROGRAM – PROGRAM**

	PONEDELJEK – MONDAY, 13. 10. 2008	TOREK – TUESDAY, 14. 10. 2008	SREDA – WEDNESDAY, 15. 10. 2008
08:40	<i>Odprtje – Opening</i>		Matjaž Torkar
09:00	Rudi Dobrozemsky	Bojan Jenko	Slavko Kanalec
09:20		András Berkó	Franc Tehovnik
09:40	Maureen E. Callow		Aleksandra Kocijan
10:00		Karlo T. Raić	Matjaž Godec
10:20	<i>Odmor – Break</i>		<i>Odmor – Break</i>
10:40	James Callow	<i>Odmor – Break</i>	Janko Kokošar
11:00		Zijad Džemić	Boštjan Pirnar
11:20	Marie-Genevieve Barthes-Labrousse		Jože Rodič
11:40		Varužan Kevorkijan	Jure Bernetič
12:00	Markus Kahn		Zaključek konference – Closing the Conference
12:20		Mirsada Oruč	
12:40	Adrián M.T. Silva		
13:00			
13:20	13:20 – 15:20 Odmor za kosilo – Lunch	13:00 – 15:20 Odmor za kosilo – Lunch	
15:20	Aleš Nagode	Boris Kompare	
15:40	Franci Vode	Miro Huskić	
16:00	S. Čampelj – M. Žnidaršič	Pihura Derviš	
16:20	S. Glinšek – A. Kocjan	Vojteh Leskovšek	
16:40	A. Maglica – J. Koruza	Janez Šetina	
17:00	<i>Odmor – Break</i>	Borivoj Šuštaršič	
17:20	M. Žveglič – B. Šetina Batič		
17:40	Č. Donik – I. Paulin		
18:00	R. Barbič – J. Gontarev		
18:20	M. Lamut		
18:40			
19:00			
20:00	Podelitev nagrad MR – Young Scientists Awards Dobrodošlica –Welcome Party	Posterska sekcija – Poster Session KM, AM, P, VT, NN, VO COCKTAIL PARTY	

**PROGRAM 1. MEDNARODNE KONFERENCE O MATERIALIH IN
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1st INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY
SPONSORED BY FEMS AND IUUSTA: PROGRAM**

PONEDELJEK – MONDAY 13. 10. 2008		
	Predsedujoči – Chair: M. Jenko, S. Kobe, J. Gasperič	
8:40	ODPRTJE – OPENING	
9:00	Rudolf Dobrozemsky Vienna University of Technology, Wiedner Hauptstrasse 8-10, A-1040 Vienna, Austria SPECIAL ASPECTS OF VACUUM GAUGE CALIBRATION	VT-VP
9:40	Maureen E Callow School of Biosciences, University of Birmingham, B15 2TT, UK THE CONTROL OF BIOFOULING: PAST, PRESENT AND FUTURE CHALLENGES	P-VP
10:20	Odmor – Break	
	Predsedujoči – Chair: M. Jenko, S. Kobe, J. Gasperič	
10:40	James Callow School of Biosciences, University of Birmingham, B15 2TT, UK PROGRESS IN NANOSTRUCTURING SURFACES FOR THE CONTROL OF MARINE BIOFOULING: THE AMBIO PROJECT	P-VP
11:20	Barthes-Labrousse Marie-Genevieve ICMMO - LEMHE, CNRS UMR 8182, Batiment 410, Universite Paris-Sud - 91405 Orsay Cedex, France OF THE INTERPHASE IN EPOXY-AMINE/METAL ADHESIVE JOINTS	VT-VP
12:00	Wolfgang Waldhauser, Markus Kahn JOANNEUM RESEARCH Forschungsgesellschaft mbH, Leoben Laser Center, A-8712 Niklasdorf, Austria APPLICATION OF GRIDLESS ION SOURCES IN SURFACE ENGINEERING	KM-VP
12:40	Adrián M.T. Silva Laboratório de Catálise e Materiais (LCM), Laboratório Associado LSRE/LCM, Departamento de Engenharia Química, Faculdade de Engenharia, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal ENVIRONMENTAL CATALYSIS FROM NANO- TO MACRO-SCALE	VO-VP
13:20 – 15:20	ODMOR ZA KOSILO – LUNCH	
	Predsedujoči – Chair: S. Pejovnik, S. Kobe, M. Žigon, B. Šuštaršič, F. Vodopivec	
15:20	Aleš Nagode, Boris Ule, Monika Jenko Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia AN ANALYSIS OF CREEP BEHAVIOUR OF 9Cr-1Mo-0.2V STEEL ANALIZA LEZENJA JEKLA 9Cr-1Mo-0,2V	KM-MR
15:40	Franci Vode ¹ , Anton Jaklič ² ¹ Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenija, ² ACRONI d.o.o., c. Borisa Kidriča 44, 4270 Jesenice, Slovenija TOWARDS AUTOMATIC CONTROL OF SLAB-REHEATING IN PUSHER-TYPE FURNACE IN ACRONI d.o.o.	KM-MR

Govorni prispevki – Oral

16:00	Stanislav Čampelj ¹ , Darko Makovec ¹ , Miha Drofenik ^{1,3} ¹ Odsek za sintezo materialov, Inštitut "Jožef Stefan", Jamova 39, SI-1000 Ljubljana, Slovenija ² Fakulteta za kemijo in kemijsko tehnologijo, Univerza v Mariboru, Smetanova ulica 17, SI-2000 Maribor, Slovenija RHEOLOGICAL PROPERTIES OF FERROFLUIDS REOLOŠKE LASTNOSTI MAGNETNIH TEKOČIN	NN-MR
16:10	M. Žnidaršič, S. D. Škapin, D. Suvorov Odsek za raziskave sodobnih materialov, Institut Jožef Stefan, Jamova 39, Ljubljana, Slovenija THE STRUCTURAL AND ELECTRICAL PROPERTIES OF A SOLID SOLUTION BASED ON $\text{Na}_{0.5}\text{Bi}_{0.5}\text{TiO}_3\text{-K}_{0.5}\text{Bi}_{0.5}\text{TiO}_3$ STRUKTURNE IN ELEKTRIČNE LASTNOSTI TRDNE RAZTOPINE NA OSNOVI $\text{Na}_{0.5}\text{Bi}_{0.5}\text{TiO}_3\text{-K}_{0.5}\text{Bi}_{0.5}\text{TiO}_3$	AM-MR
16:20	Sebastjan Glinšek, Barbara Malič, Mišo Vukadinović, Brigita Kužnik, Marija Kosec Institut Jožef Stefan, Jamova 39, 1000 Ljubljana, Slovenija PROCESSING AND DIELECTRIC PROPERTIES OF $\text{KTa}_{0.6}\text{Nb}_{0.4}\text{O}_3$ THIN FILMS ON ALUMINA PRIPRAVA IN DIELEKTRIČNE LASTNOSTI TANKIH PLASTI $\text{KTa}_{0.6}\text{Nb}_{0.4}\text{O}_3$ NA PODLAGAH POLIKRISTALINIČNEGA Al_2O_3	NN-MR
16:30	Andraž Kocjan, Kristoffer Krnel, Tomaž Kosmač Odsek za inženirsko keramiko, Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenija THE SYNTHESIS OF NANOSTRUCTURED ALUMINATE COATINGS ON DENSE Y-TZP CERAMICS FROM AQUEOUS AlN SUSPENSIONSS NTEZA NANOSTRUKTURNIH ALUMINATNIH PREVLEK NA GOSTO SINTRANI Y-TZP KERAMIKI IZ VODNE SUSPENZIJE PRAHU AlN	AM-MR
16:40	Aljoša Maglica, Kristoffer Krnel, Tomaž Kosmač Institut "Jožef Stefan", Jamova 39, SI-1000 Ljubljana, Slovenija THE COATING OF Si_3N_4 POWDER WITH NANOSIZED ZrN PARTICLES PREKRIVANJE Si_3N_4 PRAHU Z NANODELCI ZrN	AM-MR
16:50	Jurij Koruza, Barbara Malič, Marija Kosec Institut Jožef Stefan, Jamova 39, 1000 Ljubljana, Slovenija SOLID STATE SYNTHESIS OF SODIUM NIOBATE SINTEZA NATRIJEVEGA NIOBATA V TRDNEM STANJU	AM-MR
17:00	ODMOR – BREAK	
	Predsedujoči – Chair: S. Pejovnik, S. Kobe, M. Žigon, B. Šuštaršič, F. Vodopivec	
17:20	Maša Žveglič ¹ , Marta Klanjšek Gunde ¹ , Marijan Maček ² , Nina Hauptman ¹ ¹ Kemijski inštitut, Hajdrihova 19, SI-1000 Ljubljana, Slovenija ² Fakulteta za elektrotehniko, Univerza v Ljubljani, Tržaška cesta 25, SI-1000 Ljubljana, Slovenija ELECTRICAL PROPERTIES OF PRINTING INKS FOR PRINTED ELECTRONICS ELEKTRIČNE LASTNOSTI TISKARSKIH BARV, KI SO PRIMERNE ZA UPORABO V TISKANIH ELEKTRONSKIH SISTEMIH	P-MR
17:30	Barbara Šetina Batič, Monika Jenko Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia NANOSTRUCTURES ON FeSi ALLOY SURFACE BY ION BEAM – SURFACE ACTIVE ELEMENTS AND THEIR ROLE	NN-MR
17:40	Črtomir Donik, Aleksandra Kocijan, Djordje Mandrino, Irena Paulin, Monika Jenko Institute of metals and technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia INITIAL OXIDATION AT ROOM TEMPERATURE OF DUPLEX STAINLESS STEEL	KM-MR
17:50	Irena Paulin ^{1,2} , Zlatko Čuš ¹ , Črtomir Donik ² , Monika Jenko ² ¹ Talum d.d. Kidričevo, Tovarniška cesta 10, SI-2325 Kidričevo, Slovenija ² Inštitut za kovinske materiale in tehnologije, Lepi pot 11, SI-1000 Ljubljana, Slovenija FLUORINE BONDING IN DRY SCRUBBER IN ELECTROLYSIS OF ALUMINIUM VEZAVA FLUORA V ČISTILNI NAPRAVI PRI ELEKTROLIZI ALUMINIJA	KM-MR

Govorni prispevki – Oral

18:00	Rok Barbič ^{1,2} , Vukašin Dragojevič ¹ , Anton Smolej ² ¹ Impol d.d., Slovenija, ² Naravoslovnotehniška fakulteta, Univerza v Ljubljani, Slovenija A NEW THERMOMECHANICAL TREATMENT FOR THE EXTRUSION OF AA 2xxx ALLOYS NOVA TERMOMEHANSKA OBDELAVA IZTISKOVANJA ALUMINIJEVIH ZLITIN VRSTE 2xxx	KM-MR
18:10	M. Lamut	
18:20	J. Gontarev	
20:00	Podelitev nagrad MR – Young Scientists Awards Dobrodošlica – Welcome Party	

TOREK – TUESDAY 14. 10. 2008		
Predsedujoči – Chair: V. Leskovšek, J. Vojvodič Tuma		
8:40	Bojan Jenko Ministrstvo za visoko šolstvo, znanost in tehnologijo, Ljubljana, Slovenija EU FUNDING OPPORTUNITIES FOR RESEARCH AND INNOVATION PRILOŽNOSTI EU ZA FINANCIRANJE RAZISKAV	RP-GP
9:20	András Berkó Reaction Kinetics Research Laboratory, Institute of Nanochemistry and Catalysis, C R C - HAS University of Szeged, H-6720 Szeged, Dóm tér 7, Hungary SOME BEARINGS OF THE GROWTH OF NOBLE METAL (Rh, Ir) NANOWIRES ON OXIDE SUPPORTS	NN-VP
10:00	Karlo T. Raić ¹ , Rebeka Rudolf ² , Kosec Borut ³ , Ivan Anžel ² ¹ University of Belgrade, Faculty of Technology and Metallurgy, Serbia, ² University of Maribor, Faculty for Mechanical Engineering, Slovenia, ³ University of Ljubljana, Faculty of Natural Sciences and Engineering, Slovenia NANOFOILS FOR SOLDERING AND BRAZING IN DENTAL JOINING PRACTICE AND JEWELLERY MANUFACTURING	KM-VP
10:40	ODMOR – BREAK	
Predsedujoči – Chair: M. Godec, A. Kocijan		
11:00	Zijad Džemić Institute of Metrology of Bosnia and herzegovina, Dolina 6, 71000 Sarajevo, BiH INSTITUTE OF METROLOGY OF BOSNIA AND HERZEGOVINA – ORGANIZATION, INFRASTRUCTURE AND PLANS	KM-VP
11:40	Varužan Kevorkijan ¹ , Srečo D. Škapin ² ¹ Zasebni raziskovalec, Betnavska cesta 6, 2000 Maribor, Slovenija ² Institut Jožef Stefan, Odsek za sodobne materiale, Jamova 39, 1000 Ljubljana, Slovenija FABRICATION AND CHARACTERIZATION OF B ₄ C-Al, B ₄ C-TiB ₂ -Al AND B ₄ C-Mg COMPOSITES PRIDOBIVANJE IN KARAKTERIZACIJA B ₄ C-Al, B ₄ C-TiB ₂ -Al IN B ₄ C-Mg KOMPOZITOV	KM-VP
12:20	Oruč Mirsada, Pihura Derviš, Mujagić Derviš University of Zenica, Metallurgical institute "Kemal Kapetanović" Zenica, B&H ON THE INFLUENCE OF DIFFERENT VACUUM TREATMENT PROCESSES ON CHANGE OF CONTENT OF SOME RESIDUAL ELEMENTS O VPLIVU RAZLIČNIH VAKUUMSKIH PROCESOV OBDELAVE NA SPREMEMBO VSEBNOSTI NEKATERIH REZIDUALNIH ELEMENTOV	VT-VP
13:00 – 15:20 ODMOR ZA KOŠILO – LUNCH		
Predsedujoči – Chair: M. Torkar, J. Šetina		
15:20	Darko Drev, Jože Panjan, Boris Kompare Institute for Waters of the Republic of Slovenia, University of Ljubljana - Faculty of Civil and Geodetic Engineering, Ljubljana, Slovenia A STUDY OF THE EFFECTS OF SPECIAL GLASS AND CERAMIC MICROBIAL BIOMASS SUPPORT MATERIALS ON THE SPEED OF BIOCHEMICAL POLLUTANT DECOMPOSITION PROCESSES IN WATER ŠTUDIJA VPLIVOV SPECIALNEGA STEKLENEGA ALI KERAMIČNEGA NOSILCA BIOMASE NA HITROST BIOKEMIJSKIH PROCESOV RAZGRADNJE NEČISTOČ V VODI	VO-GP
15:40	M. Huskić ¹ , M. Žigon ¹ , A. Sever Škapin ² , D. Mihailović ³ ¹ National Institute of Chemistry, Hajdrihova 19, Ljubljana, Slovenia, ² Slovenian National Building and Civil Engineering Institute, Dimičeva 12, Ljubljana, Slovenia, ³ Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia NANOCOMPOSITES PA12/MoSI NANOWIRES NANOKOMPOZITI PA12/MoSI NANOŽIČKE	P-GP

Govorni prispevki – Oral

16:00	Derviš Pihura ¹ , Oruč Mirsada ¹ , Lamut Jakob ² ¹ University of Zenica, Metallurgical institute "Kemal Kapetanović" Zenica, B&H, ² University of Ljubljana, FNT, Department for materials and metallurgy, Ljubljana, Slovenia	KM-GP
	ON THE PROCESS OF SELECTIVE OXIDATION OF ELEMENTS FROM THE POINT OF MANGANESE OXIDATION IN HOT METAL	
16:20	Vojteh Leskovšek Institute of Metals and Technology, Ljubljana, Slovenia	KM-GP
	DETERMINATION OF FRACTURE TOUGHNESS WITH CHARPY V-NOTCH ABSORBED ENERGY AND ROCKWELL-C HARDNESS FOR H11/H13 HOT-WORK TOOL STEELS	
16:40	Janez Šetina ¹ , Rudolf Dobrozemsky ² ¹ Institute of Metals and Technology, Lepi pot 11, SI-1000, Ljubljana, Slovenia, ² Inst. Allg. Physik, Vienna University of Technology, Wiedner Hptstr. 8-10, A-1040, Austria	VT-GP
	MODIFICATION OF VACUUM CALIBRATION SYSTEM FOR CALIBRATIONS OF PIRANI GAUGES WITH WATER VAPOR	
17:00	Borivoj Šuštaršič ¹ , Bojan Senčič ² ¹ Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia, ² Štore Steel, Železarska cesta 3, 3220 Štore, Slovenia	KM-GP
	LIFE-TIME PREDICTION OF LEAF SPRINGS BASED ON DETERMINATION OF FATIGUE BEND-STRENGTH OF NOTCHED SAMPLES OF SPRING STEEL NAPOVED DOBE TRAJANJA LISTNATIH VZMETI S POMOČJO DOLOČEVANJA UPOGIBNE TRAJNE NIHAJNE TRDNOST NA ZAREZANIH PREIZKUŠANCIH IZ VZMETNEGA JEKLA	
20:00	POSTERSKA SEKCIJA – POSTER SESSION KM, AM, P, VT, NN, VO Cocktail Party	

SREDA – WEDNESDAY 15. 10. 2008		
	Predsedujoči – Chair: A. Jaklič, M. Jenko	
8:40	Matjaž Torkar, Mirko Doberšek, Iztok Naglič Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia WORKING OF Al-ALLOYS IN SEMI-SOLID STATE PREOBLIKOVANJE Al-ZLITIN V TESTASTEM STANJU	KM-GP
9:00	Slavko Kanalec	KM-GP
9:20	Franc Tehovnik, Boris Arzenšek, Boštjan Arh, Franc Vodopivec Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia WORKABILITY OF AUSTENITIC STAINLESS STEELS PREOBLIKOVALNA SPOSOBNOST AVSTENITNIH NERJAVNIH JEKEL	KM-GP
9:40	Aleksandra Kocijan ¹ , Črtomir Donik ¹ , Monika Jenko ¹ , James A Callow ² , Maureen E Callow ² , Parnia Navabpour ³ ¹ Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia, ² School of Biosciences, The University of Birmingham, Birmingham B15 2TT, UK, ³ TEER Coatings Ltd, West Stone House, Berry Hill Industrial Estate, Droitwich, Worcestershire, WR9 9AS, UK THE CHARACTERISATION OF NANOSTRUCTURED SILICON OXIDE TYPE COATINGS DEPOSITED BY PACVD ON SI AND GLASS SUBSTRATES FOR ANTIBIOFOULING APPLICATIONS	KM-GP
10:00	Matjaž Godec Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia ELECTRON BACKSCATTER DIFFRACTION (EBSD) CHARACTERISATION OF METALS	KM-GP
10:20	ODMOR – BREAK	
	Predsedujoči – Chair: A. Jaklič, M. Jenko	
10:40	Janko Kokošar Acroni d.o.o., c. Borisa Kidrica 44, 4270 Jesenice, Slovenija ESTIMATION OF GRAIN SIZE AND TEXTURE FROM EDDY CURRENT AND HYSTERESIS LOSS DATA OCENA VELIKOSTI ZRN IN TEKSTURE IZ VRTINČNIH IN HISTEREZNIH IZGUB	KM-GP
11:00	Boštjan Pirnar SŽ Acroni d.o.o., Jesenice, Slovenia DEVELOPMENT OF LEAN DUPLEX STAINLESS STEELS RAZVOJ LEAN DUPEKSNIH NERJAVNIH JEKEL	KM-GP
11:20	Rodič Jože	KM-GP
11:40	Jure Bernetič ^{1,2} , Boštjan Bradaškja ^{1,2} , Franc Vodopivec ³ , Gorazd Kosec ¹ , Erika Bricelj ¹ , Borut Kosec ² ¹ ACRONI d.o.o., Cesta Borisa Kidriča 44, 4270 Jesenice, Slovenia, ² University of Ljubljana, Faculty of Natural Sciences and Engineering, Aškerčeva 12, 1000 Ljubljana, Slovenia, ³ Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia THE FORMATION OF NIOBIUM CARBONITRIDE EUCTECTIC IN STRUCTURAL STEEL FORMACIJA NIOBIJ KARBONITRIDEGA EVTEKTIKA V KONSTRUKCIJSKEM JEKLU	KM-GP
12:00	Zaključek konference – Closing the Conference	

POSTERSKA SEKCIJA – POSTER SESSION
TOREK – TUESDAY 14. 10. 2008 (20:00 – 22:00)

KM – KOVINSKI MATERIALI / METALLIC MATERIALS	
KM-1	Zdeněk Adolf, Tomáš Gumulec, Petr Suchánek Department of Metallurgy, FMMI, VŠB-TU Ostrava, Czech Republic MODIFICATION OF INCLUSIONS IN LADLE METALLURGY
KM-2	Boris Arzenšek ¹ , Gorazd Kosec ² , Jelena Vojvodič Tuma ¹ , Franc Tehovnik ¹ ¹ Institute of Metals and Technology, Ljubljana, Slovenija, ² ACRONI d.d., Jesenice, Slovenija BRITTLE FRACTURE STRENGTH OF A HIGH STRENGTH MICROALLOYED STEEL WITH DIFFERENT MICROSTRUCTURE KRHKA TRDNOST VISOKOTRDNEGA MIKROLEGIRANEGA JEKLA Z RAZLIČNO MIKROSTRUKTURO
KM-3	Boris Arzenšek ¹ , Franc Tehovnik ¹ , Dimitrij Kmetič ¹ , Jurij Gontarev ¹ , Iztok Naglič ¹ , Boštjan Pirnar ² , Anton Jaklič ² , Gorazd Kosec ² , Jure Bernetič ² ¹ Institute of metals and technologies, Lepi pot 11, Ljubljana, Slovenia, ² ACRONI d.d. Jesenice, Slovenia INVESTIGATION OF THE WORKABILITY OF DUPLEX STAINLESS STEEL WITH TENSILE TESTS UGOTAVLJANJE PREOBLIKOVALNIH SPOSOBNOSTI DUPLEX NERJAVNEGA JEKLA Z NATEZNIH PRESKUSOM
KM-4	Martin Balcar ¹ , Pavel Fila ¹ , Ludvík Martínek ¹ , Boris Láník ² , Václav Šmejkal ³ , Jiří Bažan ⁴ ¹ ŽDAS, a.s., Žďár nad Sázavou, Czech Republic, ² Igor Láník – Techservis Boskovice, Czech Republic, ³ Železiarne Podbrezová, a.s., Podbrezová, Slovak Republic, ⁴ VŠB TU – Ostrava, Czech Republic APPLICATION OF CERAMIC FILTERS IN INGOT CASTING PROCESS
KM-5	Jiří Bažan ¹ , Karel Stránský ² , Ludvík Martínek ³ , Martin Balcar ³ , Pavel Fila ³ ¹ Department of Metallurgy, FMMI, VŠB-TU Ostrava, Czech Republic, ² FSI, VUT Brno, Czech Republic, ³ ŽDAS, a.s., Žďár nad Sázavou, Czech Republic STEEL REOXIDATION DURING FILTRATION
KM-6	Jožica Bezjak Faculty of Education Koper, University of Primorska, Slovenia TRANSMISSION ELECTRON MICROSCOPY BASED INVESTIGATIONS OF OXIDATION BARRIER IN THE INTERNALLY OXIDIZED Ag BASED ALLOYS PREISKAVE OKSIDACIJSKE PREGRADE V NOTRANJE OKSIDIRANIH SREBROVIH ZLITINAH S POMOČJO ELEKTRONSKE MIKROSKOPIJE
KM-7	Boštjan Bradaškja ¹ , Boštjan Pirnar ¹ , Matevž Fazarinc ² ¹ ACRONI d.o.o., Cesta Borisa Kidriča 44, SI-4270 Jesenice, Slovenia, ² Faculty of natural sciences and engineering, Department of Materials and Metallurgy, University of Ljubljana, Aškerčeva 12, SI-1000 Ljubljana, Slovenia HOT WORKABILITY OF SUPERAUSTENITIC STAINLESS STEEL AISI 904L VROČA PREOBLIKOVALNOST SUPERAVSTENITNEGA NERJAVNEGA JEKLA AISI 904L
KM-8	Erika Bricelj Acroni d.o.o., c. Borisa Kidrica 44, 4270 Jesenice, Slovenija DETERMINATION OF STEEL CLEANNESS BY AUTOMATIC ANALYSIS OF INCLUSIONS ON EDS ANALYSER DOLOČANJE ČISTOČE JEKEL Z AVTOMATSKO ANALIZO VKLJUČKOV NA EDS ANALIZATORJU
KM-9	Roman Celin, Franc Vodopivec, Jelena Vojvodič Tuma, Dimitrij Kmetič, Boris Arzenšek, Borivoj Šuštaršič Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia STRAIN HARDENING EXPONENT TIME DEPENDENCE OF THERMALLY AGED CAST STAINLESS STEEL ODVISNOST EKSPONENTA UTRJEVANJA OD ČASA TERMIČNEGA STARANJA LITEGA NERJAVNEGA JEKLA

Posterska sekcija – Poster Session

KM-10	Jusuf Duraković ¹ , Jasmin Huskić ² , Jure Bernetič ^{2,3} , Diana Cubela ¹ , Borut Kosec ³ , Fuad Begovac ¹ ¹ University of Zenica, Faculty of Metallurgy and Materials, Travnička 1, 72000 Zenica, BiH, ² Acroni d.o.o., C. Borisa Kidriča 44, 4270 Jesenice, Slovenia, ³ University of Ljubljana, Faculty of Natural Sciences and Engineering, Aškerčeva 12, 1000 Ljubljana, Slovenia CEMENTATION WITH THE MIXTURE OF METHANOLE AND ACETONE IN PIT FURNACE
KM-11	M. Doberšek ¹ , J. Gontarev ² , I. Naglič ¹ ¹ Institute of metals and technology, Ljubljana, Slovenia ² Valji d.o.o. Štore, Slovenia CARBIDE IDENTIFICATION IN SEMI-HSS WITH EDS AND EBSD TECHNIQUES IDENTIFIKACIJA KARBIDOV V ZLITINI SEMI-HSS Z METODAMA EDS IN EBSD
KM-12	Denis Hren, Djordje Mandrino, Monika Jenko Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia ION SPUTTERING RATES FOR THIN OXIDE LAYER ON DUPLEX STEEL AT DIFFERENT 3 keV Ar ⁺ INCIDENCE ANGLES JEDKALNE HITROSTI ZA TANKO OKSIDNO PLAST NA DUPLEX JEKLU PRI RAZLIČNIH VPADNIH KOTIH IONOV ARGONA Z ENERGIJO 3 keV
KM-13	Stanislav Jakelj, Milan Klinar, Franci Perko, Janez Katnik, Borut Lešnik ACRONI, d.o.o., Kidričeva 44, 4270 Jesenice, Slovenija THE DEVELOPMENT OF NICKEL; ALLOYS INVAR RAZVOJ NIKLJEVIH ZLITIN – ZLITINA INVAR
KM-14	Bernarda Janet ¹ , Jure Jamer ¹ , Henrik Kaker ¹ , Vlado Perovnik ¹ ¹ Metal Ravne d.o.o. Koroška cesta 14, 2390 Ravne na Koroškem, Slovenija TURBINE BLADE STEELS AND TECHNOLOGY OPTIMIZATION FOR ROLLED QUENCHED AND TEMPERED SECTIONS PK3 (X20Cr13) JEKLA ZA TURBINSKE LOPATICE TER OPTIMIRANJE TEHNOLOGIJE VALJANIH POBOLJŠANIH PROFILOV PK3 (X20Cr13)
KM-15	Dimitrij Kmetič ¹ , Jelena Vojvodič Tuma ¹ , Roman Celin ¹ , Mojca Šolar ² , Franc Punčuh ³ ¹ Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia, ² Elektrode Jesenice, d.o.o., C. železarjev 8, 4270 Jesenice, Slovenia, ³ Esotech d.d., Preloška 1, 3320 Velenje, Slovenia COMPARISON OF THE FILLER MATERIALS FOR P91 STEEL WELDING PRIMERJAVA DODAJNIH MATERIALOV ZA VARJENJA JEKLA P91
KM-16	Aleksandra Kocijan, Črtomir Donik, Monika Jenko Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia THE CORROSION BEHAVIOUR OF AUSTENITIC AND DUPLEX STAINLESS STEELS IN ARTIFICIAL SALIVA
KM-17	Ažbe Križaj ¹ , Monika Jenko ¹ , Peter Fajfar ² , Martin Jeram ³ ¹ Institut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija ² Univerza v Ljubljani, NTF, Oddelek za materiale in metalurgijo, Aškerčeva 12, 1000 Ljubljana, Slovenija ³ ACRONI, d. o. o., Jesenice, Slovenija VPLIV TEKSTURE NA KONČNE ELEKTROMAGNETNE LASTNOSTI ELEKTROPLOČEVIN
KM-18	Tomáš Kroupa, Robert Zemčík, Jan Klepáček Faculty of Applied Sciences, Department of Mechanics, University of West Bohemia, Univerzitní 8, 306 14 Plzeň, Czech Republic TEMPERATURE DEPENDENCE OF PARAMETERS OF NON-LINEAR STRESS-STRAIN RELATIONS FOR CARBON-EPOXY COMPOSITES
KM-19	Nataša Lipovšek, Matjaž Godec, Monika Jenko, Dimitrij Kmetič Institute of Metals and Technology, Ljubljana, Slovenia PREPARATION OF SAMPLE SURFACES FOR SCANNING ELECTRON MICROSCOPY AND ELECTRON BACKSCATTERED DIFFRACTION ANALYSIS PRIPRAVA POVRŠIN VZORCEV NAMENJENIH VRSTIČNI ELEKTRONSKI MIKROSKOPIJI IN EBSD ANALIZI

Posterska sekcija – Poster Session

KM-20	Djordje Mandrino, Črtomir Donik, Monika Jenko Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia AES AND XPS OF THIN OXIDE LAYERS ON METALLIC SURFACES SPEKTROSKOPIJA AUGERJEVIH ELEKTRONOV IN RENTGENSKA FOTOELEKTRONSKA SPEKTROSKOPIJA TANKIH OKSIDNIH PLASTI NA KOVINSKIH POVRŠINAH
KM-21	Bernard Marini Commissariat à l’Energie Atomique, DEN/DANS/DMN/SRM, 91191 Gif-sur-Yvette, Cedex, France MODELLING OF THE FRACTURE SCATTER OF AGED DUPLEX STAINLESS STEELS
KM-22	Darja Oblak Metal Ravne d.o.o., Koroška c. 14, 2390 Ravne na Koroškem, Slovenija COMPARISSON OF LEDEBURITIC TOOL STEELS OCR12VM, OCR12SP AND OCR12SPW FROM THE PRODUCTION PROGRAMME OF METAL RAVNE d.o.o. PRIMERJAVA LEDEBURITNIH ORODNIH JEKEL OCR12VM, OCR12SP IN OCR12SPW IZ PROIZVODNEGA PROGRAMA METALA RAVNE d.o.o.
KM-23	Pavel Podaný, Libor Kraus COMTES FHT s.r.o. – Průmyslová 995, Dobřany, Czech Republic NICKEL SUPERALLOYS’ MICROSTRUCTURAL CHANGES CAUSED BY FORMING
KM-24	Danijela Anica Skobir ¹ , Matjaž Godec ¹ , Monika Jenko ¹ , Jure Bernetič ² ¹ Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija, ² ACRONI, d.o.o., C. Borisa Kidriča 44, 4270 Jesenice, Slovenija ANALYSIS OF CHEMICAL COMPOSITION OF CARBONITRIDE PARTICLES PRECIPITATED DURING THE SOLIDIFICATION OF HSLA STEEL ANALIZA KEMIJSKE SESTAVE KARBONITRIDNIH IZLOČKOV, KI PRECIPITIRAJO MED STRJEVANJEM HSLA JEKLA
KM-25	Darja Steiner Petrovič ¹ , Monika Jenko ¹ , Anton Jaklič ² , M. Pirnat ² ¹ Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, ² ACRONI Ltd., Kidričeva 44, 4270 Jesenice, Slovenia MAGNESIUM IN THE NON-METALLIC INCLUSIONS OF THE NON-ORIENTED ELECTRICAL STEEL SHEETS MAGNEZIJ V NEKOVINSKIH VKLJUČKIH NEORIENTIRANE ELEKTRO PLOČEVINE
KM-26	1, Boris Arzenšek ¹ , Roman Celin ¹ , Boštjan Arh ¹ , Dimitrij Kmetič ¹ , Boštjan Pirnar ² ¹ Inštitut za kovinske materiale in tehnologije, Lepi pot 11, SI-1000 Ljubljana, Slovenija, ² ACRONI Jesenice, Slovenija RECRYSTALLIZATION OF SUPERAUSTENITIC STAINLESS STEEL REKRISTALIZACIJA SUPERAUSTENITNIH NERJAVNIH JEKEL
KM-27	Matjaž Torkar, Matjaž Godec, Martin Lamut Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenia INVESTIGATION OF ANODIZED LAYER ON ALUMINIUM PREISKAVA ANODIZIRANE PLASTI NA ALUMINIJU
KM-28	Franc Vodopivec, Jelena Vojvodič-Tuma, Dimitrij Kmetič Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia EFFECT OF CHANGE OF CARBIDE PARTICLE DISTRIBUTION ON ACCELERATED CREEP RATE OF THE STEEL X20 VPLIV SPREMEMBE PORAZDELITVE KARBIDNIH IZLOČKOV NA HITROST POSPEŠENEGA LEZENJA JEKLA X20
KM-29	Jelena Vojvodič-Tuma, Dimitrij Kmetič, Franc Vodopivec Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia ON THE CREEP RESISTANCE OF WELDS O ODPORNOSTI ZVARNIH SPOJEV PROTI LEZENJU

Posterska sekcija – Poster Session

KM-30	<p>J. Vojvodič Tuma¹, B. Šuštaršič¹, F. Vodopivec¹, N. Gubelj², B. Marini³, B. Glaser⁴, M. Jenko¹ ¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija, ²Univerza v Mariboru, Smetanova 17, 2000 Maribor, Slovenija, ³Commissariat à l'énergie atomique, Centre de Saclay-91191, Gif-sur-Yvette Cedex, France, ⁴Nuklearna elektrarna Krško, Vrblina 12, 8270 Krško, Slovenija</p> <p>MODELLING OF THE RELATION TOUGHNESS, HARDNESS AND TENSILE PROPERTIES FOR TWO-PHASE Fe-NiCrMo CAST STAINLESS ALLOYS MODELIRANJE ODVISNOSTI MED ŽILAVOSTJO, TRDOTO IN RAZTRŽNIMI LASTNOSTMI PRI DVOFAZNIH Fe-NiCrMo LITIH NERJAVNIH ZLITIN</p>
KM-31	<p>J. Vojvodič Tuma¹, Š. Hozjan², J. Mahnič³ ¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija, ²Nafta Strojna d. o. o., Mlinska ulica 5, 9225 Lendava, Slovenija, ³Luka Koper d. d., Vojkovo nabrežje 38, 6000 Koper, Slovenija</p> <p>CONSTRUCTION OF RESERVOIR FOR JET FUEL IN LUKA KOPER GRADNJA REZERVOARJEV ZA LETALSKO GORIVO V LUKI KOPER</p>
KM-32	<p>Franc Zupan¹, Marjan Kunšič¹, Gorazd Kosec¹, Jure Bernetič^{1,2}, Robert Robič^{2,1}, Stanko Grbič¹, Janko Kokošar¹, Borut Kosec², Iztok Šušteršič^{2,1} ¹ACRONI d.o.o., Cesta Borisa Kidriča 44, 4270 Jesenice, Slovenia, ²University of Ljubljana, Faculty of Natural Sciences and Engineering, Aškerčeva 12, 1000 Ljubljana, Slovenia</p> <p>NEW STAINLESS STEEL HEAVY PLATES SOLUTION ANNEALING LINE LINIJA ZA TOPLOTNO OBDELAVO NERJAVNE DEBELE PLOČEVINE</p>
KM-33	<p>Tadej Kokalj Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia</p> <p>AES INVESTIGATIONS OF METAL FIBERS AES RAZISKAVE KOVINSKIH VLAKEN</p>

AM – ANORGANSKI MATERIALI / INORGANIC MATERIALS

AM-1	<p>Marjan Marinšek Univerza v Ljubljani, Fakulteta za kemijo in kemijsko tehnologijo, Aškerčeva 5, Ljubljana, Slovenija</p> <p>MODELLING OF ELECTRICAL PROPERTIES OF LSM CERAMICS MODELIRANJE ELEKTRIČNIH LASTNOSTI LSM KERAMIKE</p>
AM-2	<p>Željko Pogačnik¹, Jernej Pavšič², Anton Meden³ ¹Salonit Anhovo, gradbeni materiali, d.d., Vojkova 1, 52120 Deskle, Slovenija, ²Naravoslovnotehniška fakulteta, oddelek za geologijo, Privoz 11, 1000 Ljubljana, Slovenija, ³Fakulteta za kemijo in kemijsko tehnologijo, Aškerčeva cesta 5, 1000 Ljubljana, Slovenija</p> <p>VPLIV GEOLOŠKEGA ZAPISA NA TERMIČNE LASTNOSTI LAPOROVCEV V TEMPERATURNEM OBMOČJU DEKARBONATIZACIJE</p>
AM-3	<p>Klementina Zupan, Marjan Marinšek Faculty of Chemistry and Chemical Technology, University of Ljubljana, Aškerčeva 5, 1000 Ljubljana, Slovenia</p> <p>COMBUSTIBLE PRECURSOR BEHAVIOR IN THE LANTHANUM CHROMITE FORMATION PROCESS TERMIČNE LASTNOSTI REAKCIJSKEGA GELA ZA PRIPRAVO LANTANOVEGA KROMITA</p>

P – POLIMERI / POLYMERS

P-1	Robert Zemčík, Radek Kottner, Vladislav Laš, Tomáš Plundrich Faculty of Applied Sciences, Department of Mechanics, University of West Bohemia, Univerzitní 8, 306 14 Plzeň, Czech Republic IDENTIFICATION OF MATERIAL PROPERTIES OF QUASI- UNIDIRECTIONAL CARBON-EPOXY COMPOSITE USING MODAL ANALYSIS
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VT – VAKUUMSKA TEHNIKA / VACUUM TECHNIQUE

VT-1	Bojan Erjavec, Janez Šetina Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia STATIC SORPTION METHOD FOR CHARACTERISATION OF NON-EVAPORABLE GETTERS STATIČNA SORPCIJSKA METODA ZA KARAKTERIZACIJO NENAPARLJIVIH GETROV
VT-2	Igor Belič, Bojan Erjavec Institute of metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia THE SIMULATED ENVIRONMENT FOR MASS SPECTRA RECOGNITION SIMULACIJSKO OKOLJE ZA RAZPOZNAVANJE MASNIH SPEKTROV
VT-3	Alenka Vesel ¹ , Miran Mozetič ¹ , Simona Strnad ² , Zdenka Peršin ² , Karin Stana-Kleinschek ² , Nina Hauptman ³ ¹ Jožef Stefan Institute, Jamova 39, 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 MODIFICATION OF CELLULOSE FIBERS BY PLASMA TREATMENT MODIFIKACIJA CELULOZNIH VLAKEN S PLAZEMSKO OBDELAVO

NN – NANOMATERIALI IN NANOTEHNOLOGIJE – NANOMATERIALS AND NANOTECHNOLOGY

NN-1	M. Godec ¹ , M. Remškar ² , A. Jesih ² , A. Mrzel ² , M. Viršek ² , M. Jenko ¹ ¹ Institute of Metals and Technology, Ljubljana, Slovenia, ² Jožef Stefan Institute, Ljubljana, Slovenia NANO-CHEMICAL ANALYZES OF MoS ₂ MAMA-TUBES NANO-KEMIČNA ANALIZA MoS ₂ "MAMA-CEVK"
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VO – VARSTVO OKOLJA – ENVIRONMENTAL PROTECTION

VO-1	Alenka Lenart ¹ , Andrej Gosar ^{2,3} ¹ Jožef Stefan Institute, Ljubljana, Slovenia, ² Environmental Agency of Slovenia, Seismology and Geology Office, Ljubljana, Slovenia, ³ University of Ljubljana, Faculty of Natural Sciences and Engineering, Ljubljana, Slovenia MICROTREMOR STUDIES TO DETERMINE THE THICKNESS OF THE SEDIMENTS RAZISKAVE Z MIKROTREMORJI ZA DOLOČITEV DEBELINE SEDIMENTOV
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**1. MEDNARODNA KONFERENCA O MATERIALIH IN
TEHNOLOGIJAH POD POKROVITELJSTVOM FEMS IN IUUSTA**

13.–15. oktober 2008, Kongresni center Bernardin, Portorož, Slovenija

**1st INTERNATIONAL CONFERENCE ON MATERIALS AND
TECHNOLOGY SPONSORED BY FEMS AND IUUSTA**

13–15 October 2008, Convention Centre Bernardin, Portorož, Slovenia

KNJIGA POVZETKOV

BOOK OF ABSTRACTS

VT-VP

SPECIAL ASPECTS OF VACUUM GAUGE CALIBRATION

Rudolf Dobrozemsky
Vienna University of Technology,
Wiedner Hauptstrasse 8-10, A-1040 Vienna, Austria

For the calibration of pressure reading vacuum instruments, in-situ methods offer a significant advantage over conventional procedures. In addition, some in-situ methods also allow the determination of the effective pumping speed. By this means, even flow-rate and gas-amount measurements can be calibrated, thus significantly improving the accuracy of the latter which are essential for many practical cases.

In the first part of this presentation, several in-situ calibration methods are discussed. Besides the rather simple case of non-adsorbing gases (e.g., noble gases), special attention is drawn to the quantitative measurement of gases and vapors that exhibit strong adsorption, in particular, species such as water and oil vapor. The calibration methods presented are based either on the dynamic expansion of gases and vapors or on a molecular beam method. In the first case, gas quantities are defined by the readings of a capacity diaphragm gauge in a small chamber with known volume or, in case of water vapor, by thermal decomposition of gypsum crystals. For the second case, calibration of silicone-oil vapor with a molecular weight of up to 100,000 u, a LN₂-cooled quartz microbalance is employed. The second part of this presentation deals with the calibration of partial pressure gauges, in particular, quadrupole mass spectrometers. For this class of instruments, it is primarily not the absolute calibration but rather the quantitative spectrum decomposition that has to be dealt with. It will be shown that the components of a residual gas spectrum can be evaluated with an accuracy in the order of a few percent. For the achievement of this goal, regular and careful calibration of the cracking patterns is an indispensable prerequisite.

P-VP

THE CONTROL OF BIOFOULING: PAST, PRESENT AND FUTURE CHALLENGES

Maureen E Callow

School of Biosciences, University of Birmingham, B15 2TT, UK

Biological fouling (biofouling) is the accumulation of microorganisms, plants and animals on surfaces. All structures in marine and freshwater environments (ship hulls, membrane filters, heat exchangers, instruments, aquaculture systems) are subject to aggressive biofouling, which has consequences for efficient operation, safety and the environment and is economically costly. Examples of biofouling across a range of industries will be given. Particular reference will be made to the fouling of ship hulls, which has been recognised as a problem from ancient times. The development of strategies to control biofouling on ship hulls will be reviewed.

P-VP

PROGRESS IN NANOSTRUCTURING SURFACES FOR THE CONTROL OF MARINE BIOFOULING: THE AMBIO PROJECT

James Callow

School of Biosciences, University of Birmingham, B15 2TT, UK

Fouling of a surface by marine organisms is the outcome of the molecular interfacial processes involving the polymeric adhesives produced by the organisms, and the substrates to which they attach. This adhesion is influenced by the physico-chemical properties of a surface such as surface energy, charge, conductivity, porosity, roughness, wettability, friction, physical and chemical reactivity, all of which are influenced by the surface nanostructure. The advent of nanotechnology has created new opportunities for scientists to manipulate and understand the nanoscale properties of coatings. The AMBIO project ('Advanced Nanostructured Surfaces for the Control of Biofouling') was therefore set up to explore the potential of these new technologies for creating conceptually novel coatings for the control of aquatic fouling, without the use of biocides. AMBIO is a 5-year project incorporating 31 Partners drawn from a wide range of disciplines, and receives a budget of €11.9M from the EC's 6th Framework programme. The project started in March 2005 and has completed the 'experimental' phase during which the main aim has been to develop a range of conceptually diverse, well-characterised nanostructured coatings and to evaluate these for their intrinsic anti-fouling and fouling-release properties through a range of bioassays. Those showing most promise have been selected for scale-up and formulation as coatings to be tested in field assays representative of a range of end-user applications where fouling is a problem. The purpose of this presentation is to outline the research strategy of the project, to explain the main strands of research effort and to explore the emerging results.

KM-VP

APPLICATION OF GRIDLESS ION SOURCE TECHNOLOGY IN SURFACE ENGINEERING

Wolfgang Waldhauser¹, Markus Kahn*¹, Harald Parizek¹, Bettina Raninger¹, Miha Cekada²,
Thomas Schöberl³, Roswitha Berghauser¹, Christian Mitterer⁴, Elmar Brandstätter¹

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³Erich Schmid Institute of Materials Science of the Austrian Academy of Sciences, Jahnstrasse 12, A-8700
Leoben, Austria

⁴University of Leoben, Department of Physical Metallurgy and Materials Testing, Franz-Josef Straße 18,
8700-Leoben Austria

The paper presents newest data from the application of gridless ion source technology in surface engineering – in particular for substrate pre-treatment and direct deposition of hydrogenated tetrahedral diamond-like carbon films (ta-C:H).

In the scientific field, mainly gridded ion sources are applied, which have a high degree of complexity and require substantial maintenance to operate due to the limited lifetime of grids and the electron source. Thus, they are scarcely applicable for industrial processes. As an alternative, gridless ion sources offer an elegant solution to ion beam production.

One type of gridless ion source is the so-called anode layer source (ALS) which was used in this work for pre-treatment of different types of steel prior PVD coating at room temperature as well as for direct deposition of ta-C:H films.

The effect of the plasma treatment was investigated by contact angle measurements and microscopic investigations of the substrate surfaces. The adhesion of sputtered TiN coatings was measured by scratch test, the residual stress of the coatings was determined by XRD. The highest increase of the film adhesion was observed for hard substrates. Best results were found for medium ion energies of approximately 1000 eV. The increase of the film adhesion correlates with a decrease of the residual stresses in the films.

For coating applications the ALS was fed with acetylene to deposit highly defect free ta-C:H films at room temperature. The study focuses on the influence of the process parameters: discharge voltage, process pressure and acetylene flow on the properties of the deposited films. The structure of the films was investigated by Raman spectroscopy and the mechanical properties were investigated by nanoindentation. The residual stresses in the films were determined by employing the curvature method.

In general, the films are becoming higher in C-C sp³ content while lowering the voltage applied to the ALS in the investigated area from 3 kV to 1 kV.

VO-VP

ENVIRONMENTAL CATALYSIS FROM NANO- TO MACRO-SCALE

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In today's highly sensitive ecosystem, environmental protection is a great challenge to be faced by industry, with regulations becoming more restrictive in the future. Advanced oxidation processes (AOPs) – or technologies (AOTs) – are promising end-line solutions for waste water treatment, involving liquid-phase oxidation of pollutants by means of highly reactive species, such as hydroxyl radicals. In general, installation costs of AOPs are comparable with the ones associated to biological treatments; however, operating costs of AOPs are higher due to the use of costly chemicals. Development of tailored materials as highly active catalysts is a key approach to scale-up cost-effective environmental technologies, minimizing the needs in chemicals and increasing the level of treatment obtained. Conventional AOPs include photocatalysis, wet oxidation, Fenton process, sonolysis and ozonation. Each technology requires a different catalytic material as well as the optimization of their catalytic properties. This presentation will be an overview of some of the recent advances in the field of environmental catalysis engineering from the nano-scale (regarding functionalized surfaces, nanoparticles and molecules) to the macro-scale (focusing on real case applications of heterogeneous catalytic materials).

KM-MR

AN ANALYSIS OF CREEP BEHAVIOUR OF 9Cr-1Mo-0.2V STEEL

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Creep behaviour of 9Cr-1Mo-0.2V steel under short-term creep tests cannot be accurately described by simple Arrhenius-type power law model since the apparent stress exponent n , defined as $(\partial \ln \dot{\epsilon}_{\min} / \partial \ln \sigma)_T$, shows strong temperature dependence, whereas the apparent activation energy of creep Q_c , defined as $(\partial \ln \dot{\epsilon}_{\min} / \partial (-1/RT))_\sigma$ shows strong stress dependence. The problem of description of creep behaviour of the examined steel was first dealt with the application of threshold stress concept, i.e. introduction of threshold stress σ_{th} below which the creep deformation is assumed to be negligible. The equation which satisfactorily describes the creep behaviour of examined steel has been derived. However, it has come out that threshold stress σ_{th} strongly depends on temperature and/or applied stress and sometimes it can even change its sign. The low value of calculated activation energy of creep, which is only 185 kJ mol⁻¹ is considerably smaller than the activation energy for self-diffusion in Fe- α . Therefore, a power-law, stress-dependent activation energy model has been theoretically developed for description of creep behaviour of 9Cr-1Mo-0.2V steel. The main improvement according to the standard model is based on hypothesis that the application of stress also affects the activation energy, i.e. the energy barrier that needs to be overcome when a local region transitions, and not just the potential energy of the initial and final local states. By applying this model for description of creep behaviour of 9Cr-1Mo-0.2V steel a very good correlation between calculated and experimental data has been obtained. However, the apparent activation energy Q_c shows less stress dependence, while the stress exponent n is independent of temperature.

ANALIZA LEZENJA JEKLA 9Cr-1Mo-0,2V

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Vedenje jekla 9Cr-1Mo-0,2V pri kratkotrajnih preizkusih lezenja ni mogoče opisati z navadnim potenčnim zakonom Arrheniusovega tipa, saj je izmerjen napetostni eksponent n , definiran kot $(\partial \ln \dot{\epsilon}_{\min} / \partial \ln \sigma)_T$, zelo odvisen od temperature, izmerjena navidezna aktivacijska energija lezenja Q_c , definirana kot $(\partial \ln \dot{\epsilon}_{\min} / \partial (-1/RT))_\sigma$, pa od napetosti. Problema opisa vedenja tega jekla pri lezenju smo se najprej lotili z uporabo koncepta napetostnega praga (*threshold stress*), to je z uvedbo mejne napetosti, pod katero je lezenje zanemarljivo. Izpeljali smo enačbo, ki sicer dobro opiše vedenje jekla pri lezenju, vendar pa se je izkazalo, da je mejna napetost σ_{th} močno odvisna od temperature in/ali uporabljene napetosti ter celo spreminja predznak. Nizka vrednost izračunane navidezne aktivacijske energije lezenja Q_c , ki je dosegla le 185 kJ mol⁻¹, kar je celo manj od aktivacijske energije za samodifuzijo v Fe- α . Zato smo za opis vedenja jekla 9Cr-1Mo-0,2V pri lezenju teoretično razvili nov model potenčnega zakona lezenja z napetostno odvisno aktivacijsko energijo. Bistvena izboljšava glede na standardni model temelji na hipotezi, po kateri delujoča napetost neposredno vpliva tudi na aktivacijsko energijo oziroma na energijsko pregrado, ki jo je treba pri aktiviranju mehanizmov premagati, in ne samo na potencialno energijo začetnega in končnega stanja mikrostrukturnih območij, v katerih se lezenje odvija. Pri uporabi tega modela za opis lezenja dobimo dobro ujemanje med izračunanimi in eksperimentalnimi vrednostmi. Navidezna aktivacijska energija Q_c postane le še nekoliko odvisna od napetosti, napetostni eksponent n pa je neodvisen od temperature.

KM-MR

TOWARDS AUTOMATIC CONTROL OF SLAB-REHEATING IN PUSHER-TYPE
FURNACE IN ACRONI d.o.o.

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In hot-rolling plant of ACRONI d.o.o. steelwork steel slabs are reheated in a pusher-type furnace. Application of slab-reheating control (level 2) of pusher-type furnace in ACRONI is underway, here we present its concept, main features and technical solutions.

The furnace is equipped with on-line mathematical model of slab reheating process, which is the cornerstone of model-based slab-reheating process. The model calculates distributed slab temperature, which enables slab-temperature control according to the desired reheating parameters. The model is firstly used off-line for determination of reference reheating curves (RRCs), which are stored in a table of MySQL database. The RRC for cold slab charging are determined by simulation of mathematical model, where reheating parameters are set as prescribed by technological rules. The RRC for higher initial temperatures (100, 150, 200, ...)°C are determined using developed furnace control system. The RRC for both, cold and hot charging, consider furnace geometry as well as furnace limitations. The furnace zone-temperature limitations are considered in this phase as well as during on-line control. The RRC for each charging type is defined separately for virtually 'lower' and 'upper' half of slab. Tracing of RRC of each slab is obtained by dynamically setting appropriate reference of level 1 zone-temperature regulators in all zones. Drop out interval is feed-forwarded dynamically in that way, that each slab finishes reheating according to its RRC at a time, when it is discharged from the furnace, and where beside this are considered all kind of delays in production line including delays due to synchronization with rolling mills. The main feature of the used slab-reheating system is that it enables closed-loop slab-temperature control according to the predefined RRC during normal operation as well as during all kind of delays.

The control system is implemented using C programming language, MySQL C-API for accessing MySQL database, altogether running on standard PC with SuSE linux operating system. The data transfer from main process computer to slab-reheating-control-system computer and vice-versa are TCP/IP sockets, which demonstrated fast and reliable data transfer during tests.

NN-MR

RHEOLOGICAL PROPERTIES OF FERROFLUIDS

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Stable colloid suspensions of superparamagnetic nanoparticles, so-called ferrofluids, are very interesting for technological, as well as for biomedical applications. In addition to the magnetic properties, the rheological behaviour of ferrofluids in the presence of a magnetic field is very important for their applications. When ferrofluids are exposed to a magnetic field, a magneto-rheological effect can be observed as an increase of the suspension's viscosity, and the dispersed particles in the ferrofluid form chain-like agglomerates. These agglomerates hinder the shearing of the fluid and in this way they increase the viscosity of the ferrofluid. The change in the viscosity mainly depends on the quantity, the size and the magnetic properties of the dispersed magnetic nanoparticles.

In the present work the rheological properties of ferrofluids as a function of the applied magnetic field were measured. The measurements were made with an Anton Paar Physica MCR 301 rheometer equipped with a MRD 180/1T magneto-rheological cell. The changes in the inner structure of the ferrofluids during the shearing were monitored with the storage modulus, G' , and the loss modulus, G'' . The first modulus is a measure of the stored energy and the second one a measure of the lost energy. Without the influence of a magnetic field there is no magnetic attraction between the superparamagnetic nanoparticles. The nanoparticles are dispersed randomly and the ferrofluid behaves as a viscoelastic liquid, *i.e.*, as a sol, with $G' < G''$. When the ferrofluid is exposed to the magnetic field, the magnetic attraction between the neighbouring nanoparticles is generated, which leads to the formation of chain-like agglomerates. These agglomerates increase the amount of stored energy and the ferrofluid changes to a viscoelastic solid, *i.e.*, a gel, with $G' > G''$. With a further increase of the magnetic field the magnetic attraction occurs between the nanoparticles at larger distances. The chain-like agglomerates transform into globular agglomerates and the ferrofluid changes from the gel back to the sol.

Special attention was devoted to the magnetic field strength at which the transition from the gel to the sol occurs. This transition is an indication of the stability of the ferrofluid in the magnetic field.

REOLOŠKE LASTNOSTI MAGNETNIH TEKOČIN

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Stabilne koloidne suspenzije superparamagnetnih nanodelcev oz. magnetne tekočine so zanimive za uporabo tako v tehnološke kot tudi biomedicinske namene. Poleg magnetnih lastnosti, so za njihovo uporabo pomembne tudi reološke lastnosti v magnetnem polju. Pri magnetnih tekočinah je opazen magneto-reološki pojav – to je pojav, ko se magnetnim tekočinam v prisotnosti magnetnega polja zviša viskoznost. Ko magnetno tekočino izpostavimo magnetnemu polju, se dispergirani delci uredijo v verigam podobne aglomerate. S tem se omeji gibanje tekočine in kar privede do zvišanja viskoznosti. Sprememba v viskoznosti magnetnih tekočin je odvisna od količine dispergirane magnetne faze in njenih magnetnih lastnosti.

V pričujočem delu smo merili reološke lastnosti različnih magnetnih tekočin v odvisnosti od jakosti magnetnega polja. Meritve so bile opravljene z reometrom Anton Paar Physica MCR 301 opremljenim z magneto-reološko celico MRD 180/1T. Spremembe v notranjih strukturi magnetnih tekočinah med obremenitvijo smo zasledovali z dvema moduloma. Prvi modul G' je merilo za shranjeno energijo, drugi modul G'' pa merilo za izgubljeno energijo. Izven magnetnega polja med superparamagnetni nanodelci ni magnetnega privlaka. Nanodelci so porazdeljeni naključno in magnetna

tekočina se obnaša kot visko-elastična tekočina oz. sol, pri čemer je $G' < G''$. Ko magnetno tekočino izpostavimo magnetnemu polju, se med sosednjimi superparamagnetni nanodelci ustvari magnetni privlak, kar privede do nastanka verigam podobnih aglomeratov. Ti aglomerati povečajo delež shranjene energije in magnetna tekočina se spremeni v visko-elastično trdo snov oz. gel, pri čemer je $G' > G''$. Pri nadaljnjem večanju magnetnega polja se ustvari magnetni privlak tudi med nanodelci, ki niso v neposredni bližini. Verigam podobni aglomerati se preuredijo v globularne aglomerate in magnetna tekočina se iz gela spremeni nazaj v sol.

Posebno pozornost smo namenili jakosti magnetnega polja pri kateri pride do spremembe iz gela v sol, kar nakazuje na mejo stabilnosti magnetne tekočine v magnetnem polju.

AM-MR

THE STRUCTURAL AND ELECTRICAL PROPERTIES OF A SOLID SOLUTION
BASED ON $\text{Na}_{0.5}\text{Bi}_{0.5}\text{TiO}_3\text{-K}_{0.5}\text{Bi}_{0.5}\text{TiO}_3$

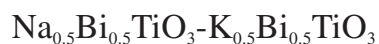
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Piezoelectric materials are used in many electronic devices, although most are based on lead, which has a negative impact on the environment. Therefore, the search for new materials for electronic applications has turned to lead-free ceramics. Previous studies have shown that an appropriate alternative to piezoelectric materials containing lead could be a solid solution of sodium-potassium bismuth titanate NBT-KBT [$x\text{Na}_{0.5}\text{Bi}_{0.5}\text{TiO}_3\text{-(1-x)}\text{K}_{0.5}\text{Bi}_{0.5}\text{TiO}_3$]. This piezoelectric material has a complex perovskite structure and exhibits ferroelectric properties across a wide temperature range. At room temperature pure NBT crystallizes in a tetragonal symmetry, whereas pure KBT crystallizes in a rhombohedral symmetry. At certain ratios of the primary constituents, NBT and KBT, the structure of the solid solution is defined by a morphotropic phase, showing both tetrahedral and rhombohedral structural features.

Ceramics of [$x\text{NBT}\text{-(1-x)}\text{KBT}$] in the compositional range from $x = 0.5$ to $x = 1$ were synthesized using the solid-state reaction method in the temperature range 1070–1100 °C. The crystal structures and the microstructures of the samples were characterized by X-ray powder diffraction, scanning electron microscopy and thermal analyses, which confirmed the pre-determined crystal structure and showed the presence of a secondary phase. The ferroelectric, dielectric and piezoelectric properties of the materials were measured at different electric fields, at various frequencies and at different temperatures. We observed that the values for the remanent polarization, the dielectric constant and the piezoelectric coefficient increase towards the NBT-rich side of the solid solution, reaching the maximum values at a defined ratio of NBT to KBT, after which they gradually decrease with an increasing content of NBT. Just the opposite was found to be true for the phase-transition temperature, which decreased towards the NBT-rich side and increased towards both ends of the solid solution.

STRUKTURNE IN ELEKTRIČNE LASTNOSTI TRDNE RAZTOPINE NA OSNOVI



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Piezoelektrični materiali se uporabljajo v številnih elektronskih napravah, čeprav je večina zasnovana na spojinah, ki vsebujejo svinec. Le-ti so iz okoljskega vidika človeku neprijazni. Zato so raziskave novih materialov usmerjene v razvoj piezomaterialov, ki ne vsebujejo svinca. Predhodne študije so pokazale, da trdna raztopina natrij – kalij bizmut titanata NBT-KBT [$x\text{Na}_{0.5}\text{Bi}_{0.5}\text{TiO}_3\text{-(1-x)}\text{K}_{0.5}\text{Bi}_{0.5}\text{TiO}_3$] predstavlja možno alternativo materialom na osnovi svinca. Značilno za NBT-KBT trdne raztopine je, da imajo kompleksno perovskitno strukturo, pa vendar izkazujejo feroelektrične lastnosti v širokem temperaturnem intervalu. Pri sobni temperaturi NBT kristalizira v romboedrični simetriji, medtem ko KBT kristalizira v tetragonalni simetriji. V določenem razmerju komponent NBT in KBT je struktura trdne raztopine določena kot morfotropna faza, ki kaže tako na tetragonalno kot tudi na romboedrično simetrijo.

Keramike na osnovi trdne raztopine [$x\text{NBT}\text{-(1-x)}\text{KBT}$] z vrednostmi x od 0,5 do 1 smo sintetizirali z reakcijskim sintranjem v trdnem pri temperaturah od 1070 °C do 1100 °C. Vzorce pripravljenih sestav smo karakterizirali z rentgensko praškovno difrakcijo, vrstično elektronsko mikroskopijo in termično analizo. Ugotovili smo, da se kristalna struktura sklada z do sedaj objavljenimi literaturnimi navedbami. Identificirali smo tudi prisotnost sekundarne faze. Feroelektrične, dielektrične in piezoelektrične lastnosti keramik smo merili pri različnih vrednostih električnega polja, frekvencah in temperaturah. Ugotovili smo, da vrednosti remanentne polarizacije, dielektrične konstante in piezoelektričnega koeficienta naraščajo z naraščajočo vsebnostjo NBT v trdni raztopini NBT-KBT in dosežejo najvišje vrednosti pri natančno določenem razmerju med NBT in KBT. Pri nadaljnjem višanju vsebnosti NBT vrednosti padajo. Temperatura faznega prehoda kaže obratno obnašanje, in sicer pada z višanjem vsebnosti NBT in narašča proti obema skrajnima komponentama, NBT in KBT.

NN-MR

PROCESSING AND DIELECTRIC PROPERTIES OF $\text{KTa}_{0.6}\text{Nb}_{0.4}\text{O}_3$ THIN FILMS ON ALUMINA

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Ferroelectric materials are promising candidates for applications in tunable high-frequency devices because of their high dielectric permittivity, relatively low dielectric loss, and their non-linear dependence of permittivity on the applied electric field, i.e. tunability n , defined as the ratio of the capacitance at 0 V to the capacitance at some non-zero voltage. High voltages needed for efficient tuning of bulk ferroelectric materials and miniaturization requirements stimulate the research of tunable ferroelectrics in the form of thin films with thicknesses of a few 100 nm [Tagantsev et al., 2003].

$\text{KTa}_{0.6}\text{Nb}_{0.4}\text{O}_3$ thin films on alumina substrates were prepared by Chemical Solution Deposition from potassium acetate and transition metal ethoxides, in stoichiometric ratio or with 10 mole % excess of potassium. The 0.4 M sols were prepared by reacting the starting compounds in 2-methoxyethanol with 24 h of reflux, followed by distillation to remove the by-products.

Thin films, prepared from the sols with 10 % excess of potassium, crystallize in perovskite phase after heating at 900 °C, while the films, prepared from the stoichiometric sols, consist of perovskite, pyrochlore and traces of secondary phase, which we attribute to loss of potassium oxide due to sublimation.

Planar Cr/Au electrodes with 3 μm gaps were patterned by photolithography and the dielectric permittivity was calculated using the partial capacitance model [Vendik et al., 1999]. The values of dielectric permittivity and tunability (C_{0V}/C_{60V}) of 240 nm thick perovskite thin films at 1 MHz are 1550 and 3.3, respectively. Temperature and frequency dependence of the dielectric permittivity indicate relaxor-type behavior of KTN thin films, are consistent with results reported for bulk KTN ceramics [Venkatesh et al., 2005].

PRIPRAVA IN DIELEKTRIČNE LASTNOSTI TANKIH PLASTI $\text{KTa}_{0.6}\text{Nb}_{0.4}\text{O}_3$ NA PODLAGAH POLIKRISTALINIČNEGA Al_2O_3

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Feroelektrični materiali so zaradi visoke dielektričnosti, razmeroma nizkih dielektričnih izgub in odvisnosti dielektričnosti od električnega polja uporabni v napetostno prilagodljivih mikrovalovnih elektronskih komponentah. Napetostna prilagodljivost n je definirana kot razmerje med kapacitivnostjo pri 0 V in kapacitivnostjo pri izbrani napetosti. Zahteve po zniževanju delovne napetosti, miniaturizaciji komponent v mikroelektroniki ter zmanjševanju proizvodnih stroškov spodbujajo raziskave tankih plasti z debelinami nekaj 100 nm [Tagantsev et al., 2003].

Pripravili smo tanke plasti $\text{KTa}_{0.6}\text{Nb}_{0.4}\text{O}_3$ s sintezo iz raztopin na podlagah polikristaliničnega Al_2O_3 . Sole smo pripravili s 24-urnim refluksom kalijevega acetata in etoksidov obeh kovin prehoda v 2-metoksietanolu. V naslednjem koraku smo z destilacijo odstranili stranske produkte. Stehiometrične sole in sole z 10 % prebitkom kalija smo na podlage nanašali z metodo vrtenja.

Tanke plasti, pripravljene iz solov z 10 % prebitkom kalija, kristalizirajo po segrevanju pri 900 °C v perovskitni fazi. Tanke plasti, pripravljene iz stehiometričnih solov, so po segrevanju sestavljene iz perovskitne, piroklorne in sledov sekundarne faze, kar je verjetno posledica sublimacije kalijevega oksida pri temperaturi segrevanja.

Na očiščeno površino tankih plasti smo s fotolitografskim postopkom nanegli planarne dvoplastne elektrode Cr/Au z režo velikosti 3 μm . Dielektričnost smo izračunali po modelu delnih kapacitivnosti [Vendik et al., 1999]. Dielektričnost in napetostno prilagodljivost (C_{0V}/C_{60V}) 240 nm debelih perovskitnih tankih plasti smo izmerili pri 1 MHz in znašata 1550 in 3,3. Temperaturna in frekvenčna odvisnost dielektričnosti tankih plasti z difuznim maksimumom, značilnim za relaksorje, se ujema z navedbami v literaturi za volumensko keramiko KTN [Venkatesh et al., 2005].

AM-MR

THE SYNTHESIS OF NANOSTRUCTURED ALUMINATE COATINGS ON DENSE Y-TZP CERAMICS FROM AQUEOUS AlN SUSPENSIONS

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The hydrolysis of the AlN powder at room temperature (RT) follows the reaction scheme:



It has been suggested that from amorphous gelatinous boehmite, which is the very first precipitated product of AlN hydrolysis at RT, bayerite ($\alpha\text{-Al}(\text{OH})_3$) is subsequently formed by a dissolution/precipitation process, similar to biomimetic apatite formation in simulated body fluid. On the other hand, at elevated hydrolysis temperatures boehmite is formed by a direct precipitation from an AlN powder suspension by the rapid hydrolysis of the aluminum cation. We exploited the AlN powder hydrolysis at elevated temperatures for the formation of uniformly thin coatings consisting of interlocked nanosized boehmite lamellas on the sintered and polished ceramic zirconia (Y-TZP) surface.

The influence of precipitation conditions, such as pH, time and temperature, on the morphology of the precipitated boehmite coatings was studied and the crystal structure of the alumina coating after the thermal treatment was determined. An as-synthesized alumina coating has the potential to improve the adhesion of dental cements to the sintered Y-TZP ceramic by a factor of 2–4, depending on the surface roughness and the dental cement used. The coating can also be used as a template for superhydrophobic thin films and as a catalytic carrier.

SINTEZA NANOSTRUKTURNIH ALUMINATNIH PREVLEK NA GOSTO SINTRANI Y-TZP KERAMIKI IZ VODNE SUSPENZIJE PRAHU AlN

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V prisotnosti vode pri sobni temperaturi prah AlN razpade po sledeči reakcijski shemi:



AlN prah sprva reagira z vodo in tvori amorfní aluminijev hidroksid, kateri se kasneje pretvori v bayerit ($\alpha\text{-Al}(\text{OH})_3$) po postopku raztapljanja in rekristalizacije, ki je podoben biomimetičnemu procesu nalaganja apatita v raztopini simulirane telesne tekočine.

Pri povišanih temperaturah hidrolize prahu AlN, aluminijev kation zelo hitro hidrolizira in rezultat je takojšnja preprecipitacija kristaliničnega bemitita kot prvega reakcijskega produkta hidrolize AlN. Hidrolizo prahu AlN pri povišanih temperaturah smo izkoristili za pripravo tankih poroznih prevlek z enakomerno porazdelitvijo prepletajočih lamel bemitita na podlagi iz z itrijem stabiliziranega cirkonijevega oksida (Y-TZP).

Namen dela je bil raziskati vpliv pogojev precipitacije, kot so pH, čas in temperatura, na morfologijo precipitiranih prevlek iz bemitita, kot tudi študij kristalne strukture in morfologije oksidne prevleke po termični obdelavi. Tako pripravljene aluminatne prevleke na keramični podlagi iz Y-TZP lahko izboljšajo adhezijo dentalnega cementa na površini od 2 do 4 krat, odvisno od uporabljenega cementa in hrapavosti površine. Prevleko bi bilo mogoče uporabiti tudi kot podlago za superhidrofobne tanke filme ali kot nosilec katalizatorjev.

AM-MR

THE COATING OF Si_3N_4 POWDER WITH NANOSIZED ZrN PARTICLES

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Recently, much attention has been devoted to the production of silicon nitride and SiAlON materials, not only because of their good fracture toughness, strength and mechanical reliability, but also because of their potential multi-functionality, especially their electrical conductivity, which can be obtained by the incorporation of electrically conductive particles into the matrix phase. Since the conductive particles are usually coarse, it is necessary to add a significant amount to achieve the percolation threshold. Such a relatively large amount of conductive phase can then in turn lead to poor sinterability and reduced mechanical properties. The use of conductive coatings on silicon nitride is one method to improve the electrical conductivity. The idea was that if the particles of ZrN were small enough and uniformly distributed they would form an electrically conductive network around the larger Si_3N_4 particles, and so a much lower amount of the conductive phase would be needed. In this work the preparation of the coated silicon nitride powder with nanosized ZrN particles will be presented. The coating was prepared by a gel-precipitation method at different pH values by the precipitation of ZrO_2 from a zirconium (IV) acetate solution using urea as a precipitating agent. The resulting coated powders were calcined and characterized using X-ray powder diffraction. The success of the coating procedure was confirmed by TEM and HRTEM observations with electron diffraction and EDX analyses. In the system Zr-Si-O-N the Si_3N_4 can react with ZrO_2 to form ZrN at 1600 °C. From the ZrN-coated Si_3N_4 powder we were able to prepare electroconductive ceramic composites with superior mechanical and electrical properties that are potentially applicable for heaters, ignition systems, etc.

PREKRIVANJE Si_3N_4 PRAHU Z NANODELCI ZrN

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V zadnjem času je bila večja pozornost posvečena izdelavi delčnih kompozotov iz Si_3N_4 in SiAlON-a, ne samo zaradi njihove izboljšane zlomne žilavosti, trdnosti in mehanske zanesljivosti ampak tudi zaradi njihove večfunkcionalnosti, še posebej električne prevodnosti, ki jo lahko dosežemo z dodatkom električno prevodnih keramičnih delcev. Zaradi dejstva, da so ti delci navadno veliki, jih je za dosego perkolacijskega praga potrebno dodati relativno velik delež, kar vodi do slabšega sintranja in neustreznih mehanskih lastnosti. Ena izmed metod za izboljšanje električne prevodnosti je uporaba nitridne keramične prevleke na Si_3N_4 . Ideja je, da če bi bili ZrN delci primerne velikosti in enakomerno razporejeni, bi lahko tvorili električno prevodno mrežo okrog večjih Si_3N_4 zrn, s čimer bi bil potreben znatno manjši delež prevodne faze.

V prispevku bom predstavili študij priprave ZrN prevleke na Si_3N_4 . Prevleko smo pripravili z gel-precipitacijsko metodo pri različnih pH vrednostih s precipitacijo ZrO_2 iz raztopine cirkonijevega (IV) acetata in uree. Nastale prevleke smo termično obdelali in karakterizirali z rentgensko praškovno difrakcijo, TEM in HRTEM preiskavami, z elektronsko difrakcijo in EDS analizo. Pri temperaturah nad 1600 °C pride v sistemu Zr-Si-O-N v atmosferi dušika do reakcije med Si_3N_4 in ZrO_2 pri čemer nastaja ZrN, kar smo izkoristili za pretvorbo ZrO_2 delcev v ZrN delce. Iz Si_3N_4 prahu prevlečenega z ZrN delci smo lahko pripravili električno-prevodne kompozitne materiale z dobrimi mehanskimi in električnimi lastnostmi, ki so lahko potencialno zanimivi za keramične grelce, prižigalce, itd.

AM-MR

SOLID STATE SYNTHESIS OF SODIUM NIOBATE

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Alkaline niobates, such as (K,Na)NbO₃ solid solution, represent an important group of environmentally-friendly lead-free piezoelectric ceramics and could replace widely used lead-based perovskites. The difficulties related to (K,Na)NbO₃ include synthesis and sintering to high density. In this work the synthesis of sodium niobate, as the end member of the KNbO₃-NaNbO₃ system, was studied.

NaNbO₃ was synthesized by solid state synthesis from Na₂CO₃ and Nb₂O₅ powders. The Na₂CO₃ was milled in a planetary mill (PL), in an attrition mill (ATR), and by high-energy milling (VEM). The as-synthesized NaNbO₃ powders were compacted and sintered at different temperatures.

Single phase NaNbO₃ powders with particle sizes between 0.4 and 0.5 μm were prepared upon heating the powder mixtures at 700 °C. The PL and ATR samples densified upon heating in a narrow temperature range between 1330 °C and 1380 °C, while the densification of the VEM sample occurred in several stages.

Relative densities of the PL and ATR samples, sintered at 1350 °C, were 79 % and 85 %, respectively, and the estimated grain size was between 4 and 6 μm. The VEM sample, sintered at 1350 °C, reached the highest density of 94.7 %. This sample also exhibited exaggerated grain growth, with grains as large as 100 μm. Chemical composition of the NaNbO₃ samples was investigated by energy-dispersive X-ray spectroscopy. The PL and ATR specimens were uniform, with the composition corresponding to the nominal composition, while in the VEM sample a small deficit of sodium was observed. The phase composition of the specimens was investigated by X-ray powder diffraction. The NaNbO₃ ceramics from the three batches had similar cell parameters, which were in good agreement with the literature data for NaNbO₃.

SINTEZA NATRIJEVEGA NIOBATA V TRDNEM STANJU

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Keramični materiali na osnovi alkalijskih niobatov, kot na primer trdna raztopina (K,Na)NbO₃, predstavljajo okolju prijazno skupino piezoelektrikov, ki bi lahko nadomestili najbolj razširjene, a ekološko oporečne piezoelektrike na osnovi svinčevih perovskitov. Osnovni problem, povezan s keramiko (K,Na)NbO₃, je sinteza. Preiskovali smo sintezo natrijevega niobata, ki je ena od mejnih spojin sistema KNbO₃-NaNbO₃.

Iz prahov Na₂CO₃ in Nb₂O₅ smo s sintezo v trdnem stanju pripravili tri šarže, ki so se razlikovale po načinu mletja Na₂CO₃: mletje v planetarnem mlinu (PL), mletje v atritorskem mlinu (ATR) in visokoenergijsko mletje (VEM). Sintetizirani prah NaNbO₃ smo nadalje stisnili v tablete in sintrali pri različnih temperaturah.

Homogenizirane prašne mešanice smo dvakrat kalcinirali pri 700 °C in pripravili enofazni NaNbO₃ s srednjo velikostjo delcev med 0,4 in 0,5 μm. Pri segrevanju tablet NaNbO₃ sta se vzorca šarž PL in ATR najhitreje zgoščevala v ozkem temperaturnem intervalu med 1330 °C in 1380 °C, medtem ko je pri šarži VEM zgoščevanje potekalo v večih stopnjah.

Vzorci šarž PL in ATR so pri sintranju pri temperaturi 1350 °C dosegli relativno gostoto 79 % oz. 85 % z ocenjeno velikostjo zrn med 4 μm in 6 μm. Največjo relativno gostoto (94,7 %), smo dosegli po sintranju vzorca šarže VEM pri temperaturi 1350 °C. Pri tem vzorcu smo opazili tudi prekomerno rast zrn, ki so celo preseglala velikost 100 μm. Kemijsko sestavo keramike smo preiskovali z energijsko disperzijsko spektroskopijo rentgenskih žarkov in ugotovili, da se sestava vzorcev PL in ATR ujema z nominalno sestavo, medtem ko ima keramika VEM majhen primanjkljaj natrija. Fazno sestavo vzorcev smo preiskovali z rentgensko fazno analizo. Parametri osnovne celice vseh treh šarž se dobro ujemajo s kristalografskimi podatki za ortorombski NaNbO₃.

P-MR

ELECTRICAL PROPERTIES OF PRINTING INKS FOR PRINTED ELECTRONICS

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All-printed electronics means fabrication of electronic systems by conventional printing technology. Therefore, it enables printing of low cost products onto flexible substrates. These are the main reasons why so many fundamental and applied interdisciplinary researches are concentrated in this subject all over the world.

To make printed electronic systems, inks with well defined electrical properties are a must. For some commercially available products, the conductivity or resistivity data are provided by producers. Inks with this information are in principle suitable for printing of electronic systems. However, the actual design of a particular electronic system depends on the conductivity or resistivity data obtained on the printed conductive strips. Our research was focused to conductive printing inks, whose data for electrical conductivity or resistivity are ready available by manufacturer. We compare the published data with the laboratory made test printed layers.

In the experimental work we have applied the four-point measurement of electrical resistivity on some thick film inks printed on different substrate media (glass, polymer foil, paper). For the better interpretation we made elemental analysis of ink by EDS (energy dispersive spectroscopy) to get data for functional (conductivity) particles in inks. The film thickness was measured to convert sheet into bulk resistivity. The present results show a reasonable agreement between manufacturer data and measurements on our printed samples. However, it was observed, that the printing substrate influences on the resistivity of printed layers which is a matter of interest.

ELEKTRIČNE LASTNOSTI TISKARSKIH BARV, KI SO PRIMERNE ZA UPORABO V TISKANIH ELEKTRONSKIH SISTEMIH

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Tiskanje elektronskih sistemov v enem prehodu pomeni proizvodnjo elektronike zgolj z metodami konvencionalnega tiska. Tak način izdelave v principu omogoča uporabo fleksibilnih substratov in najnižje možne stroške. To se ključni razlogi za živahne temeljne in aplikativne interdisciplinarne raziskave na tem področju širom po svetu.

Za izdelavo tiskanih elektronskih struktur potrebujemo tiskarske barve z določenimi električnimi lastnostmi. Za nekatere tiskarske barve proizvajalci že navajajo tudi električno prevodnost oz. upornost. Tiskarske barve, za katere poznamo ta podatek, so načeloma primerne za uporabo v tiskanih elektronskih sistemih. Konkreten design elektronskega sistema je odvisen tudi od prevodnosti oz. upornosti materiala.

Najprej smo pregledali, za katere tiskarske barve njihovi proizvajalci podajajo električno prevodnost oz. upornost. Nato smo s štiritočkovno metodo izmerili plastno upornost plasti tiskarskih barv na različnih podlagah (steklo, plastika, papir). Debelino nanosa tiskarske barve smo izmerili z dvema metodama in ocenili, katera je najbolj primerna za bodoče raziskave na tem področju. Z izmerjeno debelino smo izračunali specifično upornost plasti. S pomočjo elementne analize (EDS, energy dispersive spectrometer) smo dobili podatke o funkcionalnih (prevodnih) delcih v tiskarski barvi. Eksperimentalni del raziskave kaže razmeroma dobro ujemanje izmerjene prevodnosti s podatki proizvajalca. Analizirali smo tudi vpliv tiskovne podlage na upornost odtisa, kar kažejo meritve.

NN-MR

NANOSTRUCTURES ON FeSi ALLOY SURFACE BY ION BEAM – SURFACE
ACTIVE ELEMENTS AND THEIR ROLE

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Low-energy unfocused ion beam sputtering has recently attracted much attention as a tool for nanostructuring surfaces of a wide range of materials. Self-organized structures such as ripples of well defined wavelength, pits, mounds, pyramids or nanodots can form depending on the conditions imposed upon the ion beam and the characteristics of the sputtered material.

Polycrystalline Fe-3% Si alloy exhibits grains of different crystalline orientation ranging a few micrometers in size. Each of these grains presents an individual system on which impinging ions can induce morphological changes. By adding a small amount of surface active elements, such as P, S, Se, Sn... we can significantly alter the surface free energy and change diffusion barriers for surface diffusion, thus affecting the basic mechanisms for surface reorganization by ion beam bombardment.

The surfaces of electrical steels with added surface active elements were subjected to Ar⁺ ion beam irradiation at 6 keV – 10 keV energies at different sputter times and angles, to provide a complete determination of resulting morphologies. Preliminary experiments show that each grain behaves as a single crystal system and that different adjacent grains exhibit different morphologies. The samples were characterized by a multitechnique approach, where Field Emission Scanning Electron Microscopy (FE-SEM) provided an insight into the patterns that formed on individual grains and Atomic Force Microscopy (AFM) gave detailed information on corrugation, individual ripple wavelengths, pit depths and other morphological details. We have included also Electron Backscattered Diffraction Measurements (EBSD) to characterize the orientation of individual grains and correlate the resulting nanostructure to the grain orientation.

KM-MR

INITIAL OXIDATION AT ROOM TEMPERATURE OF DUPLEX STAINLESS STEEL

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Three different techniques were used to produce thin oxide layers on polished and sputter-cleaned duplex stainless-steel samples. These samples were exposed to 10^{-5} mbar of pure oxygen inside the vacuum chamber, exposed to ambient conditions for 24 hours, and plasma oxidized. The oxide layers thus produced were analysed using XPS depth profiling in order to determine the oxide layers' compositions with depth. We found that all the techniques produce oxide layers with different traces of metallic components and with the maximum concentration of chromium oxide shifted towards the oxide-layer–bulk-metal interface. A depletion in the amount of Cr in the bulk immediately below the interface was also observed. A simple non-destructive Thickogram procedure was used to corroborate the thickness estimates for the thinnest oxide layers.

KM-MR

FLUORINE BONDING IN DRY SCRUBBER IN ELECTROLYSIS OF ALUMINIUM

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Pure aluminium is extracted by electrolysis of alumina (Al_2O_3) that is manufactured by treating bauxite. Primary aluminium is extracted by electrolysis from alumina according to the reaction: $2 \text{Al}_2\text{O}_3 + 3 \text{C}_{(\text{graphite})} \rightarrow 4 \text{Al} + 3 \text{CO}_2(\text{g})$. The process, with additives cryolite, AlF_3 , CaF_2 etc. into electrolyte, proceeds at the temperature below 1000°C and at constant DC current of 180 kA. Electrolytic cells are connected in series in order to keep constant electrical current in all the electrolytic cells due to the Ohm's law.

In electrolytic cells the direct undesired side effect of electrolysis is the production of greenhouse gases (CO , CO_2), while the other poisonous gases (HF , F_2) are products of the additives for the reduction of the temperature of the aluminum extraction process. The scrubbers operate by direct exhausting the flue gases from the electrolytic cells directly into reactors where gases react with active alumina. From the gas mixture first the poisonous fluorine and HF are adsorbed on the active surface. The gases with active alumina are then transported through bag filters where solid alumina with adsorbed gases is removed. The fluorine-enriched alumina is after the filtration used in the electrolytic process.

VEZAVA FLUORA V ČISTILNI NAPRAVI PRI ELEKTROLIZI ALUMINIJA

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Pridobivanje najčistejšega in s tem najkvalitetnejšega aluminija poteka z elektrolizo osnovne surovine glinice, Al_2O_3 , ki se pridobi z eksploatacijo iz boksita. Elektroliza poteka po kemijski reakciji: $2\text{Al}_2\text{O}_3 + 3\text{C}_{(\text{grafit})} \rightarrow 4\text{Al} + 3\text{CO}_2(\text{g})$. Z dodatki kriolita, AlF_3 , CaF_2 , idr. poteka elektroliza pri enosmernem električnem toku 180 kA in temperaturi pod 1000°C . Elektrolizne celice so zaporedno vezane, tako da se po Ohmovem zakonu ohranja v vseh elektroliznih celicah enak električni tok.

Pri elektrolizi glinice prihaja do izhajanja plinov, tako toplogrednih (CO , CO_2), ki so direkten produkt elektrolize, kot tudi nekaterih strupenih plinov (HF , F_2), ki se tvorijo kot sekundarni produkti dodatkov za izboljšanje izkoristka elektrolize. Čistilne naprave delujejo na principu direktnega odsesavanja plinov iz elektrolitskih celic. Plini so vodeni po cevovodih do reaktorjev, kjer zreagirajo z aktivno glinico. V reaktorju se HF in F_2 vežeta na glinico. To glinico, obogateno s fluorom, se ulovi v filtrskih vrečah in vodi v proces elektrolize.

KM-MR

A NEW THERMOMECHANICAL TREATMENT FOR THE EXTRUSION OF AA 2xxx ALLOYS

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2xxx extrudates are always produced by extrusion, a separate solution treatment and ageing. On the other hand, 6xxx and 7xxx alloys (free of Cu) are usually press quenched which is a method of combining a solution treatment and extrusion, but requires the control of a large number of parameters. The aim of our research work was to create a technology without a separate solution treatment which is fairly energy consuming. Therefore, the influence of various thermomechanical treatments in the extrusion process of a precipitation hardenable 2011 alloy on hot deformation behaviour, on the formation of extrusion microstructure, mechanical properties and the capability of precipitation hardening directly after the extrusion was determined.

NOVA TERMOMEHANSKA OBDELAVA IZTISKOVANJA ALUMINIJEVIH ZLITIN VRSTE 2xxx

Termomehanska obdelava iztiskovancev iz aluminijevih zlitin vrste 2xxx so vedno proizvedeni z iztiskovanjem, ločenim raztopnim žarjenjem in staranjem. Medtem so iztiskovanci iz aluminijevih zlitin vrste 6xxx in 7xxx, ki ne vsebujejo bakra, vedno proizvedeni po procesu gašenja na iztiskovalnici. Pri procesu gašenja na iztiskovalnici so združene operacije iztiskovanja in raztopnega žarjenja, kar zahteva kontrolo velikega števila parametrov. Cilj raziskav je bila osvojitvev termomehanske obdelave iztiskovanja aluminijevih zlitin 2xxx, katera ne vsebuje operacije raztopnega žarjenja. Posledično so bili preiskane različne termomehanske obdelave iztiskovanja 2011 aluminijeve zlitine za, formiranje mikrostrukture iztiskovancev, mehanskih lastnosti in sposobnostjo izločevalnega utrjevanja iztiskovancev neposredno po iztiskovanju.

RP-GP

EU FUNDING OPPORTUNITIES FOR RESEARCH AND INNOVATION

Bojan Jenko

Ministry of Higher Education, Science and Technology

The "knowledge triangle" – research, education and innovation is a core factor in European efforts to meet the ambitious Lisbon goals to become the "most dynamic competitive knowledge-based economy in the world". Numerous programmes, initiatives and support measures are carried out at EU level in support of knowledge; from 7th *Framework Programme of the EU research activities – FP7*, *Competitiveness and Innovation Programme – CIP*, *Structural Funds and Cohesion Funds to Research Fund for Coal and Steel – RFCS* as key pillars for the *European Research Area – ERA* (<http://cordis.europa.eu/era/>).

The 7th Research Framework Programme for the period 2007-2013 – FP7 (having budget more than 50 billion €) and the 7th Framework Programme of the European Atomic Energy Community – Euratom for the period 2007-2011 (having budget close to 3 billion €) offer many opportunities for research and supporting activities including infrastructure and mobility (http://cordis.europa.eu/fp7/home_en.html).

The FP7 Collaborative research incorporates 10 thematic priorities including Nanosciences, Nanotechnologies, Materials and new Production Technologies (NMP) as the Thematic priority 4 and Information and Communication Technologies (ICT) as the Thematic priority 3. Work programmes are defining detailed work plan and details for each call regarding the thematic priority.

The 2009 calls for the *NMP* are planned to be announced in November 2008.

The *Competitiveness and Innovation Framework Programme – CIP* aims to foster the competitiveness of the European enterprises and has a budget close to 4 billion € for the period 2007-2013. SMEs are its main target. (CIP: http://ec.europa.eu/cip/index_en.htm)

In the *Research Fund for Coal and Steel – RFCS* every year around 55 million € is available to universities, research centers and private companies to fund projects. Each year the call is closed on September 15. (RFCS: http://cordis.europa.eu/coal-steel-rtd/home_en.html)

European Commission recently published "Practical Guide to EU funding opportunities for Research and Innovation" on http://cordis.europa.eu/eu-funding-guide/home_en.html.

PRILOŽNOSTI EU ZA FINANCIRANJE RAZISKAV

Bojan Jenko

Ministrstvo za visoko šolstvo, znanost in tehnologijo

"Trikotnik znanja" – raziskave, izobraževanje in inovacije so glavni dejavnik pri naporih Evrope, da izpolni ambiciozne Lizbonske cilje, da postane "najbolj dinamično, konkurenčno, na znanju temelječe gospodarstvo na svetu". Na EU ravni so številni programi, pobude in ukrepi za podporo znanju: od 7. okvirnega programa raziskovalnih dejavnosti EU – 7.OP, Programa za konkurenčnost in inovativnost – KIP, strukturnih in kohezijskih skladov do Evropskega sklada za premog in jeklo – ESPJ kot ključni stebri Evropskega raziskovalnega prostora – ERA (<http://cordis.europa.eu/era/>).

7.okvirni program Evropske skupnosti za raziskave, tehnološki razvoj in predstavitvene dejavnosti za obdobje 2007-2013 – 7.OP (s proračunom več kot 50 milijard €) in 7.okvirni program Evropske skupnosti za atomsko energijo – Euratom za obdobje 2007-2011 (s proračunom skoraj 3 milijarde €) ponujata veliko priložnosti za financiranje raziskav in podpornih dejavnosti (http://cordis.europa.eu/fp7/understand_en.html).

7.OP v posebnem programu "Sodelovanje" združuje raziskave v 10 tematskih področjih vključno z "Nanoznanosti, nanotehnologije, materiali in nove proizvodne tehnologije" (NMP) kot 4. tematsko prioriteto ter "Informacijske in komunikacijske tehnologije" (ICT) kot 3. tematsko prioriteto. Delovni programi (WP) določajo podrobnosti vsake tematske prioritete in podrobnosti razpisov. Razpisi za leto 2009 za področje NMP bodo predvidoma objavljeni v novembru letos.

Program za konkurenčnost in inovativnost – KIP je namenjen pospeševanju konkurenčnosti evropskih podjetij; njegov proračun se približuje 4 milijonom €. Namenjen je predvsem malim in srednjim podjetjem – MSP (CIP:http://ec.europa.eu/cip/index_en.htm).

V *Evropskem skladu za premog in jeklo – ESPJ*, ki ga sedaj upravlja EK, je vsako leto namenjenih približno 55 milijonov € za financiranje projektov univerz, raziskovalnih inštitucij in privatnih podjetij. Vsakoletni razpis se zaključi 15. septembra.

(RFCS: http://cordis.europa.eu/coal-steel-rtd/home_en.html)

Evropska komisija je pred kratkim izdala "Praktični vodič o možnostih EU financiranja raziskav", ki je objavljen na: http://cordis.europa.eu/eu-funding-guide/home_en.html.

NN-VP

SOME BEARINGS OF THE GROWTH OF NOBLE METAL (Rh, Ir) NANOWIRES ON OXIDE SUPPORTS

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The early stage growth of Rh and Ir nanoparticles were studied on $\text{TiO}_2(110)$ surface by metal vapour deposition technique and scanning tunnelling microscopy (STM) method. The systematic variation of the surface temperature and the deposition rate of the admetals were examined in the connection of the modification of the average nanoparticle-size and the characteristic shape. It was found that the so called "seeding and growing" method is capable to produce very narrow size-distribution on this oxide support. Moreover, the appropriate change of the deposition temperature can be resulted in extremely elongated metal particles, so called nanowires. These model catalyst surfaces were tested also in decomposition of the carbon-monoxide. Clear evidence was found for the different catalytic efficiency of the catalyst in the function of the particle shape. It will be emphasized that in the understanding and the artificial influence of the growth processes on nanoscale, it is very important to take into account the actual surface structure (surface point defects, steps, reconstructions), and the STM is an excellent tool for studiing these properties.

KM-VP

NANOFOILS FOR SOLDERING AND BRAZING IN DENTAL JOINING PRACTICE
AND JEWELLERY MANUFACTURING

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This paper presents the theory of novel reactive Al-Au nano-multilayered foils' development and its possible application in different fields. In this context, discussion is presented about nano-foils suitability for dental and jewellery applications. Moreover, this study includes the rapid joining of similar and dissimilar materials, which enable multilayer nano-foils to be placed between two components needing to be bonded, along with two layers of solder or braze. Namely, the foils would precisely control the instantaneous release of heat energy for joining and, thus, would act as a controllable local heat source. The reactive foils would range in thickness from to less than 100 μm and contain many nanoscale layers that alternate between materials with high mixing heats, such as Al and Au. By inserting a free-standing foil between two solder/braze layers and two components, heat generated by the reaction of the foil melts the solder/braze and, consequently, bonds the components. The use of reactive foils eliminates the need for a furnace, and dramatically reduces heating of the components being bonded. Thus, ceramics and metals can be fused over requested areas without those damaging thermal stresses that are typically encountered when cooling in furnace soldering or brazing operations.

In addition, a completely new plasma technology is suggested for the manufacturing of nano-foils. In this connection the first results of the preliminary experimental testing are presented.

KM-VP

FABRICATION AND CHARACTERIZATION OF B_4C -Al, B_4C -TiB₂-Al AND B_4C -Mg COMPOSITES

B_4C -Al and B_4C -Mg composites are a family of engineering materials in which a range of properties can be developed. Moreover, the Al-B-C system enables the creation of an entire spectrum of low (Al_3BC , AlB_2) and high temperature ($AlB_{12}C_2$, Al_4C_3) phases, making possible accurate tailoring of the composition and microstructure of the multiphase material. Due to the several great advantages they combine, B_4C -Al composites are the material of choice in many applications such as armour plate with high ballistic efficiency, disk drive actuators, hard disk substrates, brakes with high wear resistance, etc. Also B_4C -Mg composites are becoming emerging as advanced engineering materials for demanding applications and extreme weight saving in transportation.

The systems considered in this work were Al-Mg-B-C and Al-Mg-Ti-B-C, in which, in parallel with the formation of B_4C -Al and B_4C -TiB₂-Al composites by pressureless infiltration of a porous perform with molten aluminium alloy, the ultra-hard $AlMgB_{14}$ bonding phase was formed. The resultant B_4C -Al- $AlMgB_{14}$ and B_4C -TiB₂-Al- $AlMgB_{14}$ composites with hardnesses near the hardness of sintered boron-carbide were prepared and characterised. The mechanism of formation of the $AlMgB_{14}$ bonding phase is also discussed.

Fully dense B_4C -Al and B_4C -TiB₂-Al based composites, reactively bonded with $AlMgB_{14}$ phase, were routinely fabricated by spontaneous infiltration of green compacts at temperatures of 1100 °C to 1400 °C. The best macro-hardness values (23–24.5 GPa, that is 70% of the macro-hardness of sintered boron-carbide) were obtained at 1100 °C, approx. 50 % below the sintering temperature of B_4C .

The hardness (HR15T), elastic modulus, tensile strength and 0.2 % tensile yield strength of B_4C -Mg composites were more than doubled compared to unalloyed magnesium. The best tensile properties were obtained by introducing 30 vol. % of submicron boron carbide reinforcement, which also significantly increases the cost of the composite.

PRIDOBIVANJE IN KARAKTERIZACIJA B_4C -Al, B_4C -TiB₂-Al IN B_4C -Mg KOMPOZITOV

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Sestavljeni materiali na osnovi B_4C -Al in B_4C -Mg se pospešeno uveljavljajo kot tržno zanimiv inženirski material. V sistemu Al-B-C se srečujemo z vrsto faz (Al_3BC , AlB_2), ki so obstojne pri nižjih in fazami ($AlB_{12}C_2$, Al_4C_3) obstojnimi pri visokih temperaturah, kar odpira možnost priprave večfaznih materialov z načrtovano sestavo in mikrostrukturo. Sestavljeni materiali B_4C -Al se zaradi svojih odličnih lastnosti uporabljajo v različne namene kot na primer za lahke oklepe, za izdelavo aktuatorjev za pogon diskov v računalnikih, kot substrati za trde diske, za izdelavo zavornih oblog z visoko obrabno trdnostjo in drugo. Tudi B_4C -Mg sestavljeni materiali se vse bolj uveljavljajo pri zahtevnih aplikacijah, zlasti tistih pogojenih s precejšnjim zmanjšanjem mase komponent (npr. v letalstvu).

V svojem raziskovalnem delu smo preučili pripravo in lastnosti različnih sestavljenih materialov na osnovi Al-Mg-B-C in Al-Mg-Ti-B-C sistemov. Poleg sestavljenih materialov B_4C -Al in B_4C -TiB₂-Al, pripravljenih z infiltracijo poroznih predoblik z Al talino, smo uspešno izdelali tudi sestavljene materiale s super-trdo vezno fazo $AlMgB_{14}$. Vse vzorce B_4C -Al- $AlMgB_{14}$ in B_4C -TiB₂-Al- $AlMgB_{14}$, s trdoto podobno trdoti sintranega B_4C smo metalografsko preiskali ter pojasnili mehanizem nastanka $AlMgB_{14}$ vezne faze.

Gosto sintrane sestavljene materiale na osnovi B_4C -Al in B_4C -TiB₂-Al z vezno fazo $AlMgB_{14}$ smo laboratorijsko pripravili s spontano infiltracijo taline v zelene predoblike pri temperaturah od 1100 °C do 1400 °C. Najvišje trdote (23–24.5 GPa, kar je 70 % trdote sintranega B_4C) smo dosegli pri 1100 °C, tj. pri 50 % nižji temperaturi kot je temperatura sintranja B_4C .

Izmerjene vrednosti trdote (HR15T), modula elastičnosti, natezne trdnosti in napetosti tečenja so vsaj enkrat višje v primerjavi z nelegiranim Mg. Po svojih mehanskih lastnostih so najbolj izstopali sestavljeni materiali, diskontinuirno ojačenih s 30 vol. % B_4C , s povprečno velikostjo delcev pod 1 μm, za katere smo, po drugi strani, ugotovili tudi najvišje proizvodne stroške.

VT-VP

ON THE INFLUENCE OF DIFFERENT VACUUM TREATMENT PROCESSES ON CHANGE OF CONTENT OF SOME RESIDUAL ELEMENTS

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Higher or permitted content of residual or trace elements into alloys or steels lowering physical, chemical or mechanical properties especially high alloyed materials or steels. Vacuum treatment can influence on present content of residual or trace elements. Dependently of vacuum treatment of metal into vacuum equipment, vacuum induction furnace or electron beam furnace or onto industrial scale, appear some influence onto content of residual or trace elements to some instant. Exposing time or range of vacuum show certain influence on mentioned elements. On the change of content of residual or trace elements can influence physical properties of some present elements as well as interaction between some present material component. On the base of those indicators it is possible to improve, to some extend, material characteristics by vacuum treatment dependently of aimed properties or expected elements content

O VPLIVU RAZLIČNIH VAKUUMSKIH PROCESOV OBDELAVE NA SPREMEMBO VSEBNOSTI NEKATERIH REZIDUALNIH ELEMENTOV

Višja ali dovoljena vsebnost rezidualnih elementov v zlitinah ali jeklih slabša fizikalne, kemične in mehanske lastnosti posebno visokolegiranih materialov ali jekl. Vakuumska obdelava lahko vpliva na vsebino prisotnih rezidualnih elementov. V ovisnosti od postopka vakuumske obdelave kovin, v vakuumskih obratih, v vacuum indukcijskih pečeh, v pečeh za topljenje elektronskim žarkom, ali pa v industriskem območju, se opazujejo v določeni meri določeni vplivi vakuuma na nekatere rezidualne elemente. Čas obdelave ali velikost vakuuma pokazujejo določeni vpliv na omenjene elemente. Sprememba vsebnosti rezidualnih elementov vpliva na fizikalne lastnosti prisotnih rezidualnih elementov in tudi na interakcijo med rezidualnimi elementi. Na podlagi omenjenih pokazateljev mogoče je, v določeni meri, izboljšati karakteristike materiala vakuumskom obdelavom za pridobitev pričakovanih izboljšanih lastnosti, v določeni meri.

VO-GP

A STUDY OF THE EFFECTS OF SPECIAL GLASS AND CERAMIC MICROBIAL BIOMASS SUPPORT MATERIALS ON THE SPEED OF BIOCHEMICAL POLLUTANT DECOMPOSITION PROCESSES IN WATER

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Special glass and ceramic biomass support materials (expanded glass, expanded ceramics, thermally activated zeolite) are significantly more effective than traditional support materials (plastics, stone, river gravel). Glass biomass support materials and natural ion exchangers such as zeolite and some types of ceramics can act as catalysts for biochemical pollutant decomposition processes in water. Glass materials, having the ability to exchange hydrogen (H^+) ions and electrons, are particularly useful for such applications. A good example of the exploitation of this feature of glass materials to achieve functionality is the hydrogen-ion-selective glass electrode. However, by deducting H^+ ions and electrons from the right-hand side of reaction equations, one can also exploit this particular feature of glass materials to increase the speed of biochemical pollutant decomposition. This is possible because H^+ ions are end decomposition products in many biochemical pollutant decomposition reactions that frequently occur in wastewater. Zeolite, having the ability to accommodate metals and NH_4^+ , could also be exploited to increase the speed of some decomposition reactions. Our research to-date has shown that the intensity of biomass formation is greater on inorganic support materials than on inert support materials. Our ongoing research adds to that by exploring the catalyst properties of these inorganic support materials.

ŠTUDIJA VPLIVOV SPECIALNEGA STEKLENEGA ALI KERAMIČNEGA NOSILCA BIOMASE NA HITROST BIOKEMIJSKIH PROCESOV RAZGRADNJE NEČISTOČ V VODI

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Običajni nosilci biomase (plastika, kamenje, rečni prod) so bistveno manj učinkoviti kot specialni stekleni in keramični nosilci (ekspandirana keramika, ekspandirano steklo, termično obdelani zeolit, itd). Stekleni nosilec biomase, ali pa razni naravni ionski izmenjevalci (zeolit, posamezne vrste keramike, itd.) se lahko aktivno vključijo v proces čiščenja kot katalizatorji. Posebej zanimivo pri tem je lahko steklo, ki ima sposobnost sprejemanja in oddajanja vodikovih ionov ter elektronov. Po takšnem principu je narejena steklena elektroda za pH meter, ki je selektivna na H^+ ione. Podoben proces, ki se dogaja na stekleni elektrodi, bi lahko izkoristili za povečanje hitrosti biokemijske razgradnje nečistoč na ta način, da bi odvzemali na desni strani reakcijskih enačb nastale H^+ ione in elektrone. H^+ ioni so namreč razkrojni produkti pri mnogih reakcijah biokemijske razgradnje nečistoč v odpadni vodi. Pri uporabi zelolita, ali podobnega materiala, ki veže kovine in NH_4^+ , pa bi lahko pospeševali določene druge reakcije. Z dosedanjimi raziskavami smo ugotovili, da se biomasa veliko intenzivneje razvija na anorganskih nosilcih kot na inertnih materialih (plastika, kamenje, rečni prod, itd.). Preiskave kataliziranja biokemijske razgradnje nečistoč v odpadni pa so v teku.

P-GP

NANOCOMPOSITES PA12/MoSI NANOWIRES

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Polymer nanocomposites have been the subject of extensive research for approximately 20 years. Usually they are prepared by mixing nanoparticles such as clay, carbon nanotubes or various nanowires with polymer. Mixing can proceed in melt, solution or it is combined with in situ polymerization. Due to strong interactions, nanoparticles tend to aggregate and the properties of nanocomposites depend greatly on the dispersion of nanoparticles.

We have prepared polymer nanocomposites using polyamide 12 (PA12) as a matrix and nanowires made up of molybdenum, sulphur and iodine (MoSI). Nanocomposites having 0.5–2.0 % nanowires were prepared on laboratory twin screw extruder. Distribution of nanowires in polymer matrix was analysed by transmission electron microscopy (TEM), and their influence on crystallization of PA12 was determined by differential scanning calorimetry (DSC). Measurements of tensile mechanical properties (tensile modulus, tensile strength and strain at break) were carried out using a mechanical testing equipment (ZWICK Z 100) at a testing speed of 2 mm/min. Considerable increase in mechanical properties (up to 15 %) was observed in the case of the nanocomposites containing MoSI nanowires.

NANOKOMPOZITI PA12/MoSI NANOŽIČKE

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Raziskave polimernih nanokompozitov intenzivno potekajo že skoraj 20 let. Običajno jih pripravimo z mešanjem nanodelcev kot so glina, ogljikove nanocevke ali različne nanožičke s polimerom. To lahko izvedemo v talini, raztopini ali v kombinaciji z in situ polimerizacijo. Zaradi močnih interakcij med nanodelci pa se le-ti združujejo v agregate, ki jih je težko razbiti. Lastnosti nanokompozitov so zato v veliki meri odvisne od uspešnosti dispergiranja nanodelcev v polimerni matrici.

Pripravili smo nanokompozite iz poliamida 12 (PA12) in nanožic iz molibdena, žvepla in joda (MoSI). Delež MoSI v nanokompozitu je bil 0,5–2,0 %, vmešavanje pa smo izvedli v laboratorijskem dvopolžnem ekstruderju. Porazdelitev delcev smo ugotavljali s transmisijskim elektronskim mikroskopom, njihov vpliv na kristalizacijo PA12 pa smo določili z diferenčno dinamično kalorimetrijo (DSC). Natezne mehanske lastnosti (natezni modul, natezna trdnost, raztezek pri pretrgu) smo določili na dinamometru ZWICK Z 100 pri hitrosti 2 mm/min. Ugotovili smo znatno povišanje mehanskih lastnosti (do 15 %) pri vseh nanokompozitih z MoSI nanožičkami.

KM-GP

ON THE PROCESS OF SELECTIVE OXIDATION OF ELEMENTS FROM THE POINT OF MANGANESE OXIDATION IN HOT METAL

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Higher manganese content into hot metal during oxidation process, i. d. during steelmaking process in one hand positively influence on the process of slag formation, but in the other hand cause serious technological problems. That means that reaction between manganese and oxygen into hot metal, for a long time has been examined, but it stayed not enough solved in certain details. Examinations in metallurgy gave possibility additional involving into process of manganese oxidation, from the point of view of reaction mechanism, thermodynamics and kinetics. Counter-current statement has been appeared because of that that research work have been carried out generally on the hot metal with low manganese content and very rear on hot metal with higher manganese content higher than 3,5 % from the point of view of influence of initial manganese content. Such access gives possibilities understanding and also misunderstandings and collision of results some researchers, because of differences into initial manganese contents into hot metal, so because of way of oxygen introduction and development of reactions.

Examination of process of selective oxidation of elements into hot metal indicate on the possibility of lowering manganese content throughout different way of oxygen reactions and slag addition, what make able to reach optimal manganese content by selective oxidation of reactions of higher initial manganese content. into a few variants, with present reaction of oxygen in a few shapes with addition of slag forming components, it make possible to achieve results for lowering, especially high initial manganese content into hot metal. Final elements content of hot metal depends of initial manganese content into hot metal, state of reacting introduced oxygen, way of introducing of oxygen, as well as slag components, what has to eliminate problems during treatment of hot metal into converter as well as important slag quantity. Lowering manganese content into hot metal by selective oxidation down to initial contents which are familiar to hot metal into limits all over the world, performs to solve problems during working with hot metal into converter and to aim lowering slag quantity, increasing yield of steel for more 4 % and by improving economy of steelmaking processes.

KM-GP

DETERMINATION OF FRACTURE TOUGHNESS WITH CHARPY V-NOTCH
ABSORBED ENERGY AND ROCKWELL-C HARDNESS FOR H11/H13 HOT-WORK
TOOL STEELS

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An investigation was conducted to determine whether there are correlations between CVN, HRc and K_{Ic} test results at room temperature for AISI H11/H13 hot-work tool steels that could be developed to assist both the materials engineer and the structural designer. The results showed that such correlations do exist for electro-slag-remelted (ESR) and conventional AISI H11 hot-work tool steel. Static K_{Ic} values were correlated with the results of standard CVN impact tests and the pertained hardnesses at room temperature. Furthermore, the results show that the correlation can also be used to calculate K_{Ic} values from standard CVN impact tests and the pertained Rockwell-C hardness for AISI H13 tool steel. In general, the results of this investigation showed that the correlation between the values for the K_{Ic} , the CVN and the HRc can be used to estimate the K_{Ic} values from the CVN test results and the Rockwell-C hardness.

VT-GP

MODIFICATION OF VACUUM CALIBRATION SYSTEM FOR CALIBRATIONS OF PIRANI GAUGES WITH WATER VAPOR

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Vacuum measurements are often done indirectly by measuring different properties of gas which depend on pressure (or density), such as thermal conductivity, which also depend on gas species. Indirect measuring instruments need to be calibrated and most frequently the calibration is performed for nitrogen gas only. For accurate measurement of pressure of other gases corrections have to be applied. Most often the dominant component of the residual gas in unbaked vacuum system is water vapor, but unfortunately there is almost no data available in the literature on the relative sensitivity of thermal conductivity gauges for water vapor. In vacuum industry water desorption from surfaces during pump down presents a considerable cost of processes. More accurate vacuum measurements could bring significant time savings (i.e. cost savings) through reduced safety margin for pressure measurement uncertainty. Better accuracy has also potential in higher yield and better product quality in demanding vacuum technologies and more consistent results in science and R&D.

We have modified an existing system for calibration of vacuum gauges by comparison method. In addition to the usual gas inlet system for standard gases like nitrogen or argon a newly developed water vapor source was added. Combined gas inlet system enables comparison of water calibration curve with calibration curves for other gases and determination of relative sensitivity coefficient for different gases with respect to nitrogen. As a reference gauge an unheated capacitance diaphragm gauge is used. The reference gauge is regularly calibrated with nitrogen gas, but the measuring principle of the gauge assures its gas independence, so it can be used for water vapor also.

Calibration pressure can be established in static mode of operation of the calibration system either by expansion of water vapor from the source or by establishing equilibrium water vapor pressure above the surface of ice or water (depending on the temperature of the source).

We have explored possibility for calibration of vacuum gauges with water vapor in a range from 1 Pa to 20 kPa. The performance of the system was demonstrated by a calibration of a Pirani gauge in nitrogen and water vapor. Results were compared with recent review article on gas dependence of Pirani gauges.

KM-GP

LIFE-TIME PREDICTION OF LEAF SPRINGS BASED ON DETERMINATION OF FATIGUE BEND-STRENGTH OF NOTCHED SAMPLES OF SPRING STEEL

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Bend fatigue strength of selected spring steel was determined with a resonant pulsator using standard Charpy V-notched specimens. The finite element method (FEM) based numerical simulation was applied for the determination of stress and strain distribution in V-notched specimens, as well as for the calculation of stress concentration and notch-sensitivity factors. Bend fatigue strength of the selected unnotched spring steel was then determined considering stress concentration in the notch. The corresponding *S-N* curve was also constructed. Simultaneously, structural testing of real leaf springs for trucks was performed at selected conditions of fatigue and their life time was determined. FEM simulation of fatigue was used for the prediction of life time of springs, taking into account the selected leaf spring geometry, the mechanical properties of spring steel and conditions of fatigue. The calculated life time of the springs is in good agreement with its real life time.

In the present contribution fatigue strength of spring steels determined with a resonant pulsator, as well as FEM numerical based simulation of the notch effect in V-notched specimens and fatigue life-time prediction of leaf springs are presented.

NAPOVED DOBE TRAJANJA LISTNATIH VZMETI S POMOČJO DOLOČEVANJA UPOGIBNE TRAJNE NIHAJNE TRDNOST NA ZAREZANIH PREIZKUŠANCIH IZ VZMETNEGA JEKLA

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Upogibno trajno nihajno trdnost izbranega vzmetnega jekla smo določili z resonančnim pulzatorjem na standardnih Charpyjevih preizkušancih z V zarezo (CVN). Z numerično simulacijo, ki temelji na metodi končnih elementov (MKE) smo določili porazdelitev napetosti in deformacij v realnih pogojih utrujanja CVN preizkušancev na resonančnem pulzatorju. Na ta način smo lahko določili koncentracijo napetosti v zarezi in faktor zarezne občutljivosti. To nam je omogočilo določitev "prave" upogibne trajne nihajne trdnosti vzmetnega jekla, ki ne vsebuje zareze oziroma bi jo dobili pri preizkušanju na gladkih nezarezanih preizkušancih. Konstruirali smo pripadajočo S-N krivuljo jekla. Istočasno je potekalo tehnološko dinamično testiranje realnih listnatih vzmeti za tovornjake pri izbranih pogojih utrujanja in določena je bila njihova doba trajanja. Z MKE smo prav tako simulirali obnašanje realnih vzmeti med testiranjem in poizkušali napovedati njihovo dobo trajanja upoštevaje izbrano geometrijo vzmeti, mehanske lastnosti vzmetnega jekla in pogoje utrujanja. Izračunana doba trajanja se dobro ujema z tisto, ki je bila določena z tehnološkimi preizkusi.

V pričujočem prispevku bomo predstavili rezultate določevanja trajne nihajne trdnosti vzmetnega jekla na resonančnem pulzatorju, MKE simulacije zareznege vpliva in napoved dobe trajanja listnatih vzmeti izbranih geometrij.

KM-GP

WORKING OF Al-ALLOYS IN SEMI-SOLID STATE

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Semi-solid state represents two-phase structure that consists of liquid and solid phase ($L + \alpha Al$). Due to two-phase microstructure with globular primary phase the material shows thixotropic behaviour. That means the viscosity drops in semi solid state with increase of shear stresses in material. The consequence is good flow of material, better workability and easier manufacturing of components with thin walls.

Presented are two technologies of working in semi-solid state, Thixocasting in Rheocasting. Development of these processes represents the progress in casting of aluminium and enables better competitiveness on the market. The main factors are shape and form of solid phase, that influence the flow of material in the tool.

The comparison of thixocasting and rheocasting process at working of Al-alloys revealed their benefits and their weak points, which are necessary to be considered at the choice of one of these technologies. Research of components revealed that main reasons of presented failures are not optimised parameters of semi-solid working technology, too fast opening of the tools and not optimised shape of tools cavities.

PREOBLIKOVANJE Al-ZLITIN V TESTASTEM STANJU

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Testasto stanje predstavlja dvofazno strukturo, ki jo sestavljata tekoča in trdna faza ($L + \alpha Al$). Zaradi dvofazne mikrostrukture z globularno obliko primarne faze ima material pri preoblikovanju thixotropne lastnosti. To pomeni, da se viskoznost materiala v testastem stanju zmanjšuje z večanjem strižnih napetosti v materialu, posledica je dobro tečenje materiala, lažje preoblikovanje in možnost izdelave komponent s tanjšimi stenami.

Predstavljeni sta dve vrsti tehnologije ulivanja oz. preoblikovanja v testastem stanju, Thixocasting in Rheocasting. Razvoj teh dveh postopkov predstavlja preobrat pri postopkih ulivanja aluminija in omogoča boljšo konkurenčnost na trgu. Ključnega pomena sta delež trdne faze in oblika trdne faze, ki vplivata na tok materiala v orodju.

Primerjava thixocasting in rheocasting postopkov pri preoblikovanju Al-zlitine je pokazala njune prednosti in slabosti, ki jih je potrebno upoštevati pri odločitvi za uvedbo ene ali druge tehnologije. Raziskava je pokazala, da so glavni vzroki za prikazane napake pri preoblikovanju Al-zlitine premalo optimirani parametri tehnologije preoblikovanja v testastem stanju, prehitro odpiranje orodja in neprilagojena oblika orodij.

KM-GP

WORKABILITY OF AUSTENITIC STAINLESS STEELS

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The hot workability of the as-solidified microstructure is better in the case of the primary solidification of δ -ferrite, because it prevents the concentration of impurities in the residual interdendritic melt. The mechanisms of softening during the hot working of austenitic stainless steels are dynamic and static recrystallization. At lower temperatures the δ -ferrite was in the form of a continuous or discontinuous layer at the austenite grain boundaries, while at higher temperatures the δ -ferrite was in the form of rounded particles surrounded by the austenite matrix. The as-cast stainless steel with 0.0082 wt. % of lead was sensitive to interdendritic crack formation as the number of insoluble lead particles was increased at the dendritic surface, when the particles were pushed by the solidification front. With hot rolling of a wedge sample the temperature and the deformation step when the steel became sensitive to hot cracks were determined. Edge cross cracks appeared in the temperature range between 1100 °C and 1150 °C at around a 30 % step of deformation. Inside the hot-rolled samples microcracks were observed at the austenite and δ -ferrite boundaries, where the segregation of sulphur was observed, also.

PREOBLIKOVALNA SPOSOBNOST AVSTENITNIH NERJAVNIH JEKEL

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Preoblikovalnost jekla s strjevalno mikrostrukturo v vročem je boljša pri primarni kristalizaciji δ -ferita, ker ta prepreči koncentracijo nečistoč v preostali meddendritni talini. Mehanizma mehčanja med preoblikovanjem v vročem avstenitnih nerjavnih jekel sta dinamična in statična rekristalizacija. δ -ferit ni zmanjšal deformabilnosti jekla v temperaturnem območju med 1050 °C in 1250 °C, ne glede, ali je bil pri nižji temperaturi razporejen v obliki zvezne ali deloma prekinjene mreže okoli zrn avstenita, in pri višji temperaturi, ko je ferit v ovalnih delcih, ki so ločeni s široko plastjo avstenita. Nerjavno jeklo z masnim deležem svinca 0,0082 % s strjevalno mikrostrukturo je občutljivo za nastanek razpok po interdendritnih površinah, na katerih je večje število zrn svinca, ki jih je na meje odrinila napredujoča fronta strjevanja. Z vročim valjanjem klinastih preizkušancev smo ugotovili temperaturo in stopnjo deformacije, pri kateri je jeklo občutljivo za nastanek valjarniških napak. Med vročim valjanjem je δ -ferit enako duktilen kot avstenit. Pri temperaturah preoblikovanja 1100 °C in 1150 ° in pri okoli 30-odstotni stopnji deformacije se na robovih vzorcev pojavijo prečne razpoke, v notranjosti vzorcev pa mikrorazpoke med avstenitom in δ -feritom, ki so posledica izcejanja žvepla.

KM-GP

THE CHARACTERISATION OF NANOSTRUCTURED SILICON OXIDE TYPE COATINGS DEPOSITED BY PACVD ON SI AND GLASS SUBSTRATES FOR ANTIBIOFOULING APPLICATIONS

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Plasma-assisted chemical vapor deposition (PACVD) is known as a key technology applied in a whole range of industries including semiconductor industry, applications in dielectric thin films, corrosion protection layers on metallic surfaces, scratch-resistant films and antireflective layers on plastic surfaces and as barrier films for food packaging. For all mentioned applications, it is necessary to obtain special film properties. Thus, for the SiO₂ thin film production in semiconducting processing there is an absolute necessity to deposit very smooth films with high insulating properties. For the creation of barriers on polymer foils, SiO₂ films with a high packaging density and low gas permeability are required. For scratch-resistant films, a good adhesion and a high hardness are essentially reached by changing the hydrocarbon content in the silica films.

The present study examines the potential of PACVD silicon dioxide films for a number of applications in marine and freshwater environments where the control of biological fouling is critical, e.g. ship hulls, membrane filters, heat exchangers, instruments and aquaculture. PACVD was used to deposit a range of silicon oxide coatings with various hydrocarbon contents in order to produce a range of surface energies since this is known to be an important parameter determining adhesion of microbes and macrofouling organisms such as algae.

In the present work the adsorption and adhesion at PACVD silicon dioxide film/substrate interface was evaluated and characterized by using XPS. The morphology and thickness of the film was evaluated by using FE-SEM.

KM-GP

ELECTRON BACKSCATTER DIFFRACTION (EBSD) CHARACTERISATION OF METALS

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Today's field emission scanning electron microscope (FEG SEM) in combinations with analytical spectroscopic techniques of EDS and WDS allows us highly accurate microstructure characterization of metals. Secondary electron image gives us information on size, shape and distribution of microstructure elements, while micro chemical analysis gives us chemical composition of certain analyzing areas. For a complete description of a polycrystalline material it is necessary to consider its crystal structure and orientation of these crystals in space. Applying the EBSD method in combination with Scanning Electron Microscope allows characterisation and quantification of crystallographic orientations, misorientations, texture trends and grain boundary types on a sub-micron scale. In the lecture the bases of EBSD method as well as physical background of electron diffraction on crystal lattice plane are given. Selected case studies using EBSD are presented like texture analysis of electrical steel, phase analysis of carbides in steels, crystallization of powders and thin films.

KM-GP

ESTIMATION OF GRAIN SIZE AND TEXTURE FROM EDDY CURRENT AND HYSTERESIS LOSS DATA

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Measurement of hysteresis and eddy current losses gives more information about magnetic properties of material than only measurement of total magnetic losses. Beside of magnetic measurements we need also grain size, textures and distribution of those. Measurements of magnetic losses and permeability also give a certain information about grain size and texture. The aim is to use these data as fingerprints, at which process step the fault has occurred.

OCENA VELIKOSTI ZRN IN TEKSTURE IZ VRTINČNIH IN HISTEREZNIH IZGUB

Meritev histereznih in vrtničnih izgub da več informacij o magnetnih lastnostih materiala, kot samo meritev celotnih magnetnih izgub. Poleg magnetnih meritev potrebujemo tudi velikosti zrn, teksturo zrn in porazdelitve teh. Vendar že same meritve magnetnih izgub in permeabilnosti dajo tudi nekaj informacije o velikosti zrn in o teksturah. Cilj je iz te množice številki tudi ugotavljati, na katerih agregatih zgodile razne napake, torej te meritve uporabljati kot prstne odtise.

KM-GP

DEVELOPMENT OF LEAN DUPLEX STAINLESS STEELS

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The usefulness and perfect characteristics of duplex stainless steels were the main reasons for the researchers' development of other grades of duplex family. The choice of lean duplex steels in correlation with savings of strategically raw materials have been optimal. ACRONI develops lean duplex stainless steels ACRONI 16 Mn in ACRONI 16 LMo. These steels are very good substitutes for the more alloying - more expensive steels, like Mo grades and super austenitic steels respectively. Lean duplex stainless steels have excellent mechanical properties and very good corrosion resistance.

RAZVOJ LEAN DUPEKSNIH NERJAVNIH JEKEL

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Širok spekter uporabnosti kot posledica odličnih karakteristik dupleksnih nerjavnih jekel je determiniral razvoj novih tovrstnih materialov. Optimalna izbira v korelaciji s surovinskimi prihranki so bila manj legirana - lean dupleksna nerjavna jekla. ACRONI razvija manj legirani dupleksni nerjavni jekli ACRONI 16 Mn in ACRONI 16 LMo. Jekli sta v večini primerov odlični nadomestili za bolj legirana - dražja dupleksna jekla, kot tudi ostala jekla legirana z molibdenom oziroma super avstenitna nerjavna jekla. Lean dupleksna nerjavna jekla imajo odlične mehanske lastnosti in še vedno dobro korozijsko obstojnost.

KM-GP

THE FORMATION OF NIOBIUM CARBONITRIDE EUTECTIC IN STRUCTURAL STEEL

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Niobium is an important alloying element in many modern structural steels. Small additions of Nb can have strong effects on the development of steel microstructure, especially during thermo – mechanical processing, and as a result strongly influence the mechanical properties.

During the solidification a small amount of Fe+NbC eutectic is formed regardless of the initial composition or solidification rate.

There are some indications that Fe+NbC eutectic result in reduced ductility particularly in the thickness direction of the plate.

In the present work, an example of morphology and distribution of eutectic carbonitride particles in commercial manufactured structural steel and its effect on final mechanical properties of hot-rolled 90 mm heavy plates is given.

FORMACIJA NIOBIJ KARBONITRIDEGA EVTEKTIKA V KONSTRUKCIJSKEM JEKLU

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Niobij je pomemben legirni element pri sodobnih konstrukcijskih jeklih. Že majhna količina dodanega niobija pomembno vpliva na razvoj mikrostrukture, še posebej med termomehanskim procesom, kar močno vpliva na končne mehanske lastnosti jekla.

Med strjevanjem se ne glede na sestavo jekla ter hitrost strjevanja izloča majhen delež evtektika Fe-NbC.

Znano je da evtektik Fe-NbC povzroča slabo duktilnost, še posebej v smeri debeline.

V prikazanem delu, podajamo morfologijo in razporeditev karbonitridnega evtektika v običajnem konstrukcijskem jeklu in vpliv na končne mehanske lastnosti 90 mm plošče.

KM-1

MODIFICATION OF INCLUSIONS IN LADLE METALLURGY

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Modification of inclusions formed mainly by aluminium oxide during steel refining in ladle is necessary condition for good steel castability on CCM. Calcium is used to that, the most often in form CaSi or CaCN₂ (in case of contemporary demand for increased content of nitrogen in steel). SBQ steels, that are characterised by increased sulphur content, can contain except Al₂O₃ inclusions even CaS inclusions. Both inclusion types have harmful effect on clogging of tundish nozzles. In presented paper results of experimental melts monitoring influence of modification calcium on morphology of aluminate inclusions during steel refining in the ladle are given.

The works were realised within the frame of the project EUREKA E!3580 SYNSLAG OE214.

KM-2

BRITTLE FRACTURE STRENGTH OF A HIGH STRENGTH MICROALLOYED STEEL WITH DIFFERENT MICROSTRUCTURE

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The aim of the investigation was to explain the cause for the formation of local brittle zones in the heat affected zone of welds. It was found that after short reheating at temperature 750 °C the notch toughness of bainite was decreased at 0 °C for approximately one order of magnitude, while, for martensite it was changed only slightly. Tensile tests were carried out below the lower shelf CVN temperature at –115 °C with notched round specimens. From the brittle tensile strength the cleavage strength was deduced.

Three types of force-extension dependence were observed: curve with clear yield strength (R_e), curve with proof strength indicating to a limited plastic deformation and curve with only elastic extension of specimens with fracture in the range of proportionality force-extension. Cleavage strength values in the range of 2362 MPa to 3132 MPa were deduced from the values of brittle tensile strength. The cleavage strength was lower after reheat and different for different microstructure. The fracture surface was examined in SEM. At all specimens, also in those fractured without plastic deformation, it consisted of a ring of ductile shearing at the notch tip and a central area of cleavage. The width of the surface ring was up to approximately 0.1 mm and generally smaller on reheated specimens. No relation was found between the cleavage strength and fracture surface appearance and the results of CVM tests of specimens with the same microstructure.

KRHKA TRDNOST VISOKOTRDNEGA MIKROLEGIRANEGA JEKLA Z RAZLIČNO MIKROSTRUKTURO

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Cilj raziskave je bil opredeliti vzrok za nastanek lokalnih krhkih področij v toplotni zoni zvarov. Ugotovili smo, da se zarezna žilavost, po kratkem ogrevanju pri temperaturi 750 °C, zmanjša pri jeklu z mikrostrukturo iz bajnita za okoli reda velikosti in se le malo spremeni pri mikrostrukturi iz martenzita. Natezne preskuse smo naredili pri temperaturi –115 °C, kar je pod spodnjim pragom žilavosti (pragom krhkega preloma) na okroglih preskušancih z zarezo. Iz vrednosti natezne trdnosti smo izračunali cepilno trdnost.

Ugotovili smo tri vrste odvisnosti sila-raztezek. Odvisnost z naravno napetostjo tečenja, odvisnost, pri kateri se je proporcionalnost med silo in podaljškom nadaljeval z omejeno plastično deformacijo in odvisnost brez plastične deformacije, s prelomom v področju elastične deformacije. Iz nateznih trdnosti smo izračunali cepilne trdnosti v področju med 2362 MPa do 3132 MPa, ki so bile nižje pri preskušancih, ogreth pri temperaturi 750 °C. Prelome smo pregledali v SEM mikroskopu. Pri vseh preskušancih, tudi tistih, ki so se prelomili v elastičnem področju, smo na prelomni površini opazili ozek obroč duktilnega zdrsa ob konici zareze in sredino z mikromorfologijo, značilno za cepljenje. Širina obroča ob konici zareze je bila do 0.1 mm in manjša pri preskušancih, ki so bili ogreti pri temperaturi 750 °C. Iz rezultatov raziskave nismo našli nobene povezave med rezultati nateznih preskusov v področju krhkosti in rezultati preskusov zrezne trdnosti jekel z enako mikrostrukturo.

KM-3

INVESTIGATION OF THE WORKABILITY OF DUPLEX STAINLESS STEEL WITH TENSILE TESTS

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The workability of steels is slightly dependent on the type of deformed steel, and depends strongly also on test method. The main competent method to investigate the steel workability is the examination of specimens taken from the deformation process and it is not applied in majority of examples. Therefore the workability is tested applying different procedures that enable to make a relative comparison of workability in dependence of deformation conditions and make inferences on true stresses during the treated deformation process.

In this work the workability of the duplex stainless steel LDX 2101 was determined with true strain – true stress curves at steel hot rolling temperature with tensile tests in temperature range 850 to 1250 °C and deformation velocities $\dot{\epsilon} = 0,01$ and $0,001 \text{ s}^{-1}$. The most favourable temperature range for hot deformation of the steel LDX 2101 and the strain hardening were established in dependence of temperature and deformation degree.

UGOTAVLJANJE PREOBLIKOVALNIH SPOSOBNOSTI DUPLEX NERJAVNEGA JEKLA Z NATEZNM PRESKUSOM

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Preoblikovalne sposobnosti jekel so odvisne predvsem od vrste preoblikovanega jekla, precej pa tudi od načina in pogojev preskušanja. Najbolj primeren način ugotavljanja preoblikovalnih sposobnosti je ugotavljanje preoblikovalnih lastnosti iz obravnavanega postopka preoblikovanja jekla, kar pa v večini primerov ni izvedljivo. Zato jih ugotavljamo po drugih postopkih, ki pa naj bi bili po načinu preoblikovanja čim bolj podobni postopku preoblikovanja, za katere preoblikovalne sposobnosti materialov ugotavljamo. Iz rezultatov omenjenih načinov ugotavljanja preoblikovalnih sposobnosti lahko naredimo le relativno primerjavo preoblikovalnih sposobnosti jekla v odvisnosti od pogojev preskušanja, ne moremo pa sklepati na velikost preoblikovalnih napetosti jekla med procesom vročega valjanja.

V predstavljenem delu smo ugotavljali preoblikovalne sposobnosti Duplex nerjavnega jekla LDX 2101, krivulje tečenja (prava napetost – log. deformacija) pri temperaturah vročega valjanja jekla. Ugotavljali smo jih z nateznim preskusom pri temperaturah od 850 do 1250 °C in dveh hitrostih preoblikovanja $\dot{\epsilon} = 0,01$ in $0,001 \text{ s}^{-1}$. Iz rezultatov omenjenih preskusov smo ugotovili v katerem temperaturnem področju ima preskušano jeklo najboljše preoblikovalne sposobnosti in kakšno je utrjevanje jekla v odvisnosti od temperature preoblikovanja in stopnje deformacije.

KM-4

APPLICATION OF CERAMIC FILTERS IN INGOT CASTING PROCESS

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In the year 2007, this paper was presented at the Ceramics preparation conference held in Herlany (Slovak Republic) and also at the Metallurgical ceramics conference held in Rožnov pod Radhoštěm (Czech Republic). As the work on this research project is still in progress this paper is the continuation of the previous one.

The aim of the application of the ceramic filters in the gating system during ingot casting is to increase steel cleanliness by the elimination of non-metallic inclusions (exogenous or endogenous). The paper includes the results of next analyses carried out within the framework of this task solution.

Repeated evaluation of the size of inclusions before and after the filter has been carried out and the micro-cleanliness level before and after the filter has also been evaluated again in accordance with DIN 50602. In addition to, the detailed chemical analysis of individual types of inclusions has been carried out.

The investigations have been performed within the EUREKA program of the E/3192 ENSTEEL project having the identification No. IP04EO169, and financial support of the Ministry of Education, Youth and Sport of the Czech Republic.

KM-5

STEEL REOXIDATION DURING FILTRATION

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The article deals with re-oxidation processes occurring at filtration of de-oxidised steel with use of various ceramic filters and de-oxidation reagents. Two series of heats weighing 40 kg each were carried out in an induction furnace and afterwards they were de-oxidised by two different reagents. The first de-oxidation reagent was a combination of ferrosilicon and aluminium, however, the final modification was made with use of CaSi. The second deoxidising reagent was a combination of silicon and manganese. The heats de-oxidised in this manner were poured altogether through 9 different types of ceramic filters from two manufacturers. The first manufacturer – KERAMTECH, s.r.o. – supplied 8 different filters based on Al_2O_3 , Cr_2O_3 , TiO_2 , ZrO_2 , SiO_2 , $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$, $\text{MgO} \cdot \text{Al}_2\text{O}_3$ and $\text{ZrO}_2 \cdot \text{SiO}_2$. The second manufacturer – EUTIT, s.r.o. – supplied the last type of filter based on corundum-baddeleyit ceramics of the type KBK. All the used filters had the following parameters: \varnothing 68 mm, height 10 mm, number of holes 19, \varnothing of holes 8 mm. Laboratory heats consisted in re-heating of steel to the temperature of 1 650 °C. After completion of de-oxidation the melt was poured through the pouring system, which contained one of the filters mentioned above. The first series of heats of filtered steel was de-oxidised by aluminium (CaSi) and 5 different ceramic filters were used: Al_2O_3 , Cr_2O_3 , $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$, $\text{ZrO}_2 \cdot \text{SiO}_2$ and KBK. The second series of heats of filtered steel was de-oxidised by manganese and silicon and 8 different types of filters were used: Al_2O_3 , Cr_2O_3 , TiO_2 , ZrO_2 , SiO_2 , KBK, $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ and $\text{MgO} \cdot \text{Al}_2\text{O}_3$ and $\text{ZrO}_2 \cdot \text{SiO}_2$. After solidification of steel the samples of metal were taken before the filter and after the filter in an ingot and a cut-out of ceramic filter were also made. Study of re-oxidation phenomena was then made on the basis of metallographic purity, more precisely by determination of chemical composition of non-metallic inclusions. It was established from the obtained results that in the course of filtration in all cases additional oxidation (so called re-oxidation) of steel occurred, which manifested itself namely by an increased share of MnO and Fe_2O_3 , oxides in non-metallic inclusions. Important influence of manner of de-oxidation on re-oxidising processes was determined as well. Intensity of the course of re-oxidation processes was indirectly proportional to the preceding degree of steel deoxidation. In our case this was manifested in the heats de-oxidised by manganese and silicon.

The works were realised within the frame of the projects GA ~R reg. no. 106/06/0393 and EUREKA E!4092 MICRST OE08009.

KM-6

TRANSMISSION ELECTRON MICROSCOPY BASED INVESTIGATIONS OF OXIDATION BARRIER IN THE INTERNALLY OXIDIZED Ag BASED ALLOYS

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Internally oxidized Ag based alloys prone to passivation were investigated. Passivation was hindered with modification. Passivation phenomenon was successfully hindered and undisturbed growth of internal oxidation zone was obtained by the addition of 0.001 do 0.5 weight % microalloying elements with high free energy of oxide formation. Investigations with electron microscopy showed in-situ formation of oxide of microalloying element followed by the formation of oxide of second alloying element. Different amounts of Mg, Si, Ti, Al, Zr and Be were proved as the most successful microalloying elements to binary Ag-Zn alloy. Distribution and density of nuclei was determined. This is the base for correct selection of concentration interval of each individual microalloying element for successful modification. TEM analyses confirmed our hypothesis relating to structure, matrix and frequency of boundaries among matrix and oxide particles.

PREISKAVE OKSIDACIJSKE PREGRADE V NOTRANJE OKSIDIRANIH SREBROVIH ZLITINAH S POMOČJO ELEKTRONSKE MIKROSKOPIJE

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Pri notranje oksidiranih zlitinah, kjer pride do pojava pasivacije, smo poskušali pasivacijo preprečiti z modificiranjem. Z dodatki mikrolegirnih elementov v velikosti 0,001 do 0,5 mas. %, ki imajo zelo veliko prosto energijo nastanka oksidov, smo uspešno preprečili pojav pasivacije ter omogočili nemoteno rast oksidacijske cone v notranjost.

Pri elektronskih raziskavah smo poskušali dokazati in-situ pojav, da se na kaleh mikrolegirnega elementa najprej tvori oksid, na katerem se uspešno nalaga oksid drugega legirnega elementa. Kot najuspešnejše mikrolegirne elemente kot dodatek binarni zlitini Ag-Zn smo dokazali Mg, Si, Ti, Al, Zr in Be.

Določili smo tudi porazdelitev in gostoto kali, ki je podlaga za pravilen izbor koncentracijskega intervala mikrolegirnega elementa, kjer je uspešnost modifikacije še zagotovljena. S TEM smo analizirali in potrdili našo hipotezo tako strukturo, pogostost, matico in meje med matico in oksidnimi delci.

KM-7

HOT WORKABILITY OF SUPERAUSTENITIC STAINLESS STEEL AISI 904L

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An extensive investigation of hot workability of superaustenitic stainless steel AISI 904L was conducted. Uniaxial compression tests were made using a thermo-mechanical simulator Gleeble 1500D, with specimen dimensions $\Phi 8 \times 12$ mm. A wide range of deformation temperatures (from 850°C to 1200°C) and strain rates (0,001; 0,01; 0,1; 1; 5 s⁻¹) was studied. Flow curves were used for calculation of the processing maps based on Dynamic Material Model. Also a complete microstructural analysis of the samples in dependence of testing parameters was made. This is the basis for better understanding of the processes in materials during the hot deformation.

VROČA PREOBLIKOVALNOST SUPERAVSTENITNEGA NERJAVNEGA JEKLA AISI 904L

Narejena je bila obsežna preiskava vroče preoblikovalnosti superavstenitnega nerjavnega jekla AISI 904L. V ta namen so bili na termomehanskem simulatorju metalurških stanj, Gleeble 1500D, izvedeni tlačni preizkusi cilindričnih vzorcev, dimenzije $\Phi 8 \times 12$ mm. Preizkusi so bili izvedeni v širokem temperaturnem območju (850°C do 1200°C) ter pri različnih hitrostih deformacije (0,001; 0,01; 0,1; 1; 5 s⁻¹). Pridobljene krivulje tečenja so bile uporabljene za izračun procesnih map, ki nam prikazujejo stabilne pogoje preoblikovanja ter so sestavljene iz map porabe moči in map nestabilnosti. Narejena je bila tudi obsežna mikrostrukturalna analiza, ki podaja razvoj mikrostrukture v odvisnosti od testnih parametrov. Taka analiza služi za optimizacijo procesne poti materiala in je osnova za boljše razumevanje procesov, do katerih v materialu prihaja med deformacijo.

KM-8

DETERMINATION OF STEEL CLEANNESS BY AUTOMATIC ANALYSIS OF INCLUSIONS ON EDS ANALYSER

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One of the most important factors for steel applicability is also cleanness of steel. It is determined by the number, size, distribution and also composition of non-metallic inclusions.

The non-metallic inclusions content is usually determined by optical microscope with the aid of comparison methods and tables prescribed by various standards.

For constant improvement of steel quality it is also important to have more precise, more objective determination of non-metallic inclusion content. This is enabled by automatic analysis which provides us with tabular and graphic results about size, distribution and composition of inclusions.

The data about automatic analysis of inclusions on scanning electron microscope and EDS analyzer will be presented.

DOLOČANJE ČISTOČE JEKEL Z AVTOMATSKO ANALIZO VKLJUČKOV NA EDS ANALIZATORJU

Za končno uporabnost izdelkov je zelo pomembna čistost jekla. Ta je določena s številom, velikostjo, porazdelitvijo in tudi sestavo nekovinskih vključkov.

Delež vključkov običajno določamo pod optičnim mikroskopom s pomočjo primerjalnih metod, ki so predpisane z različnimi standardi.

Za konstantno izboljševanje kakovosti jekel pa je včasih potrebna bolj točna analiza vključkov, brez subjektivnih faktorjev. Le-to omogoča avtomatska analiza, na osnovi katere lahko dobimo tabelarični, lahko pa tudi grafični izpis velikosti, porazdelitve in sestave vključkov.

Predstavljeni bodo rezultati avtomatske analize vključkov v različnih vrstah jekel, na vrstičnem elektronskem mikroskopu in EDS analizatorju.

KM-9

STRAIN HARDENING EXPONENT TIME DEPENDENCE OF THERMALLY AGED CAST STAINLESS STEEL

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Basic mechanical properties of metallic materials are determined with the tensile test of the smooth round-bar specimen. Dependence between tensile stress and specimen deformation is shown in an engineering stress-strain curves. Beside engineering curves, true stress-true strain curves are also used which can be described with Hollomon's equation. The tensile test curves are often used to determine strain hardening exponent n . In this contribution the determination of the strain hardening exponent from the results of tensile tests of thermally aged cast stainless steel specimens will be presented.

ODVISNOST EKSPONENTA UTRJEVANJA OD ČASA TERMIČNEGA STARANJA LITEGA NERJAVNEGA JEKLA

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Osnovne mehanske lastnosti kovinskih materialov se ugotavljajo z nateznim preizkusom gladkega cilindričnega preizkušanca. Odvisnost med natezno obremenitvijo in deformacijo preizkušanca prikazuje inženirska krivulja napetost-raztezek. Poleg inženirske krivulje je dostikrat v uporabi tudi odvisnost med pravo napetostjo in pravo deformacijo, ki se lahko tudi opiše s Hollomon-ovo enačbo. Iz krivulje dobljene pri nateznem preizkusu pa se lahko določi eksponent deformacijskega utrjevanja n . V prispevku bo predstavljena določitev eksponenta utrjevanja iz rezultatov nateznih preizkusov različno dolgo termično staranih nateznih preizkušancev iz litega nerjavnega jekla.

KM-10

CEMENTATION WITH THE MIXTURE OF METHANOLE AND ACETONE IN PIT FURNACE

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Industrial practice of cementation is commonly done by gas and liquid compounds. The problems of gas cementation are production and quality of gas for cementation on the base of butane and propane. A new solution of the problem, that showed in engineering praxis as a good solution, is the cementation with the mixture of methanole and acetone. This way of cementation is simpler and cheaper, because there is no need for production of gas for cementation and pit furnace is feeded directly with methanole and acetone.

C potential is controlled by an oxygen probe and its required value is set up via programmed device. This work presents an industrial application of cementation with methanole and acetone mixture in pit furnace in the company TRD Vares. It is the first case of application in the industrial furnaces for thermochemical treatment on the territory of the BiH.

KM-11

CARBIDE IDENTIFICATION IN SEMI-HSS WITH EDS AND EBSD TECHNIQUES

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High Speed Steels are more and more used for outside coat or working layer for centrifugally cast multilayer rolls. Different types of carbides are present in low-alloyed hypereutectoid steels alloyed with chromium, molybdenum, nickel and vanadium. Carbides present in this steel were identified with EBSD and EDS techniques. Both methods have confirmed that $(Cr, Fe)_7C_3$, $Fe_3(Mo,W)_3C$ and V_4C_3 are present in this steel.

IDENTIFIKACIJA KARBIDOV V ZLITINI SEMI-HSS Z METODAMA EDS IN EBSD

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HSS jekla se vedno bolj uporabljajo za zunanji plašč oziroma za delovno površino večslojnih centrifugalno ulitih valjev. V nizko legiranih jeklo litinah nadevtektoidne sestave legirane s kromom, molibdenom, nikljem ter vanadijem je prisotnih več vrst karbidov. V delu smo identificirali prisotne karbide z metodama EBSD in EDS. Z obema metodama smo potrdili prisotnost karbidov $(Cr, Fe)_7C_3$, $Fe_3(Mo,W)_3C$ in V_4C_3 .

KM-12

ION SPUTTERING RATES FOR THIN OXIDE LAYER ON DUPLEX STEEL AT DIFFERENT 3 keV Ar⁺ INCIDENCE ANGLES

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Thin oxide layer of several tens of nm was deposited onto duplex steel substrate by plasma oxidation. SEM image of the cross section was used to determine the thickness of the layer directly. Sample in sample holder was mounted onto the sample stage of the high resolution Auger spectroscopy apparatus equipped with a fixed ion gun. Simple depth profiling at well defined ion beam parameters was performed until substrate was reached. Then unsputtered area of the sample was chosen, sample was tilted to change the incidence angle (defined as the angle between the ion beam and normal to the sample surface) and depth profiling repeated at identical ion beam parameters as previously. Total sputtering time in each case is inversely proportional to the sputtering rate. To increase the range of possible incidence angles from approximately 45–70° defined by geometrical and engineering constraints a sample holder with tilted upper surface was manufactured to make use of another degree of freedom available from the sample stage: azimuthal rotation. In this manner, virtually all incidence angles from 0 to 90 ° became available. Measurements showed sputtering rate to be angle dependant, smaller values being located towards grazing angles and normal incidence with broad maximum in-between.

JEDKALNE HITROSTI ZA TANKO OKSIDNO PLAST NA DUPLEX JEKLU PRI RAZLIČNIH VPADNIH KOTIH IONOV ARGONA Z ENERGIJO 3 keV

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Nekaj deset nanometrov debelo oksidno plast smo pripravili z oksidacijo substrata v plazmi. Debelino oksidne plasti smo neposredno ugotovili iz visokoločljive SEM slike preseka vzorca. Vzorec na nosilcu smo vstavili v AES/SEM/XPS sistem visoke ločljivosti s fiksnim ionskim izvorom in možnostjo nagiba in azimutalne rotacije vzorca. Ob konstantnih parametrih jedkanja smo izmerili AES globinske profile oksidne plasti pri različnih vpadnih kotih ionskega curka (definiranih s kotom med normalo na jedkano ploskev in ionskim curkom). Samo z nagibanjem vzorca je dosegljivo območje vpadnih kotov približno 45–70°. Posebno izdelan nosilec vzorca z nagnjeno zgornjo ploskvijo omogoča prek ustreznih vrednosti nagiba in azimutalne rotacije vpadne kote 0–90°. Totalni jedkalni čas pri vsakem kotu je obratno sorazmeren jedkalni hitrosti. Izmerjena kotna odvisnost jedkalne hitrosti kaže manjše vrednosti, ko se približuje skrajnim vrednostim (paralelni, normalni vpad), vmes pa se nahaja širok maksimum.

KM-13

THE DEVELOPMENT OF NICKEL; ALLOYS INVAR

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The new technological process for industrial production of Invar alloy was developed. By this, Acroni became exclusive supplier for french partner Imphy Alloys – ArcelorMittal – Stainless & Nickel Alloys. Invar alloys (also Invar steels) are compositions of iron and nickel. Their temperature expansion coefficient depends on nickel content. This coefficient increases with temperature for alloys with up to 20% nickel content. For alloys with nickel content above 36 %, there is no temperature expansions. In the past, these alloys were used in production of instruments (bimetals), but in the last years their applicability has been spread over various different areas, for example construction of tankers and terminals for liquefied gases, aircraft industry. Because of this, the interest for the product on market increases.

The products made of Invar alloy are delivered as heavy plates with the following dimensions: thickness: 8 – 70 mm; length: 6.000 mm, width: 2.000 mm or as hot rolled strips with thickness 3 mm and width 1000mm.

RAZVOJ NIKLJEVIH ZLITIN – ZLITINA INVAR

Razvili smo nov tehnološki postopek za industrijsko izdelavo Invar zlitine. S tem je Acroni postal ekskluzivni dobavitelj za francoskega partnerja Imphy Alloys – ArcelorMittal – Stainless & Nickel Alloys. Invar zlitine (tudi invar jekla) so zlitine železa in niklja, katerih koeficient temperaturnega raztezka je močno odvisen od vsebnosti niklja. Zlitinam do 20 % Ni se razteznost s porastom temperature večja, nad 36 % pa praktično ni več toplotnih raztezkov.

V preteklosti so se te zlitine uporabljale predvsem za izdelavo instrumentov (bimetali), v zadnjih letih pa se je njihova uporabnost razširila na številna druga področja, n.pr. gradnja tankerjev in terminalov za utekočinjene pline, letalska industrija, kar je močno povečalo tržno zanimivost tega izdelka.

Izdelke iz Invar zlitine dobavljamo v obliki plošč debeline 8 – 70 mm, širine 2.000 in dolžine 6.000 mm ter toplovaljanih trakov debeline 3 mm in širine 1.000 mm.

KM-14

TURBINE BLADE STEELS AND TECHNOLOGY OPTIMIZATION FOR ROLLED QUENCHED AND TEMPERED SECTIONS PK3 (X20Cr13)Bernarda Janet¹, Jure Jamer¹, Henrik Kaker¹, Vlado Perovnik¹¹Metal Ravne d.o.o. Koroška cesta 14, 2390 Ravne na Koroškem, Slovenija

Steels for turbine blades – sections meant for further machining and production of blades and semi-finished products for further forging of blades represent as to their specific use (elevated temperatures, lasting constant loads) a big challenge also for METAL RAVNE. These products are incorporated into the most heavily loaded parts of turbines for the production of electric energy, where they have to guarantee 100 % operation. For the production of steels for turbine blades, we must keep control over the whole production process of manufacturing, heat treatment and an extensive and very precise final control. With these facts, we managed to satisfy very strict quality demands of the customer for macro- and microhomogeneity, corrosion resistance, creep resistance, dimensional stability, uniform toughness and mechanical properties over the cross section, a uniform hardness, surface free of defects and compactness of material. Today, Metal Ravne supplies steel to the major global producers of turbine blades.

Steel PK3 (X20Cr13) is one of the most widely used steels in the group of turbine blade steels. With the development of a technological process for this steel in Metal Ravne, we managed to improve some properties, especially for rolled tempered bars. We got the best properties like higher impact toughness, lower FATT value (Fracture Appearance Transition Temperature) and a smaller percentage of intergranular fracture at room temperature by optimizing the end rolling temperature, cooling speed after rolling and heat treatment parameters. At work, we used the following research methods: tensile testing, impact toughness testing, hardness testing, optical microscopy, scanning electron microscopy,... With the new technological process, we ensure better product properties and also increase our share on the demanding market of qualified suppliers of turbine blade steels.

JEKLA ZA TURBINSKE LOPATICE TER OPTIMIRANJE TEHNOLOGIJE VALJANIH POBOLJŠANIH PROFILOV PK3 (X20Cr13)

Jekla za turbinske lopatice – profili za nadaljnjo mehansko obdelavo in izdelavo lopatic ter polproizvodi za kovanje lopatic, predstavljajo zaradi svoje specifične uporabe (dolgotrajne konstantne obremenitve pri povišanih temperaturah), izziv tudi METAL-u RAVNE. Ti proizvodi so vgrajeni v najbolj obremenjene dele turbin za proizvodnjo električne energije, kjer morajo zagotavljati 100 % delovanje. Za izdelavo jekel za turbinske lopatice je predpogoj, da obvladujemo celoten proces izdelave, plastične predelave, toplotne obdelave in obširne ter zelo natančne končne kontrole. S tem lahko uspešno zagotavljamo ostre kakovostne zahteve kupcev kot so: makro in mikrohomogenost jekla, korozijska odpornost, odpornost proti lezenju, majhne dimenzijske spremembe, enakomerna žilavost in mehanske lastnosti po preseku, enakomerna trdota, površina brez napak, kompaktnost materiala. Metal Ravne ta jekla danes dobavlja večini večjih proizvajalcev turbinskih lopatic v svetu.

Jeklo PK3 (X20Cr13) je eno izmed najbolj uporabljanj jekel v segmentu jekel za turbinske lopatice. V Metalu Ravne smo z razvojem tehnološkega procesa bistveno izboljšali lastnosti tega jekla predvsem na valjanih poboljšanih profilih. Najboljše lastnosti kot je višja udarna žilavost, znižanje prehodne temperature žilavosti, manjši delež interkristalnega preloma pri sobni temperaturi, smo dosegli z optimiranjem končne temperature valjanja, kontroliranega ohlajanja po valjanju in z optimiranjem parametrov toplotne obdelave.

Pri delu smo uporabili naslednje raziskovalne metode: natezni preizkus, preizkušanje udarne žilavosti, merjenje trdote, optično mikroskopijo, preiskavo prelomnih površin z vrstično elektronsko mikroskopijo – SEM Z novim tehnološkim postopkom zagotavljamo boljše lastnosti izdelka, zagotovili pa smo si tudi večji delež na zahtevnem trgu potrjenih dobaviteljev jekel za turbinske lopatice.

KM-15

COMPARISON OF THE FILLER MATERIALS FOR P91 STEEL WELDING

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On components of power plants exposed to high temperature and high pressure creep damage can occur. For such components, instead of steel X20 CrMoV 121, steel P91 with better creep resistance is used.

The goal of the research was to determine microstructural characteristic, mechanical properties (yield strength, tensile strength, hardness) and creep resistance of two P91 steel butt welds. Two filler materials, EVB 91 CrMoV-LSi and EVB 91 CrMoV, were used for butt welds filler passes. From both welded joint specimens for mechanical test and creep resistance tests were made and annealed at 650 °C and 750 °C. In this contribution the effect of annealing temperature and time on properties will be presented.

PRIMERJAVA DODAJNIH MATERIALOV ZA VARJENJA JEKLA P91

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Na komponentah termoelektrarn, ki so izpostavljene visokim temperaturam in visokim tlakom lahko nastanejo poškodbe zaradi lezenja. Za tako obremenjene dele termoenergetskih objektov se namesto jekla X20 CrMoV 121 vgrajujejo komponente iz jekla P 91, ki ima boljšo odpornost proti lezenju.

Namen raziskave je bil opredeliti mikrostrukturne značilnosti, mehanske lastnosti (napetost tečenja, natezna trdnost, trdota) in odpornost proti deformaciji z lezenjem na dveh zavarjenih spojih iz jekla P 91. Za nanos polnilnih varkov sta bila uporabljena dodajna materiala EVB 91 CrMoV-LSi in EVB 91 CrMoV. Iz obeh zavarjenih spojev so bili izdelani preizkušanci za mehanske preiskave in preiskave lezenja, ki so bili žarjeni pri 650 °C in 750 °C. V prispevku bodo predstavljeni rezultati preizkusov v odvisnosti od temperature in časa žarjenja.

KM-16

THE CORROSION BEHAVIOUR OF AUSTENITIC AND DUPLEX STAINLESS STEELS IN ARTIFICIAL SALIVA

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Austenitic stainless steel AISI 316L is the most commonly used orthodontic bracket material. Its mechanical properties such as ductility and wear resistance make it attractive for dental applications. The corrosion resistance of stainless steel is relatively good. However, it is challenged by the hostile environment in the mouth, as it is susceptible to localised corrosion in environment containing chloride. It is well known that up to 22 % of the population may exhibit allergic and hypersensitivity reactions to nickel. The 2205 duplex stainless steel is being investigated as a material for orthodontic bracket fabrication. Microstructure of the duplex stainless steel is a mixture of austenitic and delta-ferritic phases. The delta-ferrite is hard and relatively less ductile. Austenite is softer and more ductile. The combination of both phases results in steel harder than the single-phase austenitic and more ductile than single phase ferritic stainless steel. The combination of both phases has a beneficial influence on the corrosion characteristics in various aqueous environments. The high Cr content together with high Mo and N contents gives rise to a high pitting-corrosion resistance in chloride solutions. The chromium adds to the overall resistance through a passivation process by forming a complex spinel-type passive film $(\text{Fe, Ni})\text{O}(\text{Fe, Cr})_2\text{O}_3$. Molybdenum increases the stability of the passive film and, therefore, the ability of the stainless steel to resist the localised corrosion, including pitting and crevice corrosion, particularly in environments containing chloride ions.

The evolution of the passive film formed on duplex stainless steel 2205 and AISI 316L stainless steel in artificial saliva was studied using cyclic voltammetry and potentiodynamic measurements. The passive layers were studied by X-ray photoelectron spectroscopy, and their compositions were analysed as a function of depth. The passive films on the duplex stainless steel contained the oxides of two main elements, i.e., Fe and Cr. The alloying elements improve the corrosion resistance of duplex stainless steels; however, their content within the passive layer was negligible.

KM-17

VPLIV TEKSTURE NA KONČNE ELEKTROMAGNETNE LASTNOSTI ELEKTROPLOČEVIN

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V zadnjem času so se smernice raziskav pri razvoju elektropločevine usmerile na vpliv tekstur na elektromagnetne lastnosti. Ko so ugotovili kakšne teksture so zaželeno v končnem produktu, so se začeli ukvarjati s tem kdaj, kje in iz česa se le te razvijejo. Ugotovitve so prišle do tega da se temelji postavijo že med vročim valjanjem.

Tako je bila naša naloga najprej ugotoviti teksturo končnega izdelka in nato iti po procesu proizvodnje v obratni smeri z namenom da ugotovimo teksturo vroče valjanih trakov. V literaturi je zaslediti, da je v končnem produktu zaželena Goss-ova struktura $\{011\}\langle 100\rangle$ in kubična struktura $\{001\}\langle 100\rangle$. Tudi podatke o tem kje naj bi nastala katera oz želenih struktur je mogoče zaslediti v literaturnih virih. Gossova struktura raste predvsem na zrnih VVT z $\{111\}\langle 112\rangle$, $\{111\}\langle 110\rangle$ in $\{112\}\langle 110\rangle$. Kubična struktura pa raste prav tako v zrnih $\{111\}\langle 112\rangle$ in v zrnih $\{112\}\langle 110\rangle$, v obeh primerih z veliko koncentracijo strižnih pasov. So pa kubična zrna, ki zrastejo na $\{112\}\langle 110\rangle$ mnogo večja kot tista ki zrastejo na $\{111\}\langle 112\rangle$. A te trditve pa so še predmet naših raziskav v prihodnosti.

KM-18

TEMPERATURE DEPENDENCE OF PARAMETERS OF NON-LINEAR
STRESS-STRAIN RELATIONS FOR CARBON-EPOXY COMPOSITES

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This work focuses on the identification of parameters of stress-strain relations of unidirectional continuous fiber carbon-epoxy composite under tensile loading for various temperatures. Simple tensile tests of thin strips with various fiber orientations are performed. Identification of parameters for chosen non-linear stress-strain relations is performed for each temperature for which the experiment is performed. Consequently, the identification of strengths is performed. The failure analysis for the determination of the first failure with the use of Puck's action plane concept is performed, whereas the tensile and shear strengths are investigated. The identification process with the use of the combination of the mathematical optimization method and finite element analysis is described with the necessary details. The temperature dependence of parameters is investigated.

KM-19

PREPARATION OF SAMPLE SURFACES FOR SCANNING ELECTRON
MICROSCOPY AND ELECTRON BACKSCATTERED DIFFRACTION ANALYSIS

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Final cleaning of metallographic samples is of key importance for microchemical and structural analysis. Especially for EBSD analysis, it is extremely important that there are no remains of polishing agents left on the surface. It is practically impossible to remove colloidal SiO₂ suspension by ultrasonic bath, and mechanical removal is not recommended especially for softer materials. The surfaces that also require cleaning procedures before examination by scanning electron microscopy are also fracture surfaces, which are usually contaminated or oxidized.

In this contribution, we will show examples of cleaning procedures for EBSD analysis by using foils for replicas and cleaning procedures for fracture surfaces.

PRIPRAVA POVRŠIN VZORCEV NAMENJENIH VRSTIČNI ELEKTRONSKI
MIKROSKOPIJI IN EBSD ANALIZI

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Končno čiščenje površine metalografskih vzorcev je ključnega pomena za natančno mikrokemijsko in strukturno analizo. Še posebno za EBSD-analizo je zelo pomembno, da na površini nimamo ostankov polirnih sredstev. Koloidno SiO₂ suspenzijo je skoraj nemogoče popolnoma odstraniti v ultrazvoku. Mehanska odstranitev pa pri mehkejših materialih ni priporočljiva. Ravno tako je za natančno opazovanje prelomnih površin zelo pomembno, da prelomno površino, ki je ponavadi delno kontaminirana oziroma oksidirana, očistimo pred opazovanjem v vrstičnem elektronskem mikroskopu. V prispevku bo prikazan način čiščenja metalografskih vzorcev namenjenih EBSD-analizi, z uporabo folij namenjenih za jemanje replike in prikazano čiščenje prelomnih površin.

KM-20

AES AND XPS OF THIN OXIDE LAYERS ON METALLIC SURFACES

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Thin oxide films produced by exposures of metallic surfaces to UHV and controlled HV oxygen atmospheres were studied by using AES and XPS. The lowest exposures produced only adsorbed oxygen layers while exposures of several tens of Langmuirs at 10^{-5} mb oxygen yielded oxide layers of several nanometers. Different types of metallic substrates were used, such as iron, chromium and duplex stainless steel. AES and XPS profiling analysis were performed. An attempt was made to correlate certain features in AES spectra, such as LMM peak intensities and MNN peak shapes of metals to the chemical state of the corresponding element. Similar approach has been tried before and may, combined with high lateral resolution AES, provide small area chemical state information. Localized chemical state information derived from MNN peak shapes seems to be in agreement with the one provided by XPS which is averaged over approximately 2 mm^2 . This is not unreasonable for thin homogeneous layer on polished substrate.

SPEKTROSKOPIJA AUGERJEVIH ELEKTRONOV IN RENTGENSKA FOTOLEKTRONSKA SPEKTROSKOPIJA TANKIH OKSIDNIH PLASTI NA KOVINSKIH POVRŠINAH

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Tanke oksidne plasti smo nanесли tako, da smo kovinske površine pod UHV in HV pogoji kontrolirano izpostavljali kisikovim atmosferam. Z najmanjšimi ekspozicijami smo dobili samo adsorbirane plasti kisika, pri nekaj deset Langmuirjih ob tlaku 10^{-5} mb pa so nastale do nekaj deset nm debele oksidne plasti. Uporabili smo različne kovinske substrate: železo, krom in nerjavno jeklo duplex. Spektroskopijo Augerjevih elektronov (AES) in rentgensko fotoelektronsko spektroskopijo (XPS) smo uporabili za profilno analizo oksidnih plasti. Poskusili smo poiskati korelacijo med nekaterimi detajli v spektrih izmerjenih z AES, kot so intenzitete kovinskih vrhov LMM in oblike kovinskih vrhov MNN, s kemijskimi stanji ustreznih kovin. Podoben pristop je že bil uporabljen in bi kombiniran z AES velike lateralne resolucije lahko preskrbel lokalne informacije o kemijskem stanju. Pokazalo se je, da se informacija o kemijskem stanju na katero se da sklepati iz oblike kovinskih vrhov MNN ujema s tisto pridobljeno iz profilne analize z XPS. Ker gre za homogeno oksidno plast na polirani kovinski podlagi, ni nepričakovano, da se lokalna informacija pridobljena z AES ujema s tisto pridobljeno z XPS (povprečje čez $\sim 2 \text{ mm}^2$).

KM-21

MODELLING OF THE FRACTURE SCATTER OF AGED DUPLEX STAINLESS STEELS

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Cast stainless duplex steels are used in PWR nuclear plants in the primary circuit. These parts (elbows, centrifuged tubes, pump volutes, etc.) exposed to temperatures ranging between 280 and 325 °C are likely to present a decrease of ductility and toughness after long-term service ageing.

The kinetics of embrittlement has been studied for two grades of Molybdenum bearing stainless steel with a ferrite content of 20 and 30%. Tensile test on notched specimens has been used to characterize the mechanisms of damage. Fracture toughness testing results exhibit a large scatter for a same metallurgical state.

This scatter has been correlated to damage heterogeneity in ferrite. The micro-mechanical damage model was implemented in a FE code and applied to the prediction of the scatter and the average value of the ductility and toughness. The model parameters have been identified from the tests on notched specimens. Calculations of the nucleation and propagation of crack in fracture toughness specimens are performed and compared to experimental results. The numerical simulations depict adequately the scatter in toughness and tearing resistance.

KM-22

COMPARISSON OF LEDEBURITIC TOOL STEELS OCR12VM, OCR12SP AND
OCR12SPW FROM THE PRODUCTION PROGRAMME OF METAL RAVNE d.o.o.

Darja Oblak

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Steel OCR12SPW is a new steel in the production programme of Metal Ravne d.o.o. It has an improved chemical composition with the addition of Tungsten for better wear resistance due to higher amount of carbides. The comparison of chemical composition, the amount and size distribution of carbides, hardness and wear resistance for steels OCR12SPW, OCR12SP and OCR12VM will be presented.

PRIMERJAVA LEDEBURITNIH ORODNIH JEKEL OCR12VM, OCR12SP IN
OCR12SPW IZ PROIZVODNEGA PROGRAMA METALA RAVNE d.o.o.

OCR12SPW je novo jeklo v proizvodnem programu Metala Ravne d.o.o. Ima izboljšano kemijsko sestavo z dodatkom W za boljšo obrabno odpornost zaradi večje količine karbidov. Podana bo primerjava kemijske sestave, količine in velikostne porazdelitve karbidov, trdot in obrabne odpornosti ter področje uporabe za jekla OCR12SPW, OCR12SP in OCR12VM.

KM-23

NICKEL SUPERALLOYS' MICROSTRUCTURAL CHANGES CAUSED BY FORMING

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The research is focused on the development of nickel alloy for ADTT systems. Accelerator-driven transmutation technology (ADTT) is a collection of programs that can reuse spent fuel from commercial nuclear reactors, and produce electric energy in reactor for transmutation of atomic waste. This article deals with the preparation of semifinished hot rolled rods for another analyses – especially creep and corrosion tests. Three different alloys – pure MoNiCr, Hastelloy B and MoNiCr + Ti – were subjected to the following experimental program: Ingot casting, hot rolling, and recrystallization annealing.

Hastelloy B and MoNiCr alloy proved good formability and ability to achieve uniform coarse-grained microstructure. Especially in the case of MoNiCr alloy, the surface quality after rolling process was very satisfying. However the MoNiCr + Ti alloy was not formable at all at 1210 °C (rolling temperature).

Other experiments (on MoNiCr and Hastelloy B) for simulation of the environment in the ADTT reactor (aggressive fluoride salts and temperatures above 700 °C) i.e. corrosion test and creep behaviour were also done.

KM-24

ANALIZA KEMIJSKE SESTAVE KARBONITRIDNIH IZLOČKOV, KI PRECIPITIRAJO MED STRJEVANJEM HSLA JEKLA

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Med strjevanjem mikrolegiranih jekel pride do izločanja kompleksnih karbonitridnih (Ti, Nb) (C, N) delčkov, ki lahko vplivajo na mehanske lastnosti HSLA jekel.

Raziskave fenomena mikrosegrecij in analize kemijske sestave karbonitridnih izločkov so bile narejene na vzorcih HSLA jekla Micral 690 z uprabo vrstičnega elektronskega mikroskopa na poljsko emisijo.

Za analizo vsebnosti Ti in N sta bili uporabljeni obe razpoložljivi analizni metodi, EDS in WDS. Ker je koncentracija N v karbonitridnih delčkih relativno nizka, je z EDS analizo tehniko dokaj težko določiti vsebnost N. K linije dušika se namreč prekrivajo z L linijami Ti, zato je za analizo boljše uporabiti WDS tehniko, ki ima boljšo resolucijo.

V delu so obravnavani tudi nekateri problemi prekrivanja N in Ti linij.

ANALYSIS OF CHEMICAL COMPOSITION OF CARBONITRIDE PARTICLES PRECIPITATED DURING THE SOLIDIFICATION OF HSLA STEEL

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During the solidification of microalloyed steels the precipitation of complex (Ti, Nb) (C, N) carbonitride particles occurs, which can influence the mechanical properties of the HSLA steels.

To investigate the microsegregation phenomena and the chemical composition of carbonitride particles the samples of HSLA steel Micral 690 were analysed by field emission scanning electron microscope.

Both available spectroscopies, EDS and WDS, were used to analyse the Ti and N content. It is quite difficult to analyse the N content by EDS due to the low concentration of N in carbonitride particles.

Also, the K lines from N virtually overlap with the L lines from Ti, therefore WDS is indicated due to better resolution.

Some problems concerning overlapping N and Ti will be also discussed in the work.

KM-25

MAGNESIUM IN THE NON-METALLIC INCLUSIONS OF THE NON-ORIENTED ELECTRICAL STEEL SHEETS

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The morphology of the non-metallic inclusions in steels formed during solidification can be modified by some alloying or impurity elements. Since the morphology of the inclusions has a significant effect on the various properties of steels, studies have to be focused on the relation between the chemical composition and the morphology.

The aim of this study was to determine the effects of Mg on the characteristics of the non-metallic inclusions in the non-oriented electrical steel sheets. The morphology of the non-metallic inclusions was investigated using optical microscopy and Scanning Electron Microscopy. The characteristics and the formation of inclusions are discussed.

MAGNEZIJ V NEKOVINSKIH VKLJUČKIH NEORIENTIRANE ELEKTRO PLOČEVINE

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Zlitinski elementi in elementi nečistoč lahko vplivajo na morfologijo nekovinskih vključkov, ki nastajajo med strjevanjem jekla. Morfologija vključkov vpliva na številne lastnosti jekel, zato je pomembno, da poznamo tako kemijsko sestavo vključkov kot tudi njihovo morfologijo.

Preučevali smo vpliv Mg na značilnosti in morfologijo nekovinskih vključkov v neorientirani elektro pločevini. Morfologijo smo določili z optično in vrstično elektronsko mikroskopijo. Podrobneje opisujemo značilnosti magnezijevih vključkov ter njihov nastanek.

KM-26

RECRYSTALLIZATION OF SUPERAUSTENITIC STAINLESS STEEL

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Superaustenitic stainless steel with high Mo amount are used in a wide variety of applications that require good corrosion resistance and mechanical properties. The poor hot workability of super-austenitic stainless steels alloyed with molybdenum depends on a number of factors. The most probable explanation is connected with a retardation of the softening processes. Dynamic recrystallization is possible in these steels at sufficiently high strains. The strain for initiation decreasing with increasing temperature and decreasing strain rate. Static recrystallization is very sluggish especially during hot rolling of highly alloyed austenitic stainless steels.

The relationship between the softening and the hot-ductility phenomena was investigated using hot tensile tests and rolling experiments with wedged specimens. The fraction of the recrystallization was determined by metallographic investigation and the degree of mechanical softening.

REKRISTALIZACIJA SUPERAVSTENITNIH NERJAVNIH JEKEL

Superavstenitna nerjavna jekla z visoko vsebnostjo molibdena se uporabljajo v industriji, kjer se zahteva dobra korozijska odpornost in mehanske lastnosti. Slabša vroča preoblikovalna sposobnost superavstenitnih nerjavnih jekel legiranih z molibdenom je odvisna od številnih vplivov. Glavni vzrok je povezan z zadržanjem procesov mehčanja med vročo predelavo. Dinamična rekristalizacija je v teh jeklih mogoča le pri zadostni stopnji deformacije. Z višjo temperaturo deformacije in manjšo deformacijsko hitrostjo je potrebna stopnja deformacije za začetek dinamične rekristalizacije manjša. Statična rekristalizacija pa je v visoko legiranih avstenitnih nerjavnih jeklih med vročim preoblikovanjem sorazmerno počasna.

Procese mehčanja in fenomene vroče preoblikovalnosti smo raziskali z vročim nateznim preskusom in valjanjem klinastih preskušancev. Delež rekristalizacije smo določili z metalografskimi preiskavami, stopnjo mehčanja pa z meritvami trdote.

KM-27

INVESTIGATION OF ANODIZED LAYER ON ALUMINIUM

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The stains were observed on the anodized surface of aluminium and they were visible only under specific angle of observation. Anodized surface was investigated with scanning electron microscopy (SEM), by metallography of cross section and EDS analysis were performed in the layer. Results of investigations are presented. The SEM investigations of the surface did not reveal a difference in morphology of area with stain and area out of stain. From that reason the cross section of the layer was checked by light microscopy. The layer was 8 μm thick. In the region of stain the metallography revealed the presence of pores, near the surface of anodized layer. The rest of anodized layer was compact and without pores. In the pores the EDS analysis confirmed the presence of oxygen, sulphur, fluorine and nickel. Researches revealed that sulphuric acid was used as electrolyte at anodization, but pores were closed with emerging into solution of NiF_2 . It was found that stains were a consequence of light diffraction on pores in transparent anodized layer. The main reason for remaining pores in anodized layer on aluminium was not optimised anodizing process.

PREISKAVA ANODIZIRANE PLASTI NA ALUMINIJU

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Na površini aluminija obdelanega z anodizacijo so bili prisotni madeži. Madeži so bili vidni le pod specifičnim kotom opazovanja. Anodizirana površina je bila preiskana z vrstično elektronsko mikroskopijo (SEM), izvršen je bil metalografski pregled preseka anodiziranega sloja in izvršene so bile analize (EDS) v sloju. Prikazani so rezultati preiskav. Morfologija površine ni pokazala razlik med področjem z madežem in izven tega področja. Zato je bil izvršen še metalografski pregled prečnega preseka anodizirane plasti, debele 8 μm . Na področju madeža je metalografski pregled odkril prisotnost zaprtih por v anodizirani plasti. Stran od madeža je bila anodizirana plast kompaktna in brez prisotnosti por. Analiza EDS je v porah pokazala prisotnost kisika, žvepla, fluora in niklja. Rezultati analiz kažejo, da je bil pri anodizaciji za elektrolit uporabljena raztopina žveplene kisline, pore pa so bile zaprte s hladnim postopkom, z namakanjem v raztopino NiF_2 . Madeži so posledica različnega lomljenja svetlobe v prosojnem anodiziranem sloju s porami. Glavni vzrok za prisotnost por v anodizirani plasti je neoptimiran postopek anodizacije aluminija.

KM-28

EFFECT OF CHANGE OF CARBIDE PARTICLE DISTRIBUTION ON ACCELERATED CREEP RATE OF THE STEEL X20

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It was shown that by annealing the steel X20 at 800 °C for up to 1440 h the accelerated creep rate was increased by approximately 4,5 times above a critical value of the calculated average carbide interparticle distance. In this work the effect of two microstructural parameters: number of carbide stringers at martensite grains and subgrains per unity of surface and of interparticle distance in stringers on accelerated creep rate was determined for the same steel and heat treatment. The number of stringers and the interparticle distance in stringers were manually assessed on micrographies. The interparticle distance in carbide stringers increased proportionally and the number of stringers per unity of surface decreased proportionally to the cubic root of the annealing time. By the longest annealing time, the interparticle distance in stringers increased for 1.46 times, the calculated interparticle distance increased for 6.2 times, the number of stringers decreased for approximately 38 times and the accelerated creep rate increased for nearly 2 orders of magnitude. It was found, also, that the accelerated creep rate increased exponentially with the decrease of the density of carbide stringers and proportionally to the interparticle distance in stringers. These experimental findings indicate, that the effect of the change of the number of carbide stringers on accelerated creep rate is stronger than the effect of the calculated interparticle distance and that the acceleration of secondary creep rate is due mainly to the decomposition of carbide stringers. It is concluded that models that do not account for the distribution of carbide particles, are not a reliable base for equations for the calculation of the creep activation energy.

VPLIV SPREMEMBE PORAZDELITVE KARBIDNIH IZLOČKOV NA HITROST POSPEŠENEGA LEZENJA JEKLA X20

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Ugotovljeno je bilo, da se zaradi podaljšanja žarjenja jekla X20 pri 800 °C hitrost pospešenega lezenja poveča za okoli 4,5 krat nad neko kritično izračunano povprečno razdaljo med karbidnimi izločki. V nadaljevanju smo opredelili vpliv dveh parametrov mikrostrukture popuščene martenzita, števila karbidnih nizov na mejah martenzitnih zrn in podzrn na enoto površine in razdalje med izločki v nizih na hitrost pospešenega lezenja. Oba parametra smo določili z analizo posnetkov mikrostruktur. Razdalja med karbidnimi izločki v nizih raste, število karbidnih nizov pa se zmanjšuje proporcionalno s tretjim korenem trajanja žarjenja. Pri najdaljšem žarjenju se je izračunana razdalja med izločki v nizih povečala za 1,46 krat, izračunana povprečna razdalja med izločki za 6,2 krat, število nizov se je zmanjšalo za 38 krat, hitrost pospešenega lezenja pa se je povečala za približno za dva reda velikosti. Hitrost lezenja se zmanjšuje eksponentno s številom karbidnih nizov na enoto površine. Ti podatki povedo, da je hitrost lezenja bolj odvisna od gostote karbidnih nizov kot povprečne teoretične razdalje med izločki, dokler jeklo ohranja mikrostrukturo iz popuščene martenzita z večino karbidnih izločkov po mejah in podmejah martenzitnih zrn. Zato analitski izrazi za aktivacijsko energijo, ki ne upoštevajo vpliva porazdelitve karbidnih izločkov, ne morejo biti prava podlaga za izračun aktivacijske energije lezenja.

KM-29

ON THE CREEP RESISTANCE OF WELDS

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The microstructure of welds of tubes of steel with increased creep resistance and their mechanical properties are very heterogeneous. Changes in microstructure were simulated with annealing three weld microstructures: deposited metal, layer of maximal coarsening of austenite grains and layer with half ferrite transformation as well of steels X20 and P 91 at 650 and 750 °C for up to 17520 h. At annealing, the hardness, yield stress and tensile strength are decreased, while elongation and ROa are little changed. In the microstructure, the density of carbide stringers at martensite grain boundaries decreased also, while the distribution of carbide particles became more uniform. After 2 hr of annealing at 750 °C the secondary creep rate was for approximately an order of magnitude smaller for the deposited metal and the coarse austenite layer, than for the layer of half ferrite transformation and the steel X20. The difference was smaller for the steel P 91 with greater creep resistance, however, of the same character. With increasing the annealing time, the difference decreased for both steels. The effect of annealing at lower temperature was smaller for all properties. It was established that the tertiary creep started allway during the 100 h static tests at 580 °C and 580 MPa if the density of carbide particles was lower than $10^6/\text{mm}^2$ and it was not observed for the density of carbide particles of $2 \cdot 10^6/\text{mm}^2$.

O ODPORNOSTI ZVARNIH SPOJEV PROTI LEZENJU

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Mikrostruktura zvarov cevi iz jekel odpornih proti lezenju, je zelo heterogena, temu ustrezno so heterogene tudi mehanske lastnosti. Spremembe v mikrostrukturi smo simulirali z žarjenjem treh mikrostruktur zvara: deponirani material, pas največjih zrn avstenita in pas polovične premene ferita ter jekel X20 in P 91 do 17520 ur pri temperaturah 650 in 750 °C. Pri žarjenju se znižujejo trdota, meja plastičnosti in trdnost, spreminja pa se tudi mikrostruktura. Spremembe so mnogo hitrejše pri višji temperaturi. Zmanjšuje se število nizov karbidnih zrn po mejah in podmejah martenzita, porazdelitev izločkov pa postaja vse bolj enakomerna. Preizkusi odpornosti proti pospešenemu lezenju so pokazali, da je pri 2 urnem žarjenju pri 750 °C hitrost sekundarnega lezenja pri strjevalni mikrostrukturi in mikrostrukturi z velikimi zrn avstenita za skoraj razred velikosti manjša, kot pri pasu polovične premene ferita in pri jeklu X 20. Razlika je podobna, vendar manjša pri jeklu P 91, ki ima večjo odpornost proti lezenju. S podaljšanjem žarjenja pri 750 °C se razlika zmanjša. Vpliv žarjenja na lastnosti je bil manjši pri 650 °C. Ugotovljeno je bilo, da se terciarno lezenje vedno pojavi pri vseh mikrostrukturah med 100 urno statično obremenitvijo 170 MPa pri 580 °C, če je gostota karbidnih izločkov manjša od $10^6/\text{mm}^2$ in da terciarnega lezenja ni, če je gostota izločkov $2 \cdot 10^6/\text{mm}^2$ ali večja.

KM-30

MODELLING OF THE RELATION TOUGHNESS, HARDNESS AND TENSILE PROPERTIES FOR TWO-PHASE Fe-NiCrMo CAST STAINLESS ALLOYS

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The effect of the content of δ -ferrite in the range of 2 % to 30 % and of ageing for up to 30.000 h in the range from 300 °C to 400 °C on mechanical properties was investigated for FeNiCrMo alloys. The content of chromium and molybdenum is greater for ferrite and the content of nickel for austenite. Due to the spinodal decomposition of the solid solution during ageing the hardness and the brittleness of ferrite are increased. The mechanical properties were determined at room temperature and at 290 °C. Due to the spinodal decomposition the average hardness of the alloys increase slightly, while the hardness of δ -ferrite is increased faster and much more at the highest ageing temperature. For this reason, after ageing, the mechanical properties are changed; yield stress and tensile strength are increased, while, reduction of area, elongation and Charpy toughness are decreased. The effect of ageing time is shown for the investigated alloys for all three ageing temperatures. The change of notch toughness is faster and stronger at higher temperature, and it is greater by testing at room temperature than at testing at elevated temperatures. The initial notch toughness and the toughness after ageing for 17520 h at 350 °C are shown for all three alloys. The initial and the as aged notch toughness are greatest for the alloy with 2 % of δ -ferrite and after ageing notch toughness is decreased significantly for the alloy with 27 % of δ ferrite. In all cases notch toughness is greater by testing at 290 °C than at room temperature, while the effect of testing temperature is opposite for the yield stress and tensile strength. The investigation will be continued with the aim to view the micromorphology of the spinodal decomposition and the development of a model that will relay the change of properties with the content of δ -ferrite and the change of notch toughness.

MODELIRANJE ODVISNOSTI MED ŽILAVOSTJO, TRDOTO IN RAZTRŽNIMI LASTNOSTMI PRI DVOFAZNIH Fe-NiCrMo LITIH NERJAVNIH ZLITIN

Raziskan je bil vpliv količine δ -ferita od 2 % do 30 %, temperature staranja 300 °C do 400 °C in trajanja staranja do 30.000 ur na mehanske lastnosti FeNiCrMo zlitin z matico iz avstenita. V feritu je več kroma in molibdena, v avstenitu pa niklja kot je povprečna sestava zlitine. Mehanske lastnosti so bile določene pri sobni temperaturi in v območju delovnih temperatur (290 °C do 350 °C). Zaradi spinodalnega razmešanja v feritu se pri staranju malo povečuje povprečna trdota zlitin, pri tem pa trdota ferita močno zraste, trdota avstenita pa ostane nespremenjena. Zato sta po staranju višja meja plastičnosti in trdnosti, zmanjša se kontrakcija in raztezek, najmočnejše pa je zmanjšana udarna zarezna žilavost. Sprememba lastnosti je odvisna od temperature in trajanjem staranja. Za preiskovane zlitine je prikazan vpliv trajanja staranja pri treh temperaturah na žilavost določeno pri sobni temperaturi in pri povišanih temperaturah. Znižanje žilavosti je hitrejše in večje pri višji temperaturi staranja in manjše pri povišanih temperaturah kot pri sobni temperaturi. Prikazana je tudi žilavost zlitin v izhodnem stanju in po 17.520 urah staranja pri 350 °C določena pri sobni temperaturi in pri 290 °C. V izhodnem in v staranem stanju je žilavost največja pri zlitini z 2 % ferita, po staranju pa se najbolj zmanjša pri zlitini s 27 % ferita. V vseh primerih je žilavost večja pri 290 °C kot pri sobni temperaturi, meja plastičnosti in raztržna trdnost pa sta nižji pri višji temperaturi preizkušanja. V nadaljevanju bo raziskana mikromorfologija spinodalnega razmešanja in razvit model, ki bo napovedoval spremembo lastnosti zlitin glede na vsebnost δ ferita in pogoje staranja.

KM-31

CONSTRUCTION OF RESERVOIR FOR JET FUEL IN LUKA KOPER

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On the terminal for liquid cargo on the pier II in Luka Koper a reservoir for airplane fuel has the capacity of $3 \times 20\,000\text{ m}^3$. The reservoirs have an inner diameter of 42.670 mm, lateral surface height 15.000 mm and lateral surface height of basin 11.500 mm. The reservoirs are covered with a self-supporting dome-shaped roof manufactured by Temcor, USA. Additionally, an inner buoyant membrane manufactured by Allentech is also built in. The basic material used for the reservoir is S355J2G3 according to EN 10025. The construction of the roof is based on sliding supports combined with integrated tension loop. The buoyant roof consists of aluminum tubular pontoons supporting an aluminum lid. When the inner buoyant roof is released, it is suspended on steel ropes that are attached to the reservoir roof with a constraining system. Tightness between the buoyant roof and the reservoir is achieved by a rubber inset. The roof consists of triangular space grids – aluminum supports with an inner strengthening ring, triangular covering panels made of Al plates 3003-H16 of 1,27 mm thickness, aluminum blockades which enable the circulation of air and ventilation of reservoir, supporting roof console, grounding cables from the foot of the roof to the lateral surface of the reservoir on every third support and attachments that are needed for attaching steel ropes of the inner floating membrane. The roof mass is 24.267 kg, diameter 42.670 mm. The buoyancy calculation of inner floating roof is made based on specific gravity of the medium in the value of 0.7 and 100 % addition for buoyant force.

GRADNJA REZERVOARJEV ZA LETALSKO GORIVO V LUKI KOPER

Na terminalu tekočih tovorov na pomolu II. V Luki Koper je zgrajen rezervoarski prostor za letalsko gorivo kapacitete $3 \times 20.000\text{ m}^3$. Rezervoarji imajo notranji premer 42.670 mm, višino plašča 15.000 mm in višino plašča lovilnega bazena 11.500 mm. Rezervoarji so pokriti z Al samonosilno kupolasto streho proizvajalca Temcor iz USA, vgrajena je tudi notranja plavajoča membrana proizvajalca Allentech. Osnovni material za rezervoarje je S355J2G3 po EN 10025. Konstrukcija strehe temelji na uporabi drsnih podpor v kombinaciji z integriranim napetostnim obročem in je vozliščno palična. Plavajoča streha se sestoji iz aluminijastih cevnih pontonov, ki podpirajo aluminijast pokrov. Ko je notranja plavajoča streha spuščena, le ta visi na jeklenih vrveh, ki so z ustreznim sistemom vpetja pritrjene na streho rezervoarja. Tesnost med plavajočo streho je dosežena z gumo. Streho sestavljajo trikotne prostorske mreže – aluminijasti nosilci z notranjim ojačilnim obročem, trikotni pokrivni paneli iz Al pločevin 3003-H16 debeline 1,27 mm, aluminijaste zapore, ki omogočajo cirkulacijo zraka in ventilacijo rezervoarja, podporne konzole strehe, ozemljitveni kabli od noge strehe do plašča rezervoarja na vsaki tretji podpori in priključki, ki so potrebni za pritrditev jeklenih vrvi notranje plavajoče membrane. Teža strehe je 24.267 kg, premer strehe pa je 42.670 mm. Izračun plovnosti notranje plavajoče strehe je izdelan na osnovi specifične gravitacije medija v vrednosti 0,7 in 100 % dodatka za plovnost-vzgon.

KM-32

NEW STAINLESS STEEL HEAVY PLATES SOLUTION ANNEALING LINE

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New stainless steel heavy plates solution annealing line made by Wellman in ACRONI Heavy plate department consists by chamber furnaces, loading system, special multimedia cooling machine and drying unit.

Technological parameters were not part of contract by supplier and we were forced to optimize heat treating process step by step during operation after start up. We were focused on following issues:

- optimizing heat treating time in order to get maximum capacity on line,
- determine optimal cooling plan in order to get:
 - flat plates after cooling
 - suitable plate temperature after cooling
 - minimal cooling water consumption
- analyzing conditions which can cause sigma phase and ferrite appearance on austenite grain borders.

LINIJA ZA TOPLOTNO OBDELAVO NERJAVNE DEBELE PLOČEVINE

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Linija za toplotno obdelavo nerjavne jeklene pločevine Wellman v obratu PDP Acroni d.o.o. je sestavljena iz štirih osnovnih enot: komorne peči, zakladalni sistem, valjčne hladilne naprave in sušilne naprave.

Ker je linija Wellman v proizvodnji Acroni d.o.o. nov agregat, so določene faze v proizvodnem procesu še neoptimizirane, zato smo pri svojem delu osredotočili predvsem na problematiko, ki jo lahko okvirno razdelimo na tri med seboj povezane vsebine:

- možnost povečanja produktivnosti peči na način, da se skrajšajo časi ogrevanja v peči,
- ugotavljanje optimalnega hlajenja plošč s hladilnimi mediji z vidika:
 - krivljenja plošč,
 - temperature plošč po hlajenja, ter
 - porabe hladilne vode.
- analiza vzrokov σ -faze in izločanja ferita po mejah kristalnih zrn.

AM-1

MODELLING OF ELECTRICAL PROPERTIES OF LSM CERAMICS

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The carbonate co-precipitation route was applied for batch $\text{La}_{0.85}\text{Sr}_{0.15}\text{MnO}_3$ (LSM) preparation as an alternative synthesis method to the solid state reaction. Because co-precipitation is a solution wet-chemistry process, maximum LSM homogeneity was achieved. The microstructural characteristics like porosity and grain size of the prepared LSM elements were controlled by submitting the green bodies to various sintering conditions. LSM sintered bodies with relative sintered densities as high as 95 % were prepared at sintering temperatures not higher than 1100 °C. The microstructure of the prepared LSM was characterized by digital on-line image analysis and microstructural parameters were determined for ceramic phase as well as for porosity. Electrical characteristics of the sintered LSM elements were for the first time in the literature described with respect to the model of sine-wave approximation of conductivity change for porous materials. The observed results of relative conductivity σ/σ_0 vs. relative density ρ/ρ_0 dependence were essentially consistent with the sine-wave approximation. As an absolute value, the highest $\sigma = 65$ S/cm at 800 °C was measured for sample with $\rho/\rho_0 = 99.58$ %.

MODELIRANJE ELEKTRIČNIH LASTNOSTI LSM KERAMIKE

$\text{La}_{0.85}\text{Sr}_{0.15}\text{MnO}_3$ (LSM) je bil pripravljen po metodi karbonatne koprecipitacije kot alternativni metodi reakcije v trdnem. Z uporabo koprecipitacijske metode kot ene izmed tehnik mokre kemije nam je uspelo pripraviti zelo homogene LSM prahove. Mikrostrukturne lastnosti končnih pripravljenih LSM elementov, kot sta poroznost in velikost zrn, smo spreminjali s sintranjem LSM surovcev pri različnih pogojih. Uspelo nam je pripraviti sintrane LSM elemente z relativno sintrano gostoto 95 % pri temperaturah sintranja, ki niso bile višje kot 1100 °C. Bolj podrobna karakterizacija mikrostrukture sintranih elementov je bila opravljena z analizo digitalnih slik. Električne lastnosti sintranih LSM elementov smo pojasnili s teoretičnim modelom vrtenine za opis električne prevodnosti porozne keramike, kar je tudi prvi tovrsten opis LSM keramike. Rezultati določitve relativne prevodnosti σ/σ_0 LSM keramike kot funkcije njene relativne gostote ρ/ρ_0 relativno dobro sledijo predlaganemu teoretičnemu modelu. Najvišjo absolutno izmerjeno vrednost električne prevodnosti $\sigma = 65$ S/cm pri 800 °C je dosegel vzorec z relativno gostoto $\rho/\rho_0 = 99.58$ %.

AM-2

VPLIV GEOLOŠKEGA ZAPISA NA TERMIČNE LASTNOSTI LAPOROVCEV V TEMPERATURNEM OBMOČJU DEKARBONATIZACIJE

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Delež CaCO_3 v laporovcih (kamnine litološkega tipa mudstones), predstavljajo večinoma skeleti odmrlih mikroorganizmov, medtem ko so karbonatni drobir, količina in tip mineralov glin ter prisotnost vsebnosti V, Ba, Cr, Ni, Mn in Ti pokazatelj specifične, paleoekološke značilnosti okolja nastanka kamnine ter njene diageneze.

Vzorci so bili analizirani s pomočjo optične mikroskopije, XRF, XRD, TGA-DTA in granulometrijske analize. Za določitev mineralov glin, so bili vzorci podvrženi kislinskemu razklopu s klorovodikovo kislino. Netopni ostanek je bil ponovno analiziran z XRD in DTG-DTA metodo v temperaturnem območju do 1000°C.

S pomočjo sklopa rezultatov analiz smo dokazali vpliv glinene in karbonatne komponente (mikropaleontološka analiza kaže na skelete kokolitov kot glavne nosilce deleža CaCO_3 , ob nastopanju karbonatnega drobirja frakcije nad 45 μm), ki posredno vplivajo na termične lastnosti kamnine.

AM-3

COMBUSTIBLE PRECURSOR BEHAVIOR IN THE LANTHANUM CHROMITE FORMATION PROCESS

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Combustion-derived lanthanum chromite (LC) powders were prepared by combustion synthesis from the citrate-nitrate precursor gels. Transformation process of reactive citrate-nitrate gel to cubic perovskite modification of (LC) was investigated. The influence of the fuel/oxidant molar ratio in the precursor gel on the combustion propagation and thermal characteristics of the combustion system was studied by simultaneous thermal analysis (TG, DTG and DTA) evolved gas analysis (MS) and gas chromatography (GC). It was found that the citrate-nitrate reaction proceeds through several separate consecutive steps and the precursor thermal decomposition characteristics depended strongly on the citrate/nitrate ratio prior to the combustion. First two steps of the thermal decomposition at approximately 150 °C and 250 °C are strongly related to the citrate-nitrate reaction, while at around 350 °C citric acid residuals combustion occurs. Last step of the thermal decomposition is caused by transformation of LaCrO_4 to LaCrO_3 . Intermediate precursors and final powder ashes were analyzed also by X-ray diffraction.

TERMIČNE LASTNOSTI REAKCIJSKEGA GELA ZA PRIPRAVO LANTANOVEGA KROMITA

Prahove lantanovega kromita (LC) smo pripravili s samovzdrževalno reakcijo iz citratno nitratnih gelov. Proučevali smo pretvorbo reaktivnega citratno-nitratnega gela v perovskitno modifikacijo lantanovega kromita. Vpliv razmerja gorivo/oksidant v izhodnem prekurzorju na hitrost gorenja in termične karakteristike smo zasledovali z simultano termično analizo (TG, DTG in DTA), EGA analizo ter plinsko kromatografijo (GC). Pri zgorevanu citratno-nitratnega gela potekajo reakcije v več zaporednih med seboj ločenih stopnjah, njegov termični razpad pa je močno odvisen od citratno-nitratenega razmerja v gelu pred sežigom. Prvi dve stopnji termičnega razpada sta povezani z reakcijo med citronsko kislino in nitratom. Stopnja pri približno 350 °C kaže na gorenje ostanka citronske kisline s kisikom iz zraka, zadnja stopnja termičnega razpada pa je povezana s pretvorbo LaCrO_4 v LaCrO_3 . Vmesne in končne produkte smo karakterizirali z rentgensko praškovno analizo.

P-1

IDENTIFICATION OF MATERIAL PROPERTIES OF QUASI- UNIDIRECTIONAL CARBON-EPOXY COMPOSITE USING MODAL ANALYSIS

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This work focuses on the identification of material parameters of carbon-epoxy composite with continuous ultrahighmodulus fibers and matrix enriched by nanoparticles. The tested structure is a cantilever beam having rectangular cross-section. The beam is manufactured by forming several fiber bundles together, each wrapped by transverse layer of fibers. The wrapping fibers provide additional strength in transverse loading. The eigen-frequencies of the beam are experimentally assessed. Corresponding modal analysis is performed using finite element method with homogenized material properties obtained using simplified analytical formulae. The real properties are identified using the combination of the mathematical optimization method and finite element analysis by minimizing the difference between measured and calculated eigen-frequencies.

VT-1

STATIC SORPTION METHOD FOR CHARACTERISATION OF NON-EVAPORABLE GETTERS

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Non-evaporable getters (NEGs) operate on chemical pumping principle. They consist of materials exhibiting large H affinity at RT as well as high O solubility at elevated temperatures, which is characteristic for elements from the IVB column (Ti, Zr, Hf).

According to the standard ASTM F 798-97, the characterization of NEGs starts with activation followed by determination of pumping performance. NEG activation takes place at elevated temperatures in UHV. During activation a protective oxide layer diffuses into the NEG bulk thus enabling fresh surfaces for effective NEG pumping performance. NEG sorption characteristics are determined at RT using the dynamic method. Its main characteristics are as follows: use of hot-cathode ionisation gauges as total pressure gauges in the gas manifold and in the test chamber, variable gas flow through the known conductance, constant pressure above the getter surface and pumping of non-getterable gases out of the test chamber. The standard gases are CO and H₂ as representatives of irreversibly and reversibly getterable gases. Measurement results are presented as getter pumping speed vs sorbed gas quantity.

The main characteristics of the static sorption method, developed at IMT, are constant gas flow and variable pressure above the getter surface. It is essential that a spinning rotor gauge (SRG) is used for both determining gas flow by the rate of pressure rise method and measuring pressure above the getter surface. While performing static sorption method non-getterable gases (noble gases and CH₄) might accumulate in the test chamber. Therefore, during the test the gas flow is interrupted few times in order to measure the increase of background pressure.

The advantage of the sorption method over the widely used dynamic one is reflected in the use of the inert SRG in static mode without affecting the working atmosphere. In addition, the static method enables discrete monitoring the increase of background pressure due to accumulation of inert gases throughout the test and, at the end of test, analysis of non-getterable gas composition using RGA in dynamic mode.

STATIČNA SORPCIJSKA METODA ZA KARAKTERIZACIJO NENAPARLJIVIH GETROV

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Nenaparljivi getri (NEG) delujejo na osnovi kemičnega črpanja. Sestavljajo jih materiali, ki izkazujejo veliko afiniteto za vodik pri sobni temperaturi in hkrati tudi veliko topnost za kisik pri povišani temperaturi, kar je značilno za elemente iz IVB skupine (Ti, Zr, Hf).

Po standardu ASTM F 798-97 se karakterizacija NEG pričinja z aktivacijo, ki ji sledi določanje sorpcijskih zmogljivosti. Aktivacija NEG poteka pri povišani temperaturi v ultravisokem vakuumu. Med aktivacijo zaščitna oksidna plast difundira v masivni material. Ustvari se sveža površina za učinkovito črpalno zmogljivost NEG. Sorpcijske lastnosti NEG se določajo pri sobni temperaturi z dinamično metodo. Za njo je značilna uporaba ionizacijskih merilnikov z vročo katodo kot merilnikov totalnega tlaka v komori za dovod preskusnega plina in v merilni komori, spremenljiv plinski pretok skozi znano prevodnost, konstanten tlak nad getsko površino in sprotno črpanje inertnih plinov iz merilne komore. H₂ in CO sta standardna preskusna plina, ki predstavljata pline, ki reverzibilno in ireverzibilno reagirajo z NEG. Merilni rezultat je predstavljen kot getska črpalna hitrost v odvisnosti od množine sorbiranega plina.

Za statično sorpcijsko metodo, ki je bila razvita na IMT, je značilen konstanten plinski pretok in spremenljiv tlak nad getsko površino. Bistvena je uporaba viskoznostnega merilnika z lebdečo

kroglico (SRG), ki se uporablja tako za določanje plinskega pretoka z metodo hitrosti naraščanja tlaka kot za merjenje tlaka nad getrsko površino. Pri statični metodi lahko v merilni komori poteka akumulacija inertnih plinov (žlahtnih plinov in CH_4). Zato se med preskusom plinski pretok nekajkrat prekine, kar omogoča meritev spremembe rezidualnega tlaka.

Prednost statične sorpcijske metode v primerjavi z dinamično metodo je v uporabi inertnega SRG, ki ne vpliva spremembo sestave delovne atmosfere. Statična metoda omogoča diskretno spremljanje naraščanja rezidualnega tlaka zaradi akumulacije inertnih plinov. Na koncu sorpcijskega testa je omogočena tudi analiza sestave akumuliranih plinov, uporabljajoč kvadrupolni masni spektrometer v dinamičnem načinu.

VT-2

THE SIMULATED ENVIRONMENT FOR MASS SPECTRA RECOGNITION

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The simulated environment for the mass spectra recognition is described. The mass spectra recognition process is typically a very complex one. Numerous tests of various approaches must be accomplished in order to assess different recognition processes and strategies. From the practical point of view it is not possible to make enough real measurements (at least not in the first stage) just for the purpose of studying the algorithms.

It was our goal to provide the testing ground for various recognition algorithms that will work both in a qualitative and quantitative manner. The first algorithm tested is the pseudo gradient descent method.

The mass spectra recognition can be typically accomplished by solving the system of equations (Least square method, singular value decomposition, tridiagonalisation of matrices, the Cholesky method, orthogonalisation, etc). Due to the fact that the basic constituent elements of the mass spectra of the gasses included in the vacuum chamber atmosphere are not linearly independent, nor are they orthogonal, such methods do not yield to usable results. Another practical problem represents the noise. The above mentioned methods are also not tolerant to noise.

In the simulated environment, the mass spectra patterns for 27 gasses (m/e ratio from 1 to 47) were taken into analysis, and the simulated environment was created in order to analyze the algorithm.

SIMULACIJSKO OKOLJE ZA RAZPOZNAVANJE MASNIH SPEKTROV

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Opisano je simulacijsko okolje za razpoznavanje masnih spektrov, Razpoznavanje masnih spektrov je po svji naravi zelo kompleksen proces. Za ovrednotenje delovanja posameznih algoritmov nujno potrebujemo okolje, ki ustvari različne razmere, ki jim morajo biti kos dobri algoritmi. Iz praktičnih razlogov ni mogoče izmeriti takšne količine realnih masnih spektrov, ki jih potrebujemo za natančno analizo delovanja algoritmov.

Osnovni cilj je bil postaviti testno okolje, ki bo služilo testiranju različnih algoritmov za zagotavljanje tako kvalitativne kot tudi kvantitativne analize masnih spektrov. Prvi algoritem, ki ga v opisanem okolju testiramo, uporablja psevdo gradientno metodo.

Običajno se teoretično navaja, da se probleme razpoznavanja masnih spektrov lahko izvede z eno od metod reševanja sistemov enačb (najmanjši kvadrati, dekompozicija po singularnih vrednostih, tridiagonalizacija matrike, metoda Choleskega, ortogonalizacija, itd.). Glede na dejstvo, da masni spektri posameznih sestavin atmosfere v vakuumski komori niso linearno neodvisni in da ravno tako niso ortogonalni, zgoraj omenjene metode razpoznavanja spektrov niso praktično uporabne. Dodatne težave povzroča šum, ki je v spektru vedno prisoten. Omenjene metode so na šum slabo odporne.

V pripravljeno simulacijsko okolje je vključeno 27 plinov z razmerji m/e od 1 do 47. Število različnih sestavin atmosfere nikakor ni s tem omejeno, saj se lahko okolje poljubno prilagodi.

VT-3

MODIFICATION OF CELLULOSE FIBERS BY PLASMA TREATMENT

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Regenerated cellulose textile fibres are rather hydrophilic, but in some cases, even higher reactivity is needed, namely sorption ability. The aim of the present work was to find out, if the plasma activation is appropriate procedure for surface activation of cellulose textile fibres for later chitosan adsorption and binding. A study on cold plasma treatment of a textile is presented. Samples of a pure viscose textile were exposed to a weakly ionized, highly dissociated RF plasma with an electron temperature of about 3 eV, an ion density of the order of 10^{15} m^{-3} and a density of neutral atoms of the order of 10^{21} m^{-3} . Samples were treated by oxygen, nitrogen or hydrogen plasma for 5 s. The gas pressure was 75 Pa and the RF power was 250 W. In all cases the plasma treatment induced chemical changes in the sample surface, which were determined by using high-resolution XPS (X-ray photoelectron spectrometer). The treatments in oxygen and nitrogen plasma caused increased concentration of existing as well as formation of new oxidative functional groups, while hydrogen plasma caused a substantial decrease of these functional groups. Ageing of the surface treated in oxygen plasma was studied 4 h, 24 h and 96 h after the plasma treatment. The surface seems to be rather stable. SEM analysis of the surface of the textile fibres were performed as well. The results showed that the surface of the textile fibres treated in nitrogen plasma is similar to the untreated fibres, while after treatment in hydrogen or oxygen plasma, the surface becomes rougher.

MODIFIKACIJA CELULOZNIH VLAKEN S PLAZEMSKO OBDELAVO

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Kljub temu, da so celulozna vlakna že po naravi dokaj hidrofilna, je v določenih primerih potrebna še večja površinska aktivnost, predvsem kar se tiče absorpcije in adhezije. Spremembo površinskih lastnosti materiala najlažje dosežemo z obdelavo v plazmi. Namen našega dela je ugotoviti, kako plazma vpliva na aktivacijo površine celuloznih vlaken z namenom izboljšati adhezivne lastnosti med celulozo in citozanom, ki smo ga nanašali na plazemsko obdelano tkanino. Vzorce tkanine iz celuloze smo obdelali 30 s v RF plazmi pri tlaku 75 Pa in moči 250 W. Uporabili smo plazmo kisika, dušika in vodika. Plazemsko obdelano tkanino smo analizirali z AFM in XPS. Ugotovili smo, da v vseh primerih plazme pride do kemijskih sprememb na površini vzorca. Obdelava v kisikovi in dušikovi plazmi je privedla do povečane že koncentracije obstoječih funkcionalnih skupin (C-O, O-C-O), ter tudi do tvorbe novih funkcionalnih skupin na površini (C=O, O=C-O, C-N). Nasprotno je obdelava v vodikovi plazmi povzročila redukcijo teh funkcionalnih skupin. Ugotavljali smo tudi časovno stabilnost površine, ki je bila obdelana v kisikovi plazmi. Staranje vzorca smo spremljali 4 h, 24 h in 96 h po plazemski obdelavi. Ugotovili smo, da je površina dokaj stabilna, saj so bile opazne le neznatne spremembe. Iz SEM analiz površine celuloznih vlaken smo ugotovili, da do največjih površinskih sprememb pride pri obdelavi vlaken v vodikovi plazmi, nekoliko manj v kisikovi plazmi, še najmanj pa se vlakna poškodujejo pri obdelavi v dušikovi plazmi. Pri obdelavi v dušikovi plazmi postane površina vlaken le rahlo bolj hrapava, medtem ko pri obdelavi v kisikovi ali vodikovi plazmi pride tudi do večjih poškodb vlaken, ki se začnejo luščiti.

NN-1

NANO-CHEMICAL ANALYZES OF MoS₂ MAMA-TUBESM. Godec¹, M. Remškar², A. Jesih², A. Mrzel², M. Viršek², M. Jenko¹¹Institute of Metals and Technology, Ljubljana, Slovenia²Jožef Stefan Institute, Ljubljana, Slovenia

A new material with unique morphology without a strict analogy in material science has been synthesized recently from Mo₆S₂I₈ nanowires precursors and has been named mama-tubes. MoS₂ nanoparticles are tightly encapsulated in such a nanotube and distributed along the nanotube. The very thin walls might be broken in controlled way and MoS₂ particles might be released from nanocontainers and served as lubricants. There are far more applications proposed by the author of MoS₂ nanopods (mama-tubes) among the applications in catalysis, polymer composites, solar energy system etc.

So far there have been no analyzes performed on the proportion of molybdenum regarding the sulphur in nanoparticles within the MoS₂ nanopods. The same goes for the traces of iodine in nanoparticles as well as in the thin walls. FEG SEM equipped with EDS and WDS was used for chemical analyzes of nano-regions. MoS₂ material was used as standards for molybdenum and sulphur, while MoI₂ was applied for the detection of iodine. Both standards have been previously verified by XRD. The accuracy of EDS and WDS measurements were additionally checked with Mo₆S₂I₈ precursor which has also been previously verified by XRD. Once, all the data on standards were performed, the measurements took place on MoS₂ nanopods. Due to the fact that MoS₂ particles were very small and due to the fact that analyzed nanotube were separated from the nanotube bunch, the chemical information arises only from the area excited by electron beam; which size is still smaller than the size of the nanoparticle. So the analyzing volume is within the nanoparticle. Both EDS and WDS analyses show the very similar result and proof that nanoparticles are stoichiometric MoS₂ with no trace of iodine.

NANO-KEMIČNA ANALIZA MoS₂ "MAMA-CEVK"M. Godec¹, M. Remškar², A. Jesih², A. Mrzel², M. Viršek², M. Jenko¹¹Inštitut za kovinske materiale in tehnologije, Ljubljana, Slovenija²Institut Jožef Stefan, Ljubljana, Slovenija

Pred kratkim je bil sintetiziran material z edinstveno morfologijo, ki nima nobene podobnosti z do sedaj znanimi materiali na področju znanosti o materialih. Izdelan je bil iz prekursorja nanožičk Mo₆S₂I₈ in poimenovan "mama-cevke". Nanodelci MoS₂ so tesno zaprti v nanocevk in razporejeni vzdolž nje. Na kontroliran način z razbitjem zelo tankih sten je mogoče MoS₂ nanodelce sprostiti iz nanobiralnika in tako dobiti lubrikant. Obstaja še veliko drugih možnosti uporabe, ki jih je predlagal avtor MoS₂ nanostrokov (mama-cevk), kot so aplikacije pri katalizi, pri izdelavi polimernih kompozitov in v sistemu pridobivanja sončne energije ter druge.

Vse do sedaj ni bila izvedena nobena analiza razmerja molibdena glede na žveplo v nanodelcih nanostroka. Ravno tako še ni bila narejena analiza joda, tako v nanodelcih kot v sami steni nanocevke. Narejena je bila kemična analiza posameznih nanopodročji z uporabo FEG SEM opremljenega z EDS in WDS. Uporabili smo standard MoS₂ za analizo molibdena in žvepla, standard MoI₂ pa je bil uporabljen za analizo joda. Oba standarda sta bila predhodno potrjena z XRD. Ko smo enkrat določili vse podatke na standardih, smo izvedli meritve na MoS₂ nanostroku. Glede na dejstvo, da so bili analizirane nanocevke ločene od ostalega šopa nanocev, je bila dobljena kemijska informacija le s področja vzbujenega z elektronskim curkom, katerega velikost je bila manjša od velikosti nanodelcev. Analizni volumen je tako bil znotraj nanodelcev. Na osnovi obeh EDS in WDS analiz smo določili zelo podobne rezultate in dokazali stehiometričnost MoS₂ nanodelcev, ki so bili brez sledi joda.

VO-1

MICROTREMOR STUDIES TO DETERMINE THE THICKNESS OF THE SEDIMENTS

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Microtremor measurements were carried out at the sedimentary basin Ljubljansko barje. Free-field measurements were performed at the locations of boreholes that reached the Pre-Quaternary basement of the basin and the resonance frequency of each sediment site was estimated from the main peak in the horizontal to vertical spectral ratio (HVSr). The correlation between the resonant frequency of the unconsolidated sedimentary layers and their thicknesses, which was derived from a database of 53 measurements at Ljubljansko barje, agrees well with relations known for other similar sedimentary basins in the literature. There was, however, often a large deviation in comparison with calculated depths, with information known from the drilling, especially at the sites with lower thicknesses (less than 5 m). The causes of these differences are the local site effects (the topographic effect of the subsurface, the geometry of the basin, the basin pinch-out, the lateral discontinuities, etc.). At greater depths to bedrock (> 80 m) the fundamental resonant frequency of sediments is systematically greater than expected due to the effect of the sensor, a weaker signal or the heterogeneity of the Quaternary deposits. In conclusion, microtremor measurements are best used in combination with information obtained from other geophysical methods and drilling.

RAZISKAVE Z MIKROTREMORJI ZA DOLOČITEV DEBELINE SEDIMENTOV

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V sedimentacijskem bazenu Ljubljansko barje so bile s HVSr metodo (spektralno razmerje med vodoravnima in navpično komponento) mikrotremorjev ocenjene lastne frekvence sedimentov. Meritve na prostem površju so bile opravljene na lokacijah vrtin, ki so dosegle predkvartarno podlago. Na osnovi 53 meritev je bila izpeljana eksponentna relacija med lastno frekvenco sedimentov in njihovo debelino, ki se dobro ujema z relacijami v drugih podobnih sedimentacijskih bazenih, objavljenimi v literaturi. Pokazalo se je, da izračunane globine do podlage na Ljubljanskem barju pogosto zelo odstopajo od dejanskih vrednosti, še posebej na plitvih delih bazena, kjer je podlaga manj kot 5 m globoko. To lahko pripišemo vplivu lokalne geološke zgradbe (topografija predkvartarne podlage, oblika bazena, izklinjanje plasti, bočne nezveznosti itd.). Pri velikih globinah do podlage (> 80 m) je lastna frekvenca sedimentov sistematično višja od pričakovane, kar je lahko posledica vpliva senzorja, šibkejšega signala in heterogenosti kvartarnih sedimentov. Potrjeno je bilo, da je metodo mikrotremorjev, kot pomožno geofizikalno metodo, najbolje uporabljati v kombinaciji s podatki, pridobljenimi z drugimi geofizikalnimi metodami in vrtanjem, saj le tako lahko zmanjšamo nezanesljivost rezultatov.

VT-4

IZKUŠNJE Z DOSEGANJEM ŽELENE VŽIGNE NAPETOSTI PRI PLINSKIH ODVODNIKI

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Plinski odvodniki so razelektrivne cevi, pri katerih ionizacijo vgrajenega plina povzroči prenapetost. Konstruirani so za vžig pri določeni napetosti, ki je glede na potrebe uporabnikov zelo različna, navadno med 300 in 1000 V. V nevzbujenem stanju je plinski odvodnik popolni izolator, ko pa pri nekem pojavu naraščajoča napetost doseže določeno vrednost, pride do ionizacije plinskih molekul in odvodnik preide v prevodno stanje. Prav ta pojav izkoriščamo pri zaščitnih elementih proti udaru strele s tem, da na novo odprta pot omogoči energiji strele najkrajšo pot v zemljo.

Vžig oziroma nastajanje plazme je pomembno dogajanje in je zato deležno obširnih raziskav tako na nivoju raziskav kot tudi experimentalnih izvedb. Posebej se zanje zanimajo proizvajalci naprav, ki temeljijo na uporabi plazme, kot so npr: nekateri tipi svetil, plazemske čistilne naprave, aparati za zaznavanje prisotnosti elektromagnetnih valovanj itd.

Pri razvoju prenapetostnih plinskih odvodnikov imamo poleg odpornosti na visokotokovne udare glavni cilj doseči izbrano vžigno napetost in zmanjšanje raztrosa izmerjenih vrednosti. Pri tem so vplivni predvsem velikost reže med elektrodama ter tlak in vrsta uporabljenega plina. V ta namen smo izvedli številne tehnološke in konstrukcijske preskuse in prišli do določenih izkušenj. Poleg plina in reže je pomembna tudi izbira materiala za elektrode, gladkost površin, posebni dodatki in oblikovanje medelektrodne prostora. V prispevku je vse to na kratko predstavljeno.

NN-2

PREPARATION OF NANO-ANATASE TiO₂

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Titania occurs in nature as rutile, anatase and brookite. The most common and stable form represents rutile. In other words, when heating, anatase and brookite transform into rutile type of titania. Rutile has been used for decades in electronic industry, as a white pigment material for dyes, top coats, as a screening material. Nano-anatase shows interesting photo-catalytic and super-hydrophilic properties. It is used in self-cleaning surfaces. Nano-anatase titania shows great potential for use in dye-sensitive solar cells, intelligent sensors and actuators, fast electrochromic system, catalysis, multifunctional devices and photonic crystals.

Goal of our project is to build well-defined self-assembled self-supporting structures (nanorods, nanowires, quantum dots...) using self-assembly of colloidal particles of titania in liquid media on solid surface. Composition, morphology, size, structure, surface and properties will be controlled with preparation parameters and chemistry.

In the beginning it is most important how to prepare colloidal particles of titania that would have nano-scale diameter, same size and would be spherical as possible. That kind of particles represents excellent starting point for well organized construction into more complex structures.

We used two commercially easy accessible powders of titania in anatase modification of different sizes. With hydrothermal syntheses we reduced particles' diameter, with addition of base we tried to dissolve upper part of anatase to get approximately equal sides. This is namely the best approximation of sphere.

PRIPRAVA NANO-ANATAZA TiO₂

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Titanov dioksid se pojavlja v naravi kot rutil, anataz in brukit. Najbolj pogosto in stabilno obliko predstavlja rutil, saj se tudi anataz ter brukit pri segrevanju spremenita v rutilno modifikacijo. Titanov dioksid v rutilni obliki se uporablja že desetletja v elektroniki, kot beli pigment v barvah, premazih, zaščitnih sredstvih. Nano-anataz pa kaže zanimive fotokatalitske in superhidrofilne lastnosti. Uporablja se ga v samočistilnih premazih. Velik potencial pa kaže za uporabo v sončnih celicah DSC, v pametnih senzorjih in aktuatorjih, elektrokromih sistemih, katalizatorjih, multifunkcionalnih sklopov in fotonih kristalih.

Naš cilj je s pomočjo samourejanja koloidnih delcev titanovega dioksida v tekočem mediju na trdni površini narediti dobro definirane, samoorganizirane samostoječe strukture (nanopalčke, nanožičke, kvantne pike...), katerih sestavo, velikost, obliko, strukturo, površino in končne lastnosti bomo kontrolirali s parametri priprave ter kemijo.

V začetni fazi je za nas pomembna priprava koloidnih delcev titanovega dioksida, ki bi bili reda velikosti nekaj nanometrov, enake velikosti ter kar se da sferični, saj nam kot taki predstavljajo dobro izhodišče za urejeno gradnjo v bolj kompleksne strukture.

Uporabili smo dva komercialno lahko dostopna prahova titanovega dioksida v anatazni modifikaciji različnih velikosti in jima s hidrotermalno sintezo manjšali premer delcev, z dodatkom baze pa smo poskušali odtopiti zgornji del kristala, da bi dobili približno enako dolge stranice, saj tak predstavlja najboljši približek sferi.

MF-1

PRODUCTION OF SiC_f/SiC COMPOSITE BY INFILTRATION OF 3D SiC FABRIC

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The poster presents the results of a study aimed to develop a SiC-based composite that will effectively substitute the currently favoured ferrous materials, which are proposed to be used in future fusion reactors.

The main stress of our investigation was to achieve the best possible particle packing in the infiltrated matrix by electrophoretic infiltration (EPI) and to find a technique of addition a sintering additive from a limited number of low-activation elements, which would enable sintering of SiC to high density at temperature below 1500° C.

Electrophoretic infiltration (EPI) has shown to be a promising technique for infiltration of ceramic suspension into SiC-fibre substrate. Effective filling the SiC-fibre woven was achieved by modification of the fibres surface using appropriate surface active agents. The critical parameters are particles' surface charge and conductivity of the SiC suspension. Al-phosphate was used as transient sintering additive (TSA), so that the SiC-based ceramics can be densified at temperature below 1500 °C.

IZDELAVA SiC_f/SiC KOMPOZITOV Z INFILTRACIJO 3D SiC TKANINE

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Poster predstavlja rezultate raziskovanja usmerjenega v razvoj kompozita na osnovi SiC, kateri bi učinkovito nadomestil trenutno uporabljene jeklene materiale, ki naj bi bili uporabljeni v bodočih fuzijskih reaktorjih.

Glavni poudarek raziskav je bil z elektroforetsko infiltracijo (EPI) doseči najboljšo možno gostoto delcev v infiltrirani matrici in najti način dodajanja dodatka za sintranje sestavljenega iz omejenega števila nizko aktivacijskih elementov, ki bi omogočil sintranje SiC do visoke gostote pri temperaturah nižjih od 1500° C.

Elektroforetska infiltracija se je izkazala za obetajočo metodo za infiltracijo keramične suspenzije v substrat iz SiC vlaken. Učinkovna zapolnitev tkanine iz SiC vlaken je bila dosežena z spremembo površine vlaken z uporabo primernih površinsko aktivnih dodatkov. Odločilna parametra sta površinski naboj delcev in prevodnost SiC suspenzije.

Kot dodatek za sintranje je bil uporabljen Al fosfat, s katerim smo lahko SiC keramiko sintrali pri temperaturah nižjih od 1500 °C.

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