

**17. KONFERENCA O MATERIALIH
IN TEHNOLOGIJAH**

16.–18. november 2009, Portorož, Slovenija

**17th CONFERENCE ON MATERIALS
AND TECHNOLOGY**

16–18 November 2009, Portorož, Slovenia

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

**UREDNIK / EDITOR
MONIKA JENKO**

INŠTITUT ZA KOVINSKE MATERIALE IN TEHNOLOGIJE, LJUBLJANA

17. KONFERENCA O MATERIALIH IN TEHNOLOGIJAH /
17th CONFERENCE ON MATERIALS AND TECHNOLOGY

Program in knjiga povzetkov / Program and book of abstracts

Izdal in založil *Inštitut za kovinske materiale in tehnologije, Ljubljana*
Lepi pot 11, Ljubljana, Slovenija

Za založnika *Monika Jenko*

Organizatorji: Inštitut za kovinske materiale in tehnologije, Kemijski inštitut, Institut Jožef Stefan,
Mednarodna podiplomska šola Jožefa Stefana

Uredila

Monika Jenko

Lektor:

Jože Gasperič (slovenski jezik)

Oblikovanje ovitka

Ignac Kofol

Tehnična urednica

Jana Jamar

Računalniški prelom

Miro Pečar

Tisk

Infokart, d. o. o., Ljubljana

Naklada

150 izvodov

Ljubljana 2009

ISBN 978-961-92518-1-2

CIP - Kataložni zapis o publikaciji
Narodna in univerzitetna knjižnica, Ljubljana

66.017(082)
669(082)
620.2(082)

KONFERENCA o materialih in tehnologijah (17 ; 2009 ; Portorož)
Program in knjiga povzetkov = Program and book of abstracts /
17. konferenca o materialih in tehnologijah, 16.-18. november 2009,
Portorož, Slovenija = 17th Conference on Materials and Technology,
16-18 November, 2009, Portorož, Slovenia ; [organizatorji Inštitut
za kovinske materiale in tehnologije [in] Kemijski inštitut [in]
Institut Jožef Stefan, Mednarodna podiplomska šola Jožefa Stefana]
; urednik, editor Monika Jenko. - Ljubljana : Inštitut za kovinske
materiale in tehnologije, 2009

ISBN 978-961-92518-1-2

1. Jenko, Monika, 1947- 2. Inštitut za kovinske materiale in
tehnologije (Ljubljana) 3. Kemijski inštitut (Ljubljana) 4.
Institut Jožef Stefan (Ljubljana). Mednarodna podiplomska šola
Jožefa Stefana
248360704

Predsednica konference – Chair: Monika Jenko

Znanstveni odbor

M. Jenko	Inštitut za kovinske materiale in tehnologije, Ljubljana
A. Jaklič	Acroni d. o. o., Jesenice
A. Gradišnik	Metal Ravne d. o. o., Ravne na Koroškem
M. Mačkošek	Štore Steel, Štore
J. Čokl	Impol, d. d., Slovenska Bistrica
F. Vodopivec	Inštitut za kovinske materiale in tehnologije, Ljubljana
J. Jamnik	Kemijski inštitut, Ljubljana
S. Pejovnik	Fakulteta za kemijo in kemijsko tehnologijo, Univerza v Ljubljani
R. Blinc	Mednarodna podiplomska šola Jožefa Stefana, Ljubljana
D. Mihailović	Mednarodna podiplomska šola Jožefa Stefana, Ljubljana
M. Drofenik	Institut "Jožef Stefan", Ljubljana
S. Kobe	Institut "Jožef Stefan", Ljubljana
D. Suvorov	Institut "Jožef Stefan", Ljubljana
M. Kosec	Institut "Jožef Stefan", Ljubljana
M. Žigon	Kemijski inštitut, Ljubljana
J. Gasperič	Institut "Jožef Stefan", Ljubljana

Organizacijski odbor

V. Nahtigal	Inštitut za kovinske materiale in tehnologije, Ljubljana
M. Torkar	Inštitut za kovinske materiale in tehnologije, Ljubljana
A. Zidanšek	Mednarodna podiplomska šola Jožefa Stefana, Ljubljana
S. Kobe	Institut "Jožef Stefan", Ljubljana
M. Huskić	Kemijski inštitut, Ljubljana
J. Šetina	Inštitut za kovinske materiale in tehnologije, Ljubljana

Mednarodni znanstveni odbor

H.J. Grabke	Max-Planck-Institute for Iron Research, Düsseldorf, Nemčija
G. Petzow	Max-Planck-Institute for Metal Research, Stuttgart, Nemčija
M. Milun	Institute of Physics, Zagreb, Hrvaška
K. Dušek	Institute of Macromolecular Chemistry Academy of Sciences of the Czech Republic

Scientific Committee

M. Jenko	Institute of Metals and Technology, Ljubljana
A. Jaklič	Acroni, Jesenice
A. Gradišnik	Metal Ravne, Ravne na Koroškem
M. Mačkošek	Štore Steel, Štore
J. Čokl	Impol, d. d., Slovenska Bistrica
F. Vodopivec	Institute of Metals and Technology, Ljubljana
J. Jamnik	National Institute of Chemistry, Ljubljana
S. Pejovnik	Faculty of Chemistry and Chemical Technology, University of Ljubljana
R. Blinc	Jožef Stefan International Postgraduate School, Ljubljana
D. Mihailović	Jožef Stefan International Postgraduate School, Ljubljana
M. Drofenik	Jožef Stefan Institute, Ljubljana
S. Kobe	Jožef Stefan Institute, Ljubljana
D. Suvorov	Jožef Stefan Institute, Ljubljana
M. Kosec	Jožef Stefan Institute, Ljubljana
M. Žigon	National Institute of Chemistry, Ljubljana
J. Gasperič	Jožef Stefan Institute, Ljubljana

Organizing Committee

V. Nahtigal	Institute of Metals and Technology, Ljubljana
M. Torkar	Institute of Metals and Technology, Ljubljana
A. Zidanšek	Jožef Stefan International Postgraduate School, Ljubljana
S. Kobe	Jožef Stefan Institute, Ljubljana
M. Huskić	National Institute of Chemistry, Ljubljana
J. Šetina	Institute of Metals and Technology, Ljubljana

International Scientific Committee

H.J. Grabke	Max-Planck-Institute for Iron Research, Düsseldorf, Germany
G. Petzow	Max-Planck-Institute for Metal Research, Stuttgart, Germany
M. Milun	Institute of Physics, Zagreb, Croatia
K. Dušek	Institute of Macromolecular Chemistry Academy of Sciences of the Czech Republic

VSEBINA – CONTENTS

PROGRAM – PROGRAM	5
PROGRAM – PROGRAM	
Govorni prispevki – Oral	7
Posterska sekcija – Poster session	14
POVZETKI – ABSTRACTS	
Govorni prispevki – Oral	
Ponedeljek – Monday	21
Torek – Tuesday	55
Sreda – Wednesday	69
Posterska sekcija – Poster session	
Kovinski materiali – Metallic materials	73
Anorganski materiali – Inorganic materials	104
Polimeri – Polymers	107
Vakuumska tehnika – Vacuum technique	108
Nanomateriali in nanotehnologije – Nanomaterials and nanotechnology	112
Varstvo okolja – Environmental protection	116
AVTORSKO KAZALO – AUTHORS INDEX	119

Legenda – Legend:

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

17. KONFERENCA O MATERIALIH IN TEHNOLOGIJAH, 16. – 18. NOVEMBER 2009
17TH CONFERENCE ON MATERIALS AND TECHNOLOGY, 16–18 NOVEMBER, 2009
PROGRAM – PROGRAM

	PONEDELJEK – MONDAY, 16. 11. 2009		TOREK – TUESDAY, 17. 11. 2009	SREDA – WEDNESDAY, 18. 11. 2009
08:45	<i>Odprtje – Opening</i>	08:45	Miran Mozetič	
09:00	Manfred Leisch	09:00		Darko Drev
09:15		09:15	Kristina Žužek Rožman	Igor Belič
09:30	Vladimir Matolin	09:30		Borivoj Šuštaršič
09:45		09:45	<i>Odmor – Break</i>	Tadeja Koscec
10:00	Alfredo Juan	10:00	Massimo Pellizzari	
10:15		10:15		
10:30	<i>Odmor – Break</i>	10:30	Stan T. Mandziej	
10:45	Bernard Marini	10:45		
11:00		11:00	<i>Odmor – Break</i>	
11:15	Bojan Jenko	11:15	Franjo Cajner	
11:30		11:30		
11:45	Dragan Uskoković	11:45	Reinhold Schneider	
12:00		12:00		Slavnost ob 60 letnici IMT 60-years IMT
12:15	Wilfried Eichlseder	12:15	Božo Smoljan	
12:30		12:30		
12:45		12:45		
13:00	13:00 – 15:00 Odmor za kosilo – Lunch		13:00 – 15:00 Odmor za kosilo – Lunch	
15:00	Andraž Kocjan	15:00	Karlo T. Raić	
15:20	B. Šetina Batič – A. Ivekovič	15:15		
15:40	P. Hájková – S. Krum	15:30	Františka Pešlová	
16:00	S. Perko – G. Trefalt	15:45		
16:20	<i>Odmor – Break</i>	16:00	Petr Jurči	
16:40	H. Uršič – B. Brulc	16:15	<i>Odmor – Break</i>	
17:00	M. Bitenc – A. Maglica	16:30	Varužan Kevorkijan	
17:20	N. Čuk – D. Pahovnik	16:45	Robert Cvelbar	
17:40	A. Bytyqi – I. Paulin	17:00	D. Steiner Petrovič	
18:00	<i>Odmor – Break</i>	17:15	Franc Tehovnik	
18:20	F. Kafexhiu – B. Poniku			
18:40	M. Malešević – M. Sefa			
19:00	S. Avdiaj – A. Križaj			
19:20	M. Soderžnik – A. Milaku			
19:40	J. Kovač – D. Pečko			
20:00	B. Žužek – B. Horvat			
20:20	M. Lamut			
21:00	Podelitev nagrad MR – Young Scientists Awards Dobrodošlica –Welcome Party	20:00	Posterska sekcija – Poster Session KM, AM, P, VT, NN, VO COCKTAIL PARTY	

PROGRAM 17. KONFERENCE O MATERIALIH IN TEHNOLOGIJAH
17th CONFERENCE ON MATERIALS AND TECHNOLOGY: PROGRAM

PONEDELJEK – MONDAY 16. 11. 2009		
Predsedujoči – Chair: Franc Vodopivec, Monika Jenko		
8:45	ODPRTJE – OPENING	
9:00	M. Leisch, P. Frank, L. Westerberg* Institute of Solid State Physics, Graz University of Technology, A 8010 Graz, Austria *Department of Physics, Uppsala University, SE 75121 Uppsala, Sweden SURFACE CHARACTERIZATION OF VACUUM FIRED STAINLESS STEELS BY AFM, STM AND ATOM PROBE	VT-VP
9:30	V. Matolín Charles University, V Holešovičkách 2, 18000 Prague 8, Czech Republic NEW ANODE MATERIAL FOR PEM FUEL CELLS: Pt-CERIUM OXIDE THIN FILMS DEPOSITED ON CNTs	KM-VP
10:00	Alfredo Juan Universidad Nacional del Sur, 8000 Bahia Blanca, Argentina HYDROGEN – IRON INTERACTIONS IN METALS WITH VACANCIES FROM A THEORETICAL POINT OF VIEW	KM-VP
10:30	Odmor – Break	
Predsedujoči – Chair: Jelena Vojvodič Tuma, Spomenka Kobe		
10:45	B. Marini, C. Toffolon, P. Forget CEA/DEN/DANS/DMN, 91191 Gif-sur-Yvette, France CORRELATION BETWEEN THE α - α' DECOMPOSITION OF THE FERRITE AND THE MECHANICAL PROPERTIES OF CAST DUPLEX STAINLESS	KM-VP
11:15	Bojan Jenko Ministry of Higher Education, Science and Technology, Slovenia EU FUNDING OF RESEARCH – FP7 EU-FINANCIRANJE RAZISKAV – 7. OP	RP-VP
11:45	Dragan Uskoković Institute of Technical Sciences of the Serbian Academy of Sciences and Art, Knez Mihailova 35/IV, 11000 Belgrade, Serbia THE DESIGN OF FINE PARTICLES WITH CONTROL AT THE NANO SCALE	AM-VP
12:15	Wilfried Eichlseder University of Leoben/Austria ENHANCED FATIGUE ANALYSIS – INCORPORATING DOWNSTREAM MANUFACTURING PROCESSES	KM-VP
13:00 – 15:00 ODMOR ZA KOŠILO – LUNCH		
Predsedujoči – Chair: Danilo Suvorov, Manfred Leisch, Spomenka Kobe, Majda Žigon		
15:00	A. Kocjan, P. J. McGuinness, S. Kobe Department for nanostructured materials, Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, EU HYDROGEN ABSORPTION IN Ti-Zr-Ni ALLOYS ABSORPCIJA VODIKA V ZLITINAH Ti-Zr-Ni	AM-VP
15:20	Barbara Šetina Batič, Monika Jenko Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenia CRYSTAL ORIENTATION-DEPENDENT NANOSTRUCTURING BY ION BEAM: RIPPLES, FACETS AND ETCH PITS	VT-MR

Govorni prispevki – Oral

15:30	Aljaž Ivekovič ¹ , Katja König ¹ , Marko Jagodič ² , Saša Novak ¹ , Goran Dražič ¹ ¹ Department for Nanostructured Materials, Jožef Stefan Institute, SI-1000 Ljubljana, Slovenia ² Institute of Mathematics, Physics and Mechanics, Jadranska 19, SI-1000 Ljubljana, Slovenia INVESTIGATION OF THERMAL CONDUCTIVITY IN SiC _f /SiC COMPOSITES FOR FUSION APPLICATION	MF-MR
15:40	Hájková Pavlína Faculty of Mechanical Engineering, CTU in Prague, Karlovo náměstí 13, Praha 2, 121 35 Czech Republic THE INFLUENCE OF δ-FERRITE ON FATIGUE RESISTANCE OF VANE MATERIALS	KM-MR
15:50	Krum Stanislav, Sobotová Jana, Jurči Petr Faculty of Mechanical Engineering, CTU in Prague, Karlovo náměstí 13, Praha 2, 121 35 Czech Republic EFFECT OF VARIOUS HEAT TREATMENT REGIMES ON STRUCTURE AND PROPERTIES OF Cr-V LEDEBURITIC STEEL	KM-MR
16:00	Sebastjan Perko, Aleš Dakskobler, Tomaž Kosmač Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia PREPARATION AND MECHANICAL PROPERTIES OF POROUS Y-TZP CERAMICS FOR DENTAL APPLICATIONS	AM-MR
16:10	Gregor Trefalt, Marija Kosec, Barbara Malič, Danjela Kuščer Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia MODELING OF DISTRIBUTION OF COLLOIDAL PARTICLES IN SUSPENSIONS	AM-MR
16:20	ODMOR – BREAK	
	Predsedujoči – Chair: Stane Pejovnik, Manfred Leisch, Spomenka Kobe, Majda Žigon	
16:40	Hana Uršič ¹ , Marko Hrovat ¹ , Janez Holc ¹ , Marina Santo Zarnik ^{1,2} , Marija Kosec ¹ ¹ Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia ² HIPOT-R&D, d. o. o., Trubarjeva 7, SI-8310 Šentjernej, Slovenia 0.65Pb(Mg _{1/3} Nb _{2/3})O ₃ -0.35PbTiO ₃ THICK FILM ACTUATORS ON THIN Pt SUPPORTS	AM-MR
16:50	Blaž Brulc*, Ema Žagar, Majda Žigon National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia HOMO- AND BLOCK COPOLYMERIZATION OF BENZYLIC PROTECTED ASPARTIC ACID AND GLUTAMIC ACID N-CARBOXYANHYDRIDES AND THEIR COPOLYMERIZATION WITH L,L-LACTIDE	P-MR
17:00	Marko Bitenc ¹ , Zorica Crnjak Orel ¹ , Peter Podbršček ¹ , Pavo Dubček ² , Sigrid Bernstorff ³ , Goran Dražič ⁴ , Marjan Marinšek ⁵ ¹ National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia ² Ruđer Bošković Institute, P.O. Box 180, 10002 Zagreb, Croatia ³ Sincrotrone Trieste S.C.p.A., I-34012 Basovizza TS, Italy ⁴ Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia ⁵ Faculty of Chemistry and Chemical Technology, Aškerčeva 5, SI-1000 Ljubljana, Slovenia ZINC OXIDE: MORPHOLOGY AND GROWTH	AM-MR
17:10	Aljoša Maglica, Kristoffer Krnel, Tomaž Kosmač Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia PREPARATION OF ELECTROCONDUCTIVE Si ₃ N ₄ /ZrN CERAMIC COMPOSITES	AM-MR
17:20	Nataša Čuk ¹ , Sergej Medved ² , Matjaž Kunaver ¹ ¹ National Institute of Chemistry, Hajdrihova 19, SI-Ljubljana, Slovenia ² University of Ljubljana, Biotechnical Faculty, Rožna dolina C VIII/34, 1000 Ljubljana, Slovenia LIQUEFIED WOOD AS AN ADHESIVE FOR PARTICLEBOARD PRODUCTION PRIPRAVA RAZLIČNIH MORFOLOGIJ POLIANILINA V VODNIH RAZTOPINAH IONSKIH TEKOČIN	P-MR

Govorni prispevki – Oral

17:30	D. Pahovnik ^a , E. Žagar ^a , J. Vohlidal ^b , M. Žigon ^{a*} ^a Laboratory for Polymer Chemistry and Technology, National Institute of Chemistry, Hajdrihova 19, 1000 Ljubljana, Slovenia ^b Department of Physical and Macromolecular Chemistry, Faculty of Science, Charles University, Hlavova 8/2030, CZ-128 40 Prague 2 – Albertov, Czech Republic PREPARATION OF POLYANILINE OF DIFFERENT MORPHOLOGIES FROM AQUEOUS IONIC LIQUID SOLUTIONS PRIPRAVA RAZLIČNIH MORFOLOGIJ POLIANILINA V VODNIH RAZTOPINAH IONSKIH TEKOČIN	P-MR
17:40	Arsim Bytyqi, Monika Jenko Institut of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia CHARACTERIZATION OF INCLUSIONS IN SPRING STEELS USING LIGHT AND SCANNING ELECTRON MICROSCOPY	KM-MR
17:50	Irena Paulin ^{1,2} , Črtomir Donik ² , Monika Jenko ² , Varužan Kevorkijan ² ¹ TALUM d.d. Kidričevo, Tovarniška cesta 10, SI-2325 Kidričevo, Slovenia ² Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia CHARACTERIZATION OF ALUMINIUM FOAM MADE OF AISi7 ALLOY KARAKTERIZACIJA ALUMINIJEVE PENE NA OSNOVI ZLITINE AISi7	KM-MR
18:00	ODMOR – BREAK	
	Predsedujoči – Chair: Stane Pejovnik, Manfred Leisch, Spomenka Kobe, Majda Žigon	
18:20	Fevzi Kafexhiu, Jelena V. Tuma Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia CORRELATION BETWEEN CREEP RESISTANCE AND HARDNESS OF STEEL PARTS IN THERMAL POWER PLANTS KORELACIJA MED ODPORNOST PROTI LEZENJU IN TRDOTE JEKLENIH DELOV V TERMOELEKTRARNAH	KM-MR
18:30	Besnik Poniku, Monika Jenko Institute of metals and technology, Lepi pot 11, Ljubljana, Slovenia USING CHARGE COMPENSATION TO ANALYSE METAL OXIDES	KM-MR
18:40	Milan Malešević, J. V. Tuma, F. Tehovnik Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia INFLUENCE OF AGING ON DELTA FERRITE CONTENT IN Cr-Ni-BASED STEELS	KM-MR
18:50	Makfir Sefa ¹ , Janez Šetina ² ¹ Lotrič d.o.o., Selca 163, 4227 SELCA, Slovenia ² Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia UNCERTAINTY CALCULATION OF GAS FLOW MEASUREMENT	VT-MR
19:00	Sefer Avdiaj ¹ , Janez Šetina ² , Barabara Šetina Batič ² ¹ Lotrič, d. o. o., Selca 163, 4227 SELCA, Slovenia ² Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia INVESTIGATION OF OXYGEN DIFFUSION IN ST 707 NON-EVAPOABLE GETTER MATERIAL	VT-MR
19:10	Ažbe Križaj ¹ , Peter Fajfar ² , Jelena Vojvodič Tuma ¹ ¹ Institute of Metals and Technology, 1000 Ljubljana, Slovenia ² University of Ljubljana, Faculty of Natural Sciences and Engineering, Aškerceva 12, 1000 Ljubljana, Slovenia INFLUENCE OF HOT ROLLING ON ELECTROMAGNETIC PROPERTIS OF ELECTRICAL STEELS	KM-MR
19:20	¹ Marko Soderžnik, ² Janvit Golob ¹ Jozef Stefan Institute, Ljubljana, Slovenia ² Faculty of Chemistry and Chemical Technology, University of Ljubljana, Slovenia THE TECHNOLOGY OF THE MICROENCAPSULATION OF INSECTICIDES	P-MR

Govorni prispevki – Oral

19:30	<p>Milaku A.¹, Lešer V², Drobne D.², Godec M.¹, Torkar M.¹, Jenko M.¹, Marziale Milani³, Francesco Tatti⁴ ¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, SI-1000 Ljubljana, Slovenija ²Biotehniška fakulteta, Oddelek za biologijo, Univerza v Ljubljani, Večna pot 111, Slovenija ³Materials Science Department and Laboratory FIB/SEM “Bombay”, University of Milano-Bicocca, Via Cozzi 53, I-20125 Milano, Italy ⁴FEI Italia, Viale Bianca Maria 21, I-20122 Milano, Italy</p> <p>SURFACE CHARACTERISTICS OF DIGESTIVE GLAND EPITHELIUM OF A TERRESTRIAL ISOPODA PORCELLIO SCABER STUDIED BY SEM ZNAČILNOSTI POVRŠINE EPITELIJA PREBAVNE ŽLEZE ORGANIZMA PORCELLIO SCABER PREISKOVANE S SEM</p>	NN-MR
19:40	<p>Jaka Kovač¹, Edvard Govekar², Andraž Legat¹ ¹Slovenian National Civil Building and Engineering Institute, Dimičeva 12, SI-1000 Ljubljana, Slovenia ²Faculty of Mechanical Engineering, University of Ljubljana, Aškerčeva 6, SI-1000 Ljubljana, Slovenia</p> <p>THE USE OF ELECTROCHEMICAL NOISE, ACOUSTIC EMISSION AND COMPLEMENTARY MEASURING TECHNIQUES FOR DETECTION AND CHARACTERIZATION OF INTERGRANULAR SCC UPORABA ELEKTROKEMIJSKEGA ŠUMA, AKUSTIČNE EMISIJE IN KOMPLEMENTARNIH METOD ZA ZAZNAVANJE IN KARAKTERIZACIJO INTERKRISTALNEGA NKP</p>	KM-MR
19:50	<p>Darja Pečko¹, Kristina Rožman Žužek¹, Boris Pihlar², Spomenka Kobe¹ ¹Jožef Stefan Institute, Ljubljana, Slovenia ²Faculty of Chemistry and Chemical Technology, University of Ljubljana, Slovenia</p> <p>ELECTRODEPOSITION AND CHARACTERIZATION OF Fe-Pd MAGNETIC THIN FILMS</p>	NN-MR
20:00	<p>Borut Žužek¹, Milan Terčelj², Ladislav Kosec², Peter Fajfar² ¹Institute of metals and technology, Ljubljana, Slovenia ²University of Ljubljana, Faculty of Natural Sciences and Engineering, Slovenia</p> <p>ROLL THERMAL FATIGUE TEMPERTURNO UTRUJANJE VALJEV</p>	KM-MR
20:10	<p>Barbara Horvat, Aleksander Rečnik, Goran Dražić Institut Jožef Stefan, Jamova cesta 39, SI-1000 Ljubljana, Slovenija</p> <p>HYDROTHERMAL SYNTHESIS OF DIFFERENT SHAPES OF NANOANATASE TiO₂ HIDROTHERMALNA SINTEZA NANOANATAZA TiO₂ RAZLIČNIH OBLIK</p>	NN-MR
20:20	<p>Martin Lamut Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia</p> <p>A MICRO-MACRO APPROACH TO MODELLING MULTI-PHASE MATERIALS</p>	KM-MR
21:00	<p>Podelitev nagrad MR – Young Scientists Awards Dobrodošlica – Welcome Party</p>	

TOREK – TUESDAY 17. 11. 2009		
Predsedujoči – Chair: Janez Šetina, Aleksandra Kocijan		
8:45	Miran Mozetič Odsek za tehnologijo površin in optoelektroniko, Institut "Jožef Stefan", Jamova cesta 39, 1000 Ljubljana, Slovenija SURFACE MODIFICATION OF MATERIALS BY EXTREMELY NON-EQUILIBRIUM OXYGEN PLASMA MODIFIKACIJA POVRŠINE MATERIALOV Z EKSTREMNO NERAVNOVESNO KISIKOVO PLAZMO	VT-VP
9:15	Kristina Žužek Rožman ¹ , Sašo Šturm ¹ , Paul J. McGuinness ¹ , Zoran Samardžija ¹ , Darja Pečko ¹ , Spomenka Kobe ¹ , Costas Cefalas ² ¹ Jožef Stefan Institute, Ljubljana, Slovenia ² National Hellenic Research Foundation, Athens, Greece FERROMAGENTIC (SHAPE-MEMORY) MATERIALS WITH REDUCED DIMENSIONALITY	KM-VP
9:45 ODMOR – BREAK		
Predsedujoči – Chair: Janez Šetina, Aleksandra Kocijan		
10:00	M. Pellizzari Department of Materials Engineering and Industrial Technologies, via Mesiano 77, 38050 Trento – ITALY THERMODYNAMIC MODELING FOR THE ALLOY DESIGN OF HIGH SPEED STEELS AND HIGH CHROMIUM CAST IRONS	KM-VP
10:30	S. T. Mandziej Advanced Materials Analysis, Enschede, NL PHYSICAL SIMULATION OF METALLURGICAL PROCESSES	KM-VP
11:00 ODMOR – BREAK		
Predsedujoči – Chair: Vojteh Leskovšek, Borivoj Šuštaršič		
11:15	Franjo Cajner ¹ , Darko Landek ¹ , Vojteh Leskovšek ² ¹ University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Ivana Lučića 1, Zagreb, Croatia ² Institute of Metals and Technology, Lepi pot 11, Ljubljana, Slovenia SURFACE MODIFICATIONS OF MARAGING STEELS USED IN MANUFACTURING OF MOULDS AND DIES	KM-VP
11:45	R. Schneider Upper Austria Univ. of Appl. Sciences – Camus Wels DETERMINATION OF THE HARDNESS – IMPACT TOUGHNESS RELATIONSHIP FOR SHORT-CYCLE HEAT TREATED STEELS	KM-VP
12:15	B. Smoljan, D. Iljkić, F. Traven University of Rijeka, Faculty of Engineering, Department of Materials Science and Engineering, Vukovarska 58, 51000 Rijeka, Croatia COMPUTER SIMULATION OF MECHANICAL PROPERTIES OF QUENCHED AND TEMPERED STEEL	KM-VP
13:00 – 15:00 ODMOR ZA KOSILO – LUNCH		
Predsedujoči – Chair: Matjaž Torkar, Jelena Vojvodič Tuma		
15:00	K. T. Raić ¹ , R. Rudolf ² , A. Todorović ³ , D. Stamenković ³ , I. Anžel ² ¹ Faculty of Technology and Metallurgy, Belgrade University, Karnegijeva 4, Belgrade, Serbia ² University of Maribor, Faculty of Mechanical Engineering, Maribor, Slovenia ³ University of Belgrade, School of Dentistry, Clinic for Prosthodontics, Belgrade, Serbia METAL-CERAMIC INTERFACES IN DENTAL PRACTICE AND JEWELLERY MANUFACTURING	KM-VP

Govorni prispevki – Oral

15:30	Pešlová, F. ² , Hajdúchová, L. ¹ Faculty of Mechanical Engineering, CTU in Prague, Karlovo náměstí 13, Praha 2, 121 35 Czech Republic STUDY OF MICROSTRUCTURE OF SELECTED AUSTENITIC STEELS FOR COLD ROLLING	MF-VP
16:00	Petr Jurčí ¹ , Borivoj Šuštaršič ² , Vojteh Leskovšek ² ¹ Czech Technical University in Prague, Faculty of Mechanical Engineering, Karlovo nám. 13, 121 35 Prague 2, Czech Republic ² Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia FRACTURE CHARACTERISTICS OF THE Cr-V LEDEBURITIC STEEL VANADIS 6 LOMNOMEHANSKE ZNAČILNOSTI Cr-V LEDEBURITNEGA JEKLA VANADIS 6	KM-GP
16:15	ODMOR – BREAK	
	Predsedujoči – Chair: Vojteh Leskovšek, Borivoj Šuštaršič	
16:30	Varužan Kevorkijan ¹ , Srečo Davor Škapin ² ¹ Independent Researching plc, Betnavska cesta 6, Maribor, Slovenia ² Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia FABRICATION AND CHARACTERIZATION OF Al-Fe, Ti-Al, Mg-Si AND Mg-Sn INTERMETALLIC MATRIX COMPOSITES REINFORCED WITH CERAMIC PARTICLES SINTEZA IN KARAKTERIZACIJA KOMPOZITOV NA OSNOVI INTERMETALNIH SPOJIN Fe-Al, Ti-Al, Mg-Si in Mg-Sn OJAČENIH S KERAMIČNIMI DELCI	KM-GP
16:45	Robert Cvelbar ¹ , Borut Bundara ¹ , Borut Prašnikar ² , Miha Nastran ² , Metod Bonča ¹ , Marjan Suban ¹ ¹ Inštitut za metalne konstrukcije, Mencingerjeva 7, 1000 Ljubljana ² ETRA 33, Šlandrova 10, 1000 Ljubljana DYNAMICAL CHARACTERIZATION OF THE TRANSFORMER'S CORE MODEL	VO-GP
17:00	D. Steiner Petrovič ¹ , Franc Tehovnik ¹ , A. Jaklič ² , J. Medved ³ ¹ Institute of Metals and Technology, 1000 Ljubljana, Slovenia ² ACRONI, d. o. o., 4270 Jesenice, Slovenia ³ University of Ljubljana, Faculty of Natural Sciences and Engineering, Aškerčeva 12, 1000 Ljubljana, Slovenia PRECIPITATION IN NON-ORIENTED ELECTRICAL STEEL CONTAINING IMPURITY ELEMENTS	KM-GP
17:15	Tehovnik Franc ¹ , Arzenšek Boris ¹ , Vode Franci ¹ , Žužek Borut ¹ , Pirnar Boštjan ² , Jaklič Anton ² , Jakelj Stane ² ¹ Institute of Metals and Technology, 1000 Ljubljana, Slovenia ² ACRONI, d. o. o., 4270 Jesenice, Slovenia FORMING FORCE DURING HOT ROLLING OF STAINLESS STEELS	KM-GP
20:00	POSTERSKA SEKCIJA – POSTER SESSION KM, AM, P, VT, NN, VO Cocktail Party	

SREDA – WEDNESDAY 18. 11. 2009		
	Predsedujoči – Chair: Matjaž Godec, Igor Belič	
9:00	Darko Drev, Goran Đorđić, Jože Panjan, Boris Kompare IzVRS, EKO GEA d.o.o., FGG Ljubljana NEW ENVIRONMENTALLY SUSTAINABLE TECHNOLOGICAL PROCESSES FOR PRODUCING BIOGAS FROM ORGANICALLY POLLUTED WASTEWATER AND WASTE	VO-GP
9:15	Igor Belič Institute of metals and technology, Lepi pot 11, 1000 Ljubljana THE IMPROVED PSEUDO GRADIENT ALGORITHM FOR THE RESIDUAL GAS ANALYSIS IZBOLJŠANA PSEVDOGRADIENTNA METODA ZA ANALIZO MASNIH SPEKTROV	VT-GP
9:30	B. Šuštaršič, J. V. Tuma, M. Godec, A. Kocijan, B. Marini, C. Toffolon Masclat, P. Forget Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia DMN/SRMA and DEN-DANS, CEA, Saclay, France THE INFLUENCE OF ISOTHERMAL ANNEALING ON THE MECHANICAL PROPERTIES OF DUPLEX STAINLESS STEEL 258 TYPE VPLIV IZOTERMNEGA ŽARJENJA NA MEHANSKE LASTNOSTI DUPLEKSNEGA NERJAVNEGA JEKLA VRSTE 258	KM-GP
9:45	Tadeja Kosec ¹ , Erika Švara ¹ , Helena Otmačič Čurkovič ² , Ema Stupnišek-Lisac ² , Andraž Legat ¹ ¹ Slovenian National Building and Civil Engineering Institute, Dimičeva 12, SI-1000 Ljubljana, Slovenia ² Faculty for Chemical Engineering and Technology, University of Zagreb, Savska 16, 10000 Zagreb, Croatia CORROSION STABILITY OF BRONZE PATINAS AND ITS VERSATILE PROTECTION KOROZIJSKA STABILNOST PATIN IN RAZLIČNIH ZAŠČIT NA BRONU	KM-GP
12:00	Slavnost ob 60-letnici IMT – 60-years IMT	

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

KM – KOVINSKI MATERIALI / METALLIC MATERIALS	
KM-1	Adolf, Z., Horáková, D. VŠB-Technical University of Ostrava, Czech Republic POSSIBILITIES OF CONTROL OF SULPHUR CONTENT IN STEEL IN A LADLE FURNACE
KM-2	Boris Arzenšek, Franc Tehovnik, Franci Vode, Jurij Gontarev, Iztok Naglič, Borut Žužek, Mitja Kmetič, Boštjan Pirnar, Anton Jaklič, Stane Jakelj, Gorazd Kosec, Jure Bernetič Institute of Metals and Technology Ljubljana ACRONI, d. o. o., Jesenice DEFORMATION ABILITIES OF LEAN DUPLEX STAINLESS STEEL UGOTAVLJANJE PREOBLIKOVALNIH SPOSOBNOSTI DUPLKSNEGA NERJAVNEGA JEKLA VRSTE LEAN
KM-3	Jiří Bažan ^a , Karel Stránský ^b , Dana Horáková ^a ^a VŠB-TU Ostrava, 17. listopadu 15,708 33 Ostrava, Czech Republic ^b Brno University of Technology, Technická 2, 616 69 Brno, Czech Republic THE CHANGES OF CHEMICAL COMPOSITION OF THE CAPILLARIES OF THE OXIDE CERAMIC FILTERS DURING STEEL FILTRATION
KM-4	¹ Roman Celin, ¹ Jelena Vojvodič Tuma, ² Jure Bernetič, ¹ Boris Arzenšek ¹ Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia ² Acroni, d. o. o., Cesta Borisa Kidriča 44, 4270 Jesenice, Slovenia DETERMINATION OF WELDING PARAMETERS FOR 890 MPa HIGH STRENGTH STEEL
KM-5	M. Godec ¹ , B. Šuštaršič ¹ , M. Jenko ¹ , B. Marini ² ¹ Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia ² Commissariat à l’Energie Atomique, DMN/SRMA, 91191 Gif-sur-Yvette, Sacleay, France ORIENTATION RELATIONSHIP OF δ -FERRITE AND AUSTENITE PHASE IN Cr-Ni-Mo BASED STAINLESS-STEEL ANALYZED BY EBSD TECHNIQUE ORIENTACIJSKA ODVISNOST FAZE δ -FERITA IN AVSTENITA V Cr-Ni-Mo NERJAVNIH JEKLIH DOLOČENA Z ANALITSKO METODO EBSD
KM-6	Matjaž Godec ¹ , Aleksandra Kocijan ¹ , Drago Dolinar ² , Djordje Mandrino ¹ , Monika Jenko ¹ , Vane Antolič ² ¹ Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana ² Orthopaedic Clinic Ljubljana, Zaloška 9, 1000 Ljubljana INVESTIGATION OF THE ASEPTIC LOOSENING OF AISI 316L HIP PROSTHESIS RAZISKAVA VZROKA ASEPTIČNEGA OMAJANJA KOLČNE PROTEZE IZ JEKLA KVALITETE AISI 316L
KM-7	Varužan Kevorkijan ¹ , Srečo Davor Škapin ² ¹ Independent Researching plc, Betnavska cesta 6, Maribor, Slovenia ² Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia FOAMING Al _p -BASED PRECURSORS WITH A CaCO ₃ FOAMING AGENT IZDELAVA PEN IZ Al _p PREDOBLIK Z DODATKOM CaCO ₃ KOT SREDSTVA ZA PENJENJE
KM-8	Aleksandra Kocijan, Matjaž Godec, Monika Jenko Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia ELECTROCHEMICAL AND SURFACE CHARACTERISATION OF NiTi SHAPE MEMORY ALLOY IN ARTIFICIAL SALIVA AND FLUORIDE SOLUTION
KM-9	Vojteh Leskovšek*, Monika Jenko*, Jelena Tuma*, David Nolan** *Institute of Metals and Technology, Ljubljana, Slovenia **Faculty of Engineering, University of Wollongong, NSW Australia 2522 FRACTURE TOUGHNESS OF NITRIDED LAYERS

Posterska sekcija – Poster Session

KM-10	N. Lipovšek, M. Godec, M. Jenko Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia QUANTITATIVE METALLOGRAPHIC ANALYSIS OF FERRITE-PERLITE MICROSTRUCTURE
KM-11	Milan Malešević ¹ , J. V. Tuma ¹ , B. Šuštaršič ¹ , B. Marini ² ¹ Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia ² French Atomic Energy Commission, 91191 Gif-sur-Yvette, France DETERMINATION OF DELTA FERRITE CONTENT IN STAINLESS STEELS
KM-12	Dj. Mandrino, I. Paulin, Č. Donik, M. Jenko Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia AES AND XPS CHARACTERIZATION OF TITANIUM HYDRIDE POWDER
KM-13	Sulejman Muhamedagić, Mirsada Oruč Univerzitet u Zenici, Fakultet za metalurgiju i materijale, Travnička cesta 1, Zenica, BiH Univerzitet u Zenici, Metalurški institut "Kemal Kapetanović" Travnička cesta 7, Zenica, BiH ANALYSING OF MACRO-INCLUSIONS ON FORGING SURFACES MADE OF 42 CrMo4 GRADE STEEL
KM-14	Iztok Naglič Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija FADING OF AlTi5B1 GRIN REFINER IN Al-Fe ALLOY DURING HOLDING ZMANJŠEVANJE UČINKA SREDSTVA ZA ZMANJŠEVANJE ZRN AlTi5B1 V ZLITINI Al-Fe S KONTAKTNIM ČASOM
KM-15	Pavel Podaný ¹⁾ , Michal Zemko ¹⁾ , Jaroslav Tuček ²⁾ ¹⁾ COMTES FHT a. s., Průmyslová 995, 334 41 Dobřany, Czech Republic ²⁾ Kovohutě Rokycany, a. s., Zeyerova 285, 337 01 Rokycany, Czech Republic PRODUCTION OF FENI HOT/COLD ROLLED SHEETS
KM-16	Andrej Pregelj, Leopold Južina, Robert Rozman, France Brecelj, Aleš Štagoj Iskra Zaščite doo, Stegne 35, Ljubljana INFLUENCES ON ARC EXTINGUISHING IN GAS ARRESTERS
KM-17	Danijela Anica Skobir ¹ , Matjaž Godec ¹ , Jure Bernetič ² , Monika Jenko ¹ ¹ Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia ² ACRONI, d. o. o., c. Borisa Kidriča 44, 4270 Jesenice, Slovenia EFFECT OF TEMPERING TEMPERATURES ON THE MECHANICAL PROPERTIES AND MICROSTRUCTURES OF STRUCTURAL STEEL MICRAL 690 VPLIV TEMPERATURE POPUŠČANJA NA MEHANSKE LASTNOSTI IN MIKROSTRUKTURU KONSTRUKCIJSKEGA JEKLA MICRAL 690
KM-18	Marjan Suban, Robert Cvelbar, Borut Bundara Institute of metal constructions, Mencingerjeva 7, 1001 Ljubljana, Slovenia THE IMPACT OF STAGNANT WATER ON THE CORROSION PROCESSES IN PIPELINE VPLIV ZASTAJAJOČIH VODA V CEVOVODIH NA KOROZIJSKE PROCESSE
KM-19	B. Šuštaršič, F. Tehovnik, J. Gontarev, M. Malešević, B. Marini, C. Toffolon Masclet Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia DMN/SRMA and DEN-DANS, CEA, Saclay, France THESIS OF CAST STAINLESS STEELS WITH DIFFERENT CONTENT OF δ -FERRITE SINTEZA LITIH NERJAVNIH JEKEL Z RAZLIČNO VSEBNOSTJO δ -FERITA
KM-20	Borivoj Šuštaršič ¹ , Bojan Senčič ² , Robert Kunc ³ ¹ Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia ² Štore Steel, Železarska cesta 3, 3220 Štore, Slovenia ³ Faculty of Mechanical Engineering, University of Ljubljana FEM BASED LIFE-TIME PREDICTION OF LEAF SPRINGS NAPOVEDOVANJE DOBE TRAJANJA LISTNATIH VZMETI NA OSNOVI MKE METODE
KM-21	Franc Tehovnik ¹ , Boris Arzenšek ¹ , Darja Steiner Petrovič ¹ , Boštjan Pirnar ² ¹ IMT Ljubljana ² Acroni Jesenice PRECIPITATION OF PHASE σ IN SUPERAUSTENITIC STAINLESS STEEL UHB 904L

Posterska sekcija – Poster Session

KM-22	M. Torkar, M. Godec, M. Lamut Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana SYNTHESIS OF ALUMINIDES ON METALLIC SUBSTRATE SINTEZA ALUMINIDA NA KOVINSKI PODLAGI
KM-23	M. Torkar ¹ , V. Uršič ² , T. Marolt ³ ¹ Inštitut za kovinske materiale in tehnologije, Ljubljana, ² TERMIT d. d., Drtija pri Moravčah, ³ Štore Steel d. o. o., Štore INDUSTRIAL TEST OF PROTECTIVE COATING INDUSTRIJSKI PRESKUS VAROVALNEGA PREMAZA
KM-24	Franci Vode ¹ , Franc Tehovnik ¹ , Anton Jaklič ² , Franci Perko ² ¹ Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia ² ACRONI, d. o. o., c. Borisa Kidriča 44, 4270 Jesenice, Slovenija SHORTENING REHEATING AFTER STOPPAGES IN PUSHER-TYPE FURNACE
KM-25	F. Vodopivec, J. Vojvodič Tuma, M. Jenko IMT Ljubljana YIELD STRESS OF STEELS WITH THE MICROSTRUCTURE OF TEMPERED MARTENSITE AND ACCELERATED CREEP RATE MEJA PLASTIČNOSTI JEKEL Z MIKROSTRUKTURO IZ POPUŠČENEGA MARTENZITA IN HITROST POSPEŠENEGA LEZENJA
KM-26	Jelena Vojvodič Tuma ¹ , Štefan Hozjan ² ¹ Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia ² Nafta Strojna d.o.o., Mlinska 5, 9220 Lendava, Slovenia THE CONSTRUCTION OF TERMINAL FOR ALCOHOL IN PORTO OF KOPER IZGRADNJA TERMINALA ZA ALKOHOL V LUKI KOPER
KM-27	Jelena Vojvodič Tuma Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia CORROSION LEAKINGS OF BOTTON OF VESSELS FOR HYDROCARBONS KOROZIJSKI PRODORI DNA JEKLENIH REZERVOARJEV ZA OGLJIKOVODIKE
KM-28	Jelena Vojvodič Tuma ¹ , M. Jenko ¹ , Fevzi Kafexhiu ¹ , S. Ažman ¹ Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana ² Rikljevca c. 11, Bled, Slovenija ENERGIJA VETRNIH TURBIN
KM-29	Borut Žužek ¹ , Peter Fajfar ² , Franc Tehovnik ¹ , Boris Arzenšek ¹ , Matevž Mužan ² ¹ Inštitut za kovinske materiale in tehnologije, Ljubljana, Slovenija ² Univerza v Ljubljani, Naravoslovnotehniška fakulteta, Slovenija WEDGE TEST KLINASTI PREIZKUS
KM-30	J. Gontarev ¹ , M. Doberšek ² , I. Naglič ² ¹ Valji d.o.o. Štore ² Institute of metals and technology CARBIDE IDENTIFICATION IN SEMI-HSS WITH EDS AND EBSD TECHNIQUES EBSD IN EDS KARAKTERIZACIJA KARBIDOV V NADEVTEKTOIDNI NIZKO LEGIRANI JEKLO LITINI

AM – ANORGANSKI MATERIALI / INORGANIC MATERIALS

AM-1	Kristoffer Krnel ¹ , Franc Švegl ² , Krunoslav Vidovič ^{1,3} , Tomaž Kosmač ¹ ¹ Jožef Stefan Institute, Jamova 39, Ljubljana, SI-1000 ² Zavod za gradbeništvo Slovenije, Dimičeva 1, SI-1000 Ljubljana ³ ESAL d.o.o., Anhovo 9, SI-5210 Deskle INFLUENCE OF VARIOUS FILLERS ON THE PROPERTIES OF FIBRE-CEMENT COMPOSITES
------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

AM-2	Matej Hočevar ^{1,2} , Peter Trontelj ¹ , Maja Zagmajster ¹ ¹ Oddelek za biologijo, Biotehniška fakulteta, Univerza v Ljubljani, Slovenija ² Inštitut za kovinske materiale in tehnologije, Ljubljana, Slovenija HABITATE USE AND ROOST SELECTION OF THE NOCTULE BAT (<i>NYCTALUS NOCTULA</i>) IN URBAN ENVIRONMENT
AM-3	Natalija Orešek ¹ , Franc Berk [†] , Niko Samec ¹ , Franc Zupanič ¹ ¹ Univerza v Mariboru, Fakulteta za strojništvo, Smetanova 17, 2000 Maribor, Slovenia [†] Javno podjetje za komunalne storitve Rogaška Slatina, d. o. o., Rogaška Slatina THERMAL TREATMENT AND VITRIFICATION OF MUNICIPAL SOLID WASTE INCINERATOR FLY ASH TERMIČNA PREDELAVA IN ZASTEKLITEV LETEČEGA PEPELA IZ SEŽIGA KOMUNALNIH ODPADKOV

P – POLIMERI / POLYMERS

P-1	¹ B. Klofutar, ² J. Golob, ² B. Likozar, ³ C. Klofutar, ⁴ E. Žagar, ⁴ I. Poljanšek ¹ ZORD Slovenija, 1000 Ljubljana, Slovenia ² University of Ljubljana, Faculty of Chemistry and Chemical Technology, 1000 Ljubljana, Slovenia ³ University of Ljubljana, Biotechnical Faculty, Department of Food Technology, 1000 Ljubljana, Slovenia ⁴ National Institute of Chemistry Slovenia, 1001 Ljubljana, Slovenia KINETICS AND MASS TRANSFER OF TRANSESTERIFICATION OF RAPESEED AND WASTE SUNFLOWER OILS
-----	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

VT – VAKUUMSKA TEHNIKA / VACUUM TECHNIQUE

VT-1	Bojan Erjavec, Janez Šetina Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana IMPROVED STATIC GAS-SORPTION METHOD FOR CHARACTERIZING NON-EVAPORABLE GETTERS IZBOLJŠANA STATIČNA SORPCIJSKA METODA ZA KARAKTERIZACIJO NENAPARLJIVIH GETROV
VT-2	Sefer Avdiaj ¹ , Janez Šetina ² , Albert Januzaj ³ ¹ Lotrič, d. o. o., Selca 163, 4227 SELCA, Slovenia ² Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia ³ University of Prishtina, Mother Teresa av, 10000 Prishtina, Kosovo NUMERICAL SOLVING OF POISSON EQUATION IN 3D BY FINITE DIFFERENCE METHOD (FDM)
VT-3	A. Vesel ¹ , K. Eleršič ¹ , M. Mozetič ¹ , Janez Pavlič ² , Aleš Iglič ² ¹ Institut "Jožef Stefan", Jamova 39, 1000 Ljubljana, Slovenija ² Fakulteta za elektrotehniko, Tržaška 25, 1000 Ljubljana, Slovenija SITHESYS OF MAGNETIC LIPOSOMES SINTEZA MAGNETNIH LIPOSOMOV
VT-4	R. Zaplotnik ^{1,2} , A. Vesel ¹ , M. Mozetič ¹ ¹ Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia ² Induktio, d. o. o., Litostrojska 44 d, 1000 Ljubljana, Slovenia IMPEDANCE MATCHING NETWORK FOR INDUCTIVELY COUPLED PLASMA SYSTEMS

NN – NANOMATERIALI IN NANOTEHNOLOGIJE – NANOMATERIALS AND NANOTECHNOLOGY

NN-1	<p>M. Conradi^a, M. Remškar^b, A. Mrzel^b, M. Chambers^{a,c}, V. Domenici^d, B. Zalar^b ^aInstitute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana ^bJ. Stefan Institute, Jamova 39, SI-1000 Ljubljana ^cKrško Nuclear Power Plant, Vrbina 12, SI-8270 Krško, Slovenia ^dDipartimento di Chimica e Chimica Industriale, Università degli studi di Pisa, via Risorgimento 35, 56126 Pisa, Italy</p> <p>POLYMER-FIBER COMPOSITES BUILT FROM NEW MoO_{3-x} NANOWIRE MATERIALS</p>
NN-2	<p>Darja Jenko, Črtomir Donik, Borivoj Šuštaršič, Monika Jenko Institute of metals and technology, Lepi pot 11, p.p. 431, SI-1000 Ljubljana, Slovenia</p> <p>PREPARATION OF THIN SECTION SAMPLES FOR TEM USING Ar ION SLICING</p>
NN-3	<p>Darja Jenko, Monika Jenko Institute of metals and technology, Lepi pot 11, p.p. 431, SI-1000 Ljubljana, Slovenia</p> <p>TEM CHARACTERIZATION OF Si THIN SECTION SAMPLE PREPARED USING Ar ION SLICING</p>
NN-4	<p>Vladimira Petrovič¹, Vilma Ducman¹, Srečo D. Škapin² ¹Zavod za gradbeništvo Slovenije, Dimičeva 12, 1000 Ljubljana ²Institut Jožef Stefan, Jamova 39, 1000 Ljubljana</p> <p>DEGRADATION OF ORGANIC DYES – A METHOD FOR THE EVALUATION OF PHOTO-CATALYTIC ACTIVITY RAZPAD ORGANSKIH BARVIL – METODA ZA DOLOČITEV UČINKOVITOSTI FOTOKATALITSKEGA EFEKTA</p>
NN-5	<p>Erika Švara¹, Luka Škrlep¹, Janez Bernard¹, Petra Živec², Andrijana Sever Škapin¹ ¹Slovenian National Building and Civil Engineering Institute, Dimičeva 12, 1000 Ljubljana, Slovenia ²TRC JUB, d.o.o., Dol pri Ljubljani 28, 1262 Dol pri Ljubljani, Slovenia</p> <p>DETERMINATION OF PHOTOCATALYTIC ACTIVITY OF NANOTITANIA- CONTAINING SAMPLES DOLOČEVANJE FOTOKATALITSKE AKTIVNOSTI NANO-TiO₂ VZORCEV</p>

VO – VARSTVO OKOLJA – ENVIRONMENTAL PROTECTION

VO-1	<p>Lazarević, M.P.¹, Vasić, V.¹, Cvelbar, R.², Suban, M.² ¹Katedra za primenjenu mehaniku, Mašinski fakultet Univerziteta u Beogradu, Kraljice Marije 36, 11020 Beograd 35, Srbija ²IMK - Inštitut za metalne konstrukcije, Mencingerjeva 7, SI-1000 Ljubljana</p> <p>SOME ASPECTS OF ADVANCED APPLICATION FOR FRACTIONAL WAVELET TRANSFORM IN THE REAL LIFE APPLICATIONS</p>
------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

17. KONFERENCA O MATERIALIH IN TEHNOLOGIJAH

16.–18. november 2009, Kongresni center GH Bernardin, Portorož, Slovenija

17th CONFERENCE ON MATERIALS AND TECHNOLOGY

16–18 November 2009, Congress Centre GH Bernardin, Portorož, Slovenia

KNJIGA POVZETKOV

BOOK OF ABSTRACTS

VT-VP

SURFACE CHARACTERIZATION OF VACUUM FIRED STAINLESS STEELS BY
AFM, STM AND ATOM PROBE

M. Leisch¹, P. Frank¹, L. Westerberg²

¹Institute of Solid State Physics, Graz University of Technology, A 8010 Graz, Austria

²Department of Physics, Uppsala University, SE 75121 Uppsala, Sweden

Stainless steel is one of the most used construction materials in vacuum technology. In order to reduce the outgassing of hydrogen a high temperature treatment (vacuum firing) is a common used method especially in XHV applications. Since the outgassing process is strongly related to surface morphology the surface of AISI grade 304L and 316LN stainless steels, after low temperature bake-out processes and vacuum annealing, have been studied by atomic force microscopy (AFM) and scanning tunnelling microscopy (STM). The local elemental composition on the surface before and after thermal treatment has been investigated by atom probe (AP) depth profiling measurements. After vacuum annealing AFM and STM show distinct changes in the surface structure and topology. Compared to the studies on grade 304L stainless steel recrystallisation and surface reconstruction is less pronounced on the 316LN material. AP depth profiling analyses on 304L samples result in significant nickel enrichment on the surface, on 316LN this Ni enrichment is less pronounced. Since the recombinative desorption of hydrogen is almost controlled by surface structure and composition the experimental results give additional insight in the complex process of outgassing on a technical material produced in large scale.

Work supported by "Zukunftsfonds des Landes Steiermark" project P).

KM-VP

NEW ANODE MATERIAL FOR PEM FUEL CELLS: Pt-CERIUM OXIDE THIN FILMS
DEPOSITED ON CNTs

V. Matolín

Charles University, V Holešovičkách 2, 18000 Prague 8, Czech Republic

Proton exchange membrane fuel cells (PEMFC) are being developed as an efficient power source for portable and mobile system applications. We are investigating Pt-(Sn)CeO₂ mixed oxide systems for development of new anode materials for methanol and hydrogen fed PEMFC.

30 nm thick Pt(Sn) doped CeO₂ layers were deposited by rf-magnetron sputtering on carbon nanotubes (CNTs) diffusion layers of a miniaturized polymer membrane fuel cell. Hydrogen/air fuel cell activity measurements normalized to the amount of used Pt revealed specific power of 50 W/mg relative to 0.2 W/mg obtained for a standard PtRu anode. The layer composition was investigated by the laboratory XPS, synchrotron radiation soft X-ray (SX PES at synchrotron Elettra in Italy), hard X-ray photoemission spectra (HX PES at SPring8 in Japan), SEM and HRTEM.

Hard X ray photoemission spectroscopy (6 keV) had a high observation depth about 7 nm. Depth resolved measurements, by varying the emission angle or photon energy (SX PES and HX PES), gave information about depth resolved concentration of Pt⁰, Pt²⁺ and Pt⁴⁺ species, respectively. We showed a formation of cerium oxide with completely ionized species Pt^{2+,4+} embedded in the film and small amount of Pt⁰ on the film surface.

Activity of this new cerium oxide based materials is explained by eminent activity of Pt^{2+,4+} cations to formation of protonic hydrogen H⁺. High activity and low cost together with planar deposition techniques make this material particularly promising for fabrication of miniaturized fuel cells to power portable systems.

KM-VP

CORRELATION BETWEEN THE α - α' DECOMPOSITION OF THE FERRITE AND THE MECHANICAL PROPERTIES OF CAST DUPLEX STAINLESS

B. Marini, C. Toffolon, P. Forget
CEA/DEN/DANS/DMN, 91191 Gif-sur-Yvette, France

Cast duplex stainless are used in the primary circuit of nuclear power plant thanks to their good mechanical properties and corrosion resistance. Their microstructure contains both an austenitic and a ferritic phase. In service conditions, no microstructural evolutions can be found in the austenitic phase. On the contrary, the ferritic phase, rich in Chromium, can potentially undergo into a α - α' decomposition. This transformation strongly hardens the ferrite phase and consequently embrittles the material. For products containing large amounts of ferrite, this embrittlement could be sufficient to impose the replacement of a part of the piping circuit which is very costly. So the understanding of the correlation between the α - α' decomposition and the associated evolution of the mechanical properties, with respect to the ferrite content of the steel, is of great industrial interest.

Four heat of cast duplex with different ferrite contents have been prepared and blocks machined in the plate have been aged at (300, 325, 350 and 400) °C up to a maximum of 30 000 h. Charpy type and tensile specimens have been prepared and tested for the different ageing conditions. The results show a strong effect of the ageing temperature and of the ferrite on both hardening and embrittlement. Micro-hardness measurements confirmed the transformation of the ferrite and the stability of the austenite. The α - α' decomposition has a very small characteristic length of the order of the nanometre and is very difficult to observe directly by TEM. Thus, SANS measurements have been performed in order to study this microstructural evolution. The results confirm the existence of very small particles in large amount.

In this paper, it has been chosen to rely on thermodynamic computations to evaluate the microstructural evolution of the ferrite. The Thermocalc software, coupled with TCFE5 thermodynamic database for Fe base alloys, is used to define the ferrite composition of the different steels. The results are in good agreement with chemical analyses performed by... in a TEM. From this composition, the evolution of microstructure is predicted using the Dictra software. Correlations between α' content and mechanical properties are established and discussed.

RP-VP

EU FUNDING OF RESEARCH – FP7

Bojan Jenko

Ministry of Higher Education, Science and Technology, Slovenia

EU has numerous programmes, initiatives and support measures at EU level in support of knowledge; from 7th Framework Programme of the EU research activities – FP7, Competitiveness and Innovation Programme – CIP (http://ec.europa.eu/cip/index_en.htm), Structural Funds and Cohesion Funds to Research Fund for Coal and Steel – RFCS (http://cordis.europa.eu/coal-steel-rtd/home_en.html) as key pillars for the European Research Area – ERA (<http://cordis.europa.eu/era/>). European Commission last autumn published "Practical Guide to EU funding opportunities for Research and Innovation" on Cordis web page (http://cordis.europa.eu/eu-funding-guide/home_en.html).

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). Work programmes are defining detailed work plan and details for each call regarding the thematic priority.

Slovenia has been successful in FP7; 274 Slovenian participants in 227 projects were eligible in contracts for more than 40 million € in the first two FP7 years placing Slovenia (per capita) above the EU average.

EC published 51 calls on July 30 this year (including 10 NMP thematic priority calls) for 4.1 billion € EU contribution (which include Recovery Plan Public-Private-Partnership – PPP Calls) <http://cordis.europa.eu/fp7/dc/index.cfm?fuseaction=UserSite.FP7CallsPage>; first calls will be closed before the end of this year; opened calls' thematics regarding conference (Nano-Materials) will be presented.

EU-FINANCIRANJE RAZISKAV – 7. OP

Bojan Jenko

Ministrstvo za visoko šolstvo, znanost in tehnologijo, Slovenija

EU ima številne programe, pobude in ukrepe za podporo znanju: od 7. okvirnega programa raziskovalnih dejavnosti EU – 7.OP, Programa za konkurenčnost in inovativnost – KIP (CIP: http://ec.europa.eu/cip/index_en.htm), strukturnih in kohezijskih skladov do Evropskega sklada za premog in jeklo – ESPJ (http://cordis.europa.eu/coal-steel-rtd/home_en.html), ki so ključni stebri Evropskega raziskovalnega prostora – ERA (<http://cordis.europa.eu/era/>). Evropska komisija je lani jeseni izdala "Praktični vodič o možnostih EU financiranja raziskav", ki je objavljen na spletni strani Cordisa (http://cordis.europa.eu/eu-funding-guide/home_en.html).

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 možnosti 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 s področjem "Nanoznanosti, nanotehnologije, materiali in nove proizvodne tehnologije" (NMP). Delovni programi (WP) določajo podrobnosti vsake tematske prioritete in razpisov.

Slovenija je tudi v 7. OP uspešna, saj je 274 slovenskih udeležencev pri 227 projektih že v prvih dveh letih 7. OP upravičenih v pogodbah do več kot 40 milijonov € sredstev Evropske komisije (EK) in je v EU nadpovprečno uspešna glede na število prebivalstva.

Za leto 2010 je EK 30. julija letos objavila 51 razpisov (vključno 10 za področje NMP) v vrednosti 4,1 mrd. € sredstev EK, vključno razpise v okviru Načrta za gospodarsko okrevanje (PPP calls) <http://cordis.europa.eu/fp7/dc/index.cfm?fuseaction=UserSite.FP7CallsPage>. Prvi razpisi se bodo končali že letos. Razpisane tematike s področja konference bodo pregledno predstavljene.

AM-MR

THE DESIGN OF FINE PARTICLES WITH CONTROL AT THE NANO SCALE

Dragan Uskoković

Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Belgrade, Serbia

Many advanced applications, either already existing or currently only conceived, require fine particles with precisely set structural properties and functional response. Methods for producing such particles, whereby controlling their structure at the finest, atomic and molecular scales, can be therefore seen as residing at the bases of the practical aspects of materials science and engineering. In our group, we are focused on multiple bottom-up and top-down methods for preparation of such powders and compact materials with highly controlled properties. The examples of spherical particles with narrow size distributions obtained using some of these synthesis procedures in our laboratory include various compositions: oxide, non-oxide, metallic, polymeric, free and drug-containing nanocomposite core-shell particles, etc. Materials that are subjects of our investigations have a high potential to be applicable in numerous engineering fields, and that as electronic, energy-related, sensory, optical, catalytic and biomedical functional materials. Ideally, the research activities such as those deployed in our lab may prove to be relevant for ensuring the sustained development of humanity in energy, health, environmental, water and other global sectors.

KM-VP

ENHANCED FATIGUE ANALYSIS – INCORPORATING DOWNSTREAM
MANUFACTURING PROCESSES

Wilfried Eichlseder
University of Leoben/Austria

The calculation of the fatigue life of geometrically complex structures requires the knowledge of the local fatigue behaviour of the material. Generally the investigation of the local fatigue behaviour by component test is not possible, as the study of parameters influencing the components fatigue behaviour takes too much time. Therefore a method is required to compute the fatigue life under local influences.

The local fatigue strength is influenced by notches, type of loading, temperature, load level and sequence etc. The manufacturing process has a considerable influence. This paper is concerned with the manufacturing processes and their influences on the microstructure and fatigue strength. Especially the effects of casting-, forming-, welding- and surface treatment-processes are investigated. The different processes were simulated to get local effects such as solidification time, strain rates or residual stresses. Specimens with defined process parameters were produced and their fatigue life determined by tests. These test results are the base for the models created to compute local S/N-curves by simulation. The models allow the fatigue life prediction of geometrically complex components based on finite element results, taking into account local stresses, stress gradients and the manufacturing process. The simulation of the manufacturing process and the understanding of the influence of the local condition on the fatigue life enable to close the simulation chain from manufacturing process to fatigue life prediction.

AM-VP

HYDROGEN ABSORPTION IN Ti-Zr-Ni ALLOYS

¹A. Kocjan, ¹P. J. McGuinness, ¹S. Kobe

¹Department for nanostructured materials, Jožef Stefan Institute, Jamova cesta 39,
1000 Ljubljana, Slovenia, EU

Our research was focused on the preparation, hydrogenation and dehydrogenation of $\text{Ti}_{40}\text{Zr}_{40-x}\text{Ni}_{20}\text{Cu}_x$ ($x = 3, 5$), $\text{Ti}_{45}\text{Zr}_{38-x}\text{Ni}_{17}\text{Cu}_x$ ($x = 3, 5$), $\text{Ti}_{53}\text{Zr}_{27-x}\text{Ni}_{20}\text{Cu}_x$ ($x = 3, 5$) and $\text{Ti}_{58}\text{Zr}_{24-x}\text{Ni}_{18}\text{Cu}_x$ ($x = 3, 5$) alloys. Using a thermogravimeter and an attached mass spectrometer we studied the weight percent of desorbed hydrogen and the distribution of desorption temperatures, which gave us an insight into the hydrogen bonding energies (sites) in the material, depending on the structure, i.e. amorphous, quasicrystalline and crystalline, composition and hydrogen content.

For the preparation of quasicrystalline (i-phase) samples we used only melt-spinning technique, whereas double-phase crystalline powder samples of hexagonal C14 Laves phase and cubic Ti/Zr solid solution were prepared by annealing of i-phase ribbons for 2 h at 700 °C in dynamic vacuum. Amorphous powder samples were obtained by mechanical alloying of i-phase ribbons. We found that all samples exhibit paramagnetic behaviour, where the susceptibility is fairly constant, regardless of the structure. A linear decrease of quasi-lattice cell parameter with increasing Ti/Zr ratio was observed for both, as-prepared and hydrided samples, where the cell constants of loaded samples were about 6 % higher. Using TEM we determined that the average i-phase grain size on the wheel side of the ribbon was approximately 50 nm, whereas on the argon side the grains were five times larger, i.e. 250 nm. The 5-fold symmetry (besides 3- and 2-fold) was confirmed by electron diffraction and high-resolution TEM, which is the basic structural property of icosahedral quasicrystals. XPS analysis showed that the thickness of an (zirconium and titanium) oxide layer on the surface of the ribbons that were exposed to air for 30 d was only 7 nm, which implies on the passivation of the material.

At the end we did a series of vacuum-casting experiments with different sizes of copper cold molds, (3, 2 and 1.5) mm, for samples with the same compositions as we used for the melt-spinning. Three millimetre quenched rods of various compositions were hydrided and studied by vibrating sample magnetometer (VSM) to see how the magnetic properties are affected by the absorbed hydrogen. Also, we compared the mass-spectra of hydrogen from the quenched rods with those from the melt-spun ribbons to see how the cooling regime affects the hydrogen-bonding energy distribution.

ABSORPCIJA VODIKA V ZLITINAH Ti-Zr-Ni

¹A. Kocjan, ¹P. J. McGuinness, ¹S. Kobe

¹Odsek za nanostrukturane materiale, Institut "Jožef Stefan", Jamova cesta 39,
1000 Ljubljana, Slovenija, EU

Delo je obsegalo pripravo, navodičenje in razvodičenje zlitin z naslednjimi sestavami: $\text{Ti}_{40}\text{Zr}_{40-x}\text{Ni}_{20}\text{Cu}_x$ ($x = 3, 5$), $\text{Ti}_{45}\text{Zr}_{38-x}\text{Ni}_{17}\text{Cu}_x$ ($x = 3, 5$), $\text{Ti}_{53}\text{Zr}_{27-x}\text{Ni}_{20}\text{Cu}_x$ ($x = 3, 5$) in $\text{Ti}_{58}\text{Zr}_{24-x}\text{Ni}_{18}\text{Cu}_x$ ($x = 3, 5$). Z metodo termogravimetrije in masnim spektrometrom smo preučevali masni delež desorbiranega vodika in odvisnost temperatur desorpcije oz. vezavnih energij vodika od strukture, tj. amorfne, kvazikristalne in kristalne, in sestave ter deleža vodika.

Ikozaedrično kvazikristalno fazo, tj. i-fazo, smo pripravili direktno z ultra hitrim ohlajevanjem taline s t. i. spinskim kaljenjem (ang. "melt-spinning"), medtem ko smo praškaste vzorce dvofaznega sistema heksagonalne Lavesove faze C14 in kubične trdne raztopine titana in cirkonija dobili po dveurni toplotni obdelavi kvazikristalnih trakov pri 700 °C v dinamičnem vakuumu. Amorfne praškaste vzorce pa smo dobili z mletjem kvazikristalnih trakov v planetarnem mlinu. Ugotovili smo, da vsi vzorci kažejo paramagneten odziv, pri čemer je susceptibilnost konstanta, ne glede na strukturo materiala. Opazili smo tudi linearno manjšanje konstante kvazikristalne rešetke z večanjem razmerja Ti/Zr, tako za surove kot navodičene vzorce, pri čemer so celični parametri slednjih večji za okoli 6 %. S TEM-analizo smo pokazali, da je povprečna velikost zrn i-faze v traku na strani hladilnega valja okoli 50 nm, medtem ko so zrna na strani argona petkrat večja, torej 250 nm. Z elektronsko difrakcijo

in visokoločljivostno transmisijsko elektronsko mikroskopijo (HRTEM) smo neposredno potrdili obstoj 5-števne simetrije (poleg 3- in 2-števne) v materialu, ki je značilna za ikozaedrične kvazikristale. XPS-analiza je pokazala, da je debelina (cirkonijeve in titanove) oksidne plasti na površini teh trakov, ki so bili izpostavljeni zraku 30 d, le okoli 7 nm, kar kaže na pasivacijo materiala. Na koncu smo opravili še serijo poskusov vakuumskega kaljenja z bakrenimi modeli, pri čemer smo dobili vzorce paličastih oblik različnih premerov, in sicer (3, 2 in 1,5) mm, z enakimi sestavami, kot smo jih uporabili za ultra hitro rotirajoče kaljenje. Vzorce premera 3 mm različnih sestav smo navodili ter študirali vpliv navodičenja na magnetne lastnosti, z masno spektrometrijo pa smo preverili vpliv načina kaljenja na porazdelitev vodikovih vezavnih energij v primerjavi z masnimi spektri vodika iz trakov.

VT-MR

CRYSTAL ORIENTATION-DEPENDENT NANOSTRUCTURING BY ION BEAM:
RIPPLES, FACETS AND ETCH PITS

Barbara Šetina Batič, Monika Jenko
Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana

Ion bombardment has recently attracted much attention as a tool for inducing self-organized patterns on various metal, semiconductor and amorphous surfaces. Depending on the conditions imposed upon the ion beam as well as on the properties of the material, different surface morphologies can form.

Polycrystalline Fe-2 % Si alloy (silicon steel) was chosen as a model system for studying sputter induced topography modulations: each grain, ranging few μm in size and of different crystalline orientation, behaves as a single-crystal surface that sputters independently of the surrounding grains. Thus, it is possible to experimentally include a large amount of grains of different crystallographic orientations in the same experimental run.

Samples of Fe-3 % Si alloy were polished to achieve a smooth starting surface and subjected to Ar⁺ ion beam irradiation of different energy, angle and ion dose to obtain a complete set of experimental data on ion induced morphology changes. Results show that the surface exhibits grain-orientation dependent patterns, ranging from well-defined ripple structures to terraces, etch pits of various shapes, or pyramidal structures. The characteristic length of these structures is in the order of a few hundred nanometres. Preliminary results show that surface active elements, such as Se, have a determining role on the formation of ripple-like patterns, causing the ripples to develop facet-like characteristics. The samples were characterized using a multitechnique approach: Field Emission Scanning Electron Microscope (FE-SEM, Jeol JSM 6500-F) was used for the determination of different structures that formed in individual grains and to visualize a larger area of the sample, while Atomic Force Microscope (AFM, Veeco) gave detailed information on corrugation, individual ripple wavelengths, facet angles, pit depths and other morphological details. XPS and AES analysis show the surface composition undergoes certain changes, which then leads towards individual pattern development.

MF-MR

INVESTIGATION OF THERMAL CONDUCTIVITY IN SiC_f/SiC COMPOSITES FOR FUSION APPLICATION

Aljaž Ivekovič¹, Katja König¹, Marko Jagodič², Saša Novak¹, Goran Dražič¹

¹Department for Nanostructured Materials, Jožef Stefan Institute, Slovenia

²Institute of Mathematics, Physics and Mechanics, Jadranska 19, SI-1000 Ljubljana, Slovenia

Silicon carbide (SiC) is considered as a promising material for high temperature structural applications due to its intrinsic properties. Low neutron activation of pure SiC, along with its high mechanical and thermal stability make SiC a candidate material to be used as a structural material in future fusion reactors. To ensure sufficient fracture toughness and reliability of the material, SiC is proposed to be used in the form of continuous SiC-fibre-reinforced SiC composite (SiC_f/SiC). Thermal conductivity of SiC_f/SiC composites is one of the most important parameters for the use of such material in the future fusion reactors. To elevate the energy conversion efficiency of the reactor the transverse thermal conductivity of the material has to be improved. The effect of reduction of porosity on thermal transport properties by densifying the SiC matrix with polymer infiltration and pyrolysis (PIP) process was investigated. Samples of SiC matrix and SiC_f/SiC composites were prepared via electrophoretic deposition of aqueous suspension of SiC powder. Green parts were then infiltrated with polycarbosilane (PCS) and cured, pyrolyzed and crystallized in order to further densify the matrix. The effect of CNTs on thermal transport properties of the material was also investigated. CNTs were incorporated into the matrix or deposited on the SiC fibres prior to the infiltration with SiC powder. Thermal transport properties were measured at room temperature on a Quantum Design Physical Property Measurement System (PPMS) with a 9 T magnet using the standard two-probe or four-probe lead configuration.

KM-MR

THE INFLUENCE OF δ -FERRITE ON FATIGUE RESISTANCE OF VANE
MATERIALS

Hájková Pavlína

Faculty of Mechanical Engineering, CTU in Prague, Karlovo náměstí 13, Praha 2, 121 35 Czech Republic

Low pressure parts of TG 1000 MW of the third wheels are made from modified 12 % Cr martensitic steel AK1 TD. 9 and low pressure parts of the fourth wheels are made from X2CrNiMo13-4 steel. Fracture of the third turbine wheels at the point of dendritical connection of vane has high cycle fatigue character with multiple initiation sites. Analysis of microstructure has proved the influence of both δ -ferrite content and arrangement on the initiation phase of fatigue process. Also, inspection of the fatigue crack's kinetics' development in relationship to the operative mode of the power plant has been carried out.

KM-MR

EFFECT OF VARIOUS HEAT TREATMENT REGIMES ON STRUCTURE AND
PROPERTIES OF Cr-V LEDEBURITIC STEEL

Krum Stanislav, Sobotová Jana, Jurčí Petr

Faculty of Mechanical Engineering, CTU in Prague, Karlovo náměstí 13, Praha 2, 121 35 Czech Republic

The tool steels are very specific materials. Generally they have to be hard and wear resistant. This work investigates the influence of sub-zero treatment on mechanical properties and microstructure of a PM tool steel. Samples made from the Vanadis 6 ledeburitic type tool steel were heat treated and some of them consequently sub-zero processed. Microstructure of samples was evaluated using optical microscope and scanning electron microscope. Sensitivity against the crack initiation was determined by the three point bending test and hardness was evaluated using Vickers and Rockwell methods. Also a fractographical analysis has been carried out on the three point bending samples.

AM-MR

PREPARATION AND MECHANICAL PROPERTIES OF POROUS Y-TZP CERAMICS FOR DENTAL APPLICATIONS

Sebastjan Perko, Aleš Dakskobler, Tomaž Kosmač
Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia

Y-TZP ceramics are becoming increasingly popular in the field of biomaterials, especially in dentistry. They are used as fixed partial dentures (FPDs), implants and implant abutments. When fully sintered, these materials exhibit excellent flexural strength (δ) and fracture toughness. One of the problems with dental zirconia is related to its high elastic modulus (E) compared to that of dentine. However, the problem can be solved by introducing moderate porosity into the sintered body, although inevitably this reduces the flexural strength of the material.

In the present work we report on the development of moderately porous Y-TZP ceramics with a useful flexural strength and a low elastic modulus. To reach this compromise solution the core-shell concept was adopted during the preparation of the starting materials. The concept exploits homoaggregation, which results in a homogeneous distribution of nano-sized particles attached to the surface of submicron-sized particles. It was assumed that the addition of the nanoparticles would enhance the formation of necks between the nano-sized and/or the submicron-sized particles, thus increasing the strength of the moderately porous ceramic body.

After slip casting, the green pellets were biscuit-sintered at various temperatures in an ambient air atmosphere. The flexural strength of the core-shell nanocomposite increased with the fractional density, starting from 80 MPa at 55 % of TD, reaching a plateau of 670 MPa at 70 % of TD, and exhibiting an abrupt jump from 200 MPa to 450 MPa with minimal densification from 58 % TD to 60 % TD. This rather large increase in the flexural strength over a relatively narrow temperature range was explained by the formation of interparticle necks as a result of surface diffusion.

AM-MR

MODELING OF DISTRIBUTION OF COLLOIDAL PARTICLES IN SUSPENSIONS

Gregor Trefalt, Marija Kosec, Barbara Malič, Danjela Kuščer
Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia

Computer modeling is an important field of modern science. It is useful for predictions of properties of materials or systems and it can save us a lot of experimental work. It is also used in cases where properties are experimentally hard to measure or are even immeasurable. Colloidal suspensions are the systems where computer simulations are widely used. Interactions between colloidal particles and their distribution in the suspensions influence on the macroscopic properties of these systems. However it is usually hard to experimentally observe processes at the particle or even molecular level. Therefore we implemented computer modeling for the prediction of the behavior of the colloidal systems.

We have proposed a new method for the synthesis of the $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3$ (PMN). The starting powders of PbO , Nb_2O_5 and $(\text{MgCO}_3)_4 \cdot \text{Mg}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$ were mixed in aqueous suspension. After adjustment of the pH and attrition milling, the suspensions were dried and subsequently calcined to get the PMN powder. We believe that the distribution of the colloidal particles in the suspension is crucial for the formation of the perovskite without parasitic pyrochlore phases. The Monte Carlo simulation technique was used to simulate the distribution of the PbO , Nb_2O_5 and $(\text{MgCO}_3)_4 \cdot \text{Mg}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$ particles in the suspension at different pH values. Namely, based on the values of the surface charge of the constituent particles, which were obtained from the zeta potential measurements, different interactions were predicted depending on the pH. The results of modeling are compared to macroscopic behavior of the powder mixtures after drying and heating.

AM-MR

0.65Pb(Mg_{1/3}Nb_{2/3})O₃-0.35PbTiO₃ THICK FILM ACTUATORS ON THIN Pt SUPPORTS

Hana Uršič¹, Marko Hrovat¹, Janez Holc¹, Marina Santo Zarnik^{1,2}, Marija Kosec¹

¹Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia

²HIPOT-R&D, d. o. o., Trubarjeva 7, SI-8310 Šentjernej, Slovenia

An actuator is defined as a device for the conversion of electrical energy into mechanical energy. Piezoelectric and electrostrictive actuators have simple structures, compact sizes, quick responses and they can be positioned precisely, meaning they can be used in many applications such as micro-positioners, miniature ultrasonic motors, and adaptive mechanical dampers.

A new approach to prepare "substrate-free", large-displacement actuators with thick-film 0.65Pb(Mg_{1/3}Nb_{2/3})O₃-0.35PbTiO₃ (0.65PMN-0.35PT) layers will be presented. The Pt electrodes and the 0.65PMN-0.35PT thick films were screen printed and fired on alumina substrates and then peeled off from the substrate. This peeling off was assisted by the poor adhesion between the bottom Pt electrode and the alumina substrate, which was due to the formation of beta alumina grains at the interface between platinum layer and alumina substrate during firing.

A large displacement of 100 μm at 18 V (3.6 kV/cm) were achieved for actuators with dimensions of 1.8 cm × 2.5 mm × 50 μm of the 0.65PMN-0.35PT layers. This is comparable with the best reported results for substrate free actuators with comparable compositions.

The shape of the displacement curve versus the applied field indicates that two contributions from the electromechanical coupling are present, i.e., the piezoelectric linear effect (important at fields below 0.8 kV/cm) and the electrostrictive effect which prevail at higher electric fields. The finite-element analysis (FEA) of the actuator was performed using material parameters from the literature as well as experimentally obtained data.

P-MR

HOMO- AND BLOCK COPOLYMERIZATION OF BENZYLIC PROTECTED ASPARTIC ACID AND GLUTAMIC ACID *N*-CARBOXYANHYDRIDES AND THEIR COPOLYMERIZATION WITH L,L-LACTIDE

Blaž Brulc, Ema Žagar, Majda Žigon

National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia

Benzylic protected *N*-carboxyanhydrides (NCAs) of L-aspartic and L-glutamic acids were used as monomers in preparation of poly(β -benzyl L-aspartate)s and poly(γ -benzyl L-glutamate)s, respectively. By varying the molar ratio of the monomer to the primary amine initiator we were able to obtain homopolypeptides with molar mass averages close to the calculated values, and low polydispersity indices. All reactions were performed in dry DMF; poly(γ -benzyl L-glutamate) syntheses proceeded at room temperature, while poly(β -benzyl L-aspartate)s were prepared at 0 °C in order to prevent possible side reactions. The same reaction conditions were used in preparation of two- and three-armed star-shaped poly(β -benzyl L-aspartate)s.

The NH₂-terminated homopolypeptides synthesized in this way were later without the intervening isolation used as macrocoinitiators in the ring-opening polymerization of L,L-lactide using stannous(II) octanoate as the catalyst. These block copolymerizations were run in a protective nitrogen atmosphere at an elevated temperature in dry DMF.

In addition to the synthesis of linear homopolypeptides, we also synthesized their linear block copolymers. These syntheses are proving that the NH₂-terminated polyamide chains remain reactive even after more than 24 h in solution.

NMR and FT-IR spectroscopy were used to elucidate the polymers' chemical composition, and size-exclusion chromatography coupled to multi-angle laser photometer (SEC-MALLS) was used for the determination of their absolute molar mass averages.

AM-MR

ZINC OXIDE: MORPHOLOGY AND GROWTH

Marko Bitenc¹, Zorica Crnjak Orel¹, Peter Podbršček¹, Pavo Dubček², Sigrid Bernstorff³, Goran Dražić⁴,
Marjan Marinšek⁵

¹National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia

²Ruđer Bošković Institute, P.O. Box 180, 10002 Zagreb, Croatia

³Sincrotrone Trieste S.C.p.A., I-34012 Basovizza TS, Italy

⁴Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia

⁵Faculty of Chemistry and Chemical Technology, Aškerčeva 5, SI-1000 Ljubljana, Slovenia

A solution-phase preparation method, based on a combination of the polyol method and the homogeneous precipitation of zinc nitrate with urea, was used for the preparation of the ZnO particles. The influence of various reaction conditions, such as concentration of initial reagents, reaction medium and type of reactor, on final particle morphology and growth were studied. The growth of particles was proposed, as the agglomeration of the nanosized particles (with prompt crystallization), from the combination of ex-situ (FE-SEM and TEM) and in-situ (SAXS) observations. Regarding on our reaction conditions, which were applied during our experiments, the ZnO could be formed in one or two step synthesis. In one step synthesis, in a shape of hexagonal bipods the pure ZnO were formed with the agglomeration of the ZnO nanosized particles. In two steps synthesis, first the particles as a microspheric organization of multilayered nanosheets of hydrozincite (ZnHC) were formed with the agglomeration of the ZnHC nanosized particles. In the second step, after a heat treatment, the ZnO particles were formed with preserved size and the shape of the ZnHC precursor.

AM-MR

PREPARATION OF ELECTROCONDUCTIVE $\text{Si}_3\text{N}_4/\text{ZrN}$ CERAMIC COMPOSITES

Aljoša Maglica, Kristoffer Krnel, Tomaž Kosmač
Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia

Electroconductive ceramic composites with a high thermal conductivity are potentially interesting for the production of various heating elements. Generally, they consist of a strong and tough non-oxide matrix phase and an electrically conductive second phase. State-of-the-art composite materials usually consist of silicon nitride or aluminum nitride and a silicon carbide solid solution as the matrix phase, and as the conductive phase, MoSi_2 , WC , TiN , TiC and ZrN are the most commonly used. However, since the conductive particles are coarse it is necessary to add a significant amount to achieve the percolation threshold. Such a relatively large amount of conductive phase leads to poor sinterability and reduced mechanical properties. But if very small, nanometric ZrN particles were to be used they could form an electrically conductive network around larger Si_3N_4 particles and a much smaller amount of conductive phase would be needed.

In this study we report on the preparation of electroconductive $\text{Si}_3\text{N}_4/\text{ZrN}$ composites prepared using an in-situ composite method, where the conductive phase was formed by the reaction of Si_3N_4 and ZrO_2 particles. The ZrO_2 -coated Si_3N_4 powders were prepared by heterogeneous precipitation in a Si_3N_4 suspension containing zirconium (IV) acetate. It will be shown that ZrO_2 can react with Si_3N_4 to form ZrN above 1600 °C in nitrogen. TEM, HRTEM, XRD and electron diffraction analyses revealed the existence of ZrO_2 and ZrN particles on the surface of the Si_3N_4 particles. In the presence of yttria and alumina additives the $\text{Si}_3\text{N}_4/\text{ZrN}$ composites were successfully prepared by pressureless sintering at 1850 °C in nitrogen from zirconia-coated Si_3N_4 powders. The $\text{Si}_3\text{N}_4/\text{ZrN}$ composites with the volume fractions 10 % and 20 % of ZrO_2 in the starting composition exhibited high densities (>97 % TD) and superior flexural strengths, around 900 MPa. The measurements of electrical conductivity indicated that a composite with 10 % of ZrN (starting from 20 % of ZrO_2) has a suitable electrical conductivity for the production of ceramic heaters.

P-MR

LIQUEFIED WOOD AS AN ADHESIVE FOR PARTICLEBOARD PRODUCTION

Nataša Čuk¹, Sergej Medved², Matjaž Kunaver¹

¹ National Institute of Chemistry, Hajdrihova 19, SI-Ljubljana, Slovenia

² University of Ljubljana, Biotechnical Faculty, Rožna dolina C VIII/34, 1000 Ljubljana, Slovenia

Wood is one of the most abundant natural polymers which can be liquefied and used as a feedstock for production of different polymer materials: polyesters, polyurethanes and adhesives. Wood residues, bark, grinded old furniture and straw can also be liquefied. Wood liquefaction is a chemical reaction during which the main wood components are decomposed. As liquefaction reagent there are used different polyhydric alcohols and p-toluenesulphonic acid is used as a catalyst. At this conditions we can obtain up to 99 % wood liquefaction.

The main goal of our research was to evaluate the utilization of liquefied wood as an adhesive in particleboard production and to investigate physical and mechanical properties of produced particleboards. We also determined gel-time as a function of liquefied wood loading and temperature for the mixtures of liquefied wood and formaldehyde resins.

Then liquefied wood was added to different formaldehyde resins in various portions and particleboards were manufactured. Single-layer and three-layer particleboards were hot-pressed for 5 min at temperature 180 °C and pressure 3 N/mm². Produced particleboards were tested according to the European standards.

Results showed that the addition of liquefied wood had negative affect on gel-time and mechanical properties of produced particleboards, although these properties satisfied the EN standard requirements. Properties were better in three-layer particleboards and when melamine-urea-formaldehyde resin was used.

The utilization of liquefied wood in particleboard production gives a new aspect in renewable resources usage and at the same time reduces the crude oil consumption.

P-MR

PREPARATION OF POLYANILINE OF DIFFERENT MORPHOLOGIES FROM AQUEOUS IONIC LIQUID SOLUTIONS

D. Pahovnik¹, E. Žagar¹, J. Vohlidal², M. Žigon¹

¹Laboratory for Polymer Chemistry and Technology, National Institute of Chemistry, Hajdrihova 19, 1000 Ljubljana, Slovenia

²Department of Physical and Macromolecular Chemistry, Faculty of Science, Charles University, Hlavova 8/2030, CZ-128 40 Prague 2 – Albertov, Czech Republic

Polyaniline (PANI) is a conductive polymer which attracts a lot of attention because of its good properties, easy and cheap synthetic procedures and potential applicability in various fields. Special interest is given to PANI nanostructures because they combine properties of conductive organic polymers with properties of large surface-area materials. One way to prepare PANI nanoparticles is by the use of ionic liquids – as solvents or additives. The type of ionic liquid and experimental conditions have an essential effect on the morphology and properties of the formed nanoparticles.

We prepared various PANI nanostructures by a novel approach, where we used an acidic water solution of the ionic liquid, 1-butyl-3-methylimidazolium chloride, for chemical oxidation of aniline with ammonium persulfate as an oxidant. We will present how ionic liquid affects the properties and morphology of PANI and how do they change by varying molar ratio of the ionic liquid and aniline. The nanoparticles were characterized using scanning electronic microscopy (SEM), spectroscopic methods (NMR, IR, UV-VIS), size exclusion chromatography (SEC) and impedance spectroscopy.

PRIPRAVA RAZLIČNIH MORFOLOGIJ POLIANILINA V VODNIH RAZTOPINAH IONSKIH TEKOČIN

D. Pahovnik¹, E. Žagar¹, J. Vohlidal², M. Žigon¹

¹Laboratorij za polimerno kemijo in tehnologijo, Kemijski inštitut, Hajdrihova 19, 1000 Ljubljana, Slovenija

²Oddelek za fizikalno in makromolekularno kemijo, Fakulteta za znanost, Karlova univerza, Hlavova 8/2030, CZ-128 40 Praga 2 – Albertov, Češka republika

Polianilin (PANI) je prevodni polimer, ki je izredno zanimiv zaradi enostavne in poceni sinteze ter edinstvenih in raznovrstnih lastnosti, ki so podlaga za številne potencialne aplikacije na različnih področjih. Še posebej zanimive so PANI-nanostrukture, saj združujejo lastnosti prevodnih organskih polimerov z lastnostmi materialov z veliko površino. Eden novejših načinov za pripravo PANI-nanodelcev je uporaba ionskih tekočin – kot topilo ali dodatek, pri čemer vrsta ionske tekočine in eksperimentalni pogoji bistveno vplivajo na morfologijo in lastnosti pripravljenih nanodelcev.

Z novim postopkom, s kemijsko oksidacijo anilina v kisli vodni raztopini ionske tekočine, 3-butil-1-metilimidazolijevega klorida in z amonijevega persulfatom kot oksidantom smo pripravili različne nanostrukture polianilina. Predstavili bomo, kako ionska tekočina vpliva na morfologijo in lastnosti polianilina in kako se le-te spreminjajo s spreminjanjem molskega razmerja anilina in ionske tekočine. Nanodelci so bili karakterizirani z vrstično elektronsko mikroskopijo (SEM), s spektroskopskimi metodami (NMR, IR, UV-VIS), z velikostno izključitveno kromatografijo (SEC) in impedančno spektroskopijo.

KM-MR

CHARACTERIZATION OF INCLUSIONS IN SPRING STEELS USING LIGHT AND SCANNING ELECTRON MICROSCOPY

Arsim Bytyqi, Monika Jenko

Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

This seminar first reviews the sources of inclusions in steel including both indigenous and exogenous inclusions, focusing on reoxidation, slag entrainment, inclusion agglomeration in lining etc. In order to inspect the quality of spring steel characterization of inclusions is studied. Principal factor that decides high-grade steel quality depends on size, shape, distribution of inclusions in steel.

In this seminar, the determination of inclusions, size, distribution, composition, and steel cleanliness for the spring steel are studied by the light microscopy and scanning electron microscopy. The experiments with spring steel showed that the difference in inclusion content between samples is maintained but reduced. It was also established that first sample contains more inclusions than the second one, however the difference is not very pronounce.

To control the spring steel quality in means of inclusions content ultrasonic and light microscopy shall be applied which allows controlling larger area. When new steel or new production route is introduced, then some more sophisticated analytical techniques should be applied, for instance SEM/EDS, AES or EBSD.

Finally this seminar reviews operating practices to improve steel cleanliness and to build a new method for determination of inclusions by using advanced techniques.

KM-MR

CHARACTERIZATION OF ALUMINIUM FOAM MADE OF AlSi7 ALLOY

Irena Paulin^{1,2}, Črtomir Donik², Monika Jenko², Varužan Kevorkijan²

¹TALUM d.d. Kidričevo, Tovarniška cesta 10, SI-2325 Kidričevo, Slovenia

²Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia

Metal foams are advanced metal materials with high porosity (up to 90 %) and are known to have many interesting combinations of physical and mechanical properties, such as high stiffness at very low specific weight, high impact energy absorption, flame and heat resistance, sound absorption, low electric and low thermal conductivity etc. Metal foams based on aluminium and aluminium alloys are usually used in aircraft and aerospace industry, for armoured vehicles, in car industry and related areas, in shipbuilding, civil engineering, biomedical industry and for sporting equipment.

Aluminium foam of AlSi7 alloy is one of frequently used metal foams. Because of specific use of aluminium alloy foams we do research of aluminium foams with closed cell structure. Aluminium foams with closed cell structure are manufactured with foaming agents (usually TiH₂ or ZrH₂,) that are gas releasing substances. Closed cell structure has high impact energy absorption that is very important mechanical property in military and car industry. Examination of aluminium foams made of AlSi7 alloy showed interesting results on distribution and size of pores, density of material and distribution of chemical elements. Characterization was made with scanning electron microscopy with energy dispersion spectroscopy (SEM/EDS) and surface sensitive Auger electron spectroscopy for detailed surface analysis.

KARAKTERIZACIJA ALUMINIJEVE PENE NA OSNOVI ZLITINE AlSi7

Irena Paulin^{1,2}, Črtomir Donik², Monika Jenko², Varužan Kevorkijan²

¹TALUM d. d. Kidričevo, Tovarniška cesta 10, 2325 Kidričevo, Slovenija

²Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija

Kovinske pene so sodobni kovinski materiali z veliko poroznostjo (do 90 %) in dobrimi želenimi mehanskimi lastnostmi, kot so dobra absorpcija energije, toplotna odpornost, zvočna izolacija, majhna električna in toplotna prevodnost, itd. Kovinske pene, predvsem na osnovi aluminija in aluminijevih zlitin se uporablja v letalski in vesoljski industriji, v vojaške namene – oklepna vozila in protiudarna zaščita, v avtomobilski in ladijski industriji ter sorodnih industrijskih panogah, v gradbeništvu, biomedicini in celo za športne rekvizite.

Aluminijeva pena na osnovi zlitine AlSi7 je le ena od pogosto uporabljenih aluminijevih pen. Zaradi specifične uporabe pen smo raziskali pene z zaprto poroznostjo. Aluminijeve pene z zaprto poroznostjo se izdelujejo s penilnimi sredstvi, ki so različni hidridi (TiH₂, ZrH₂). Zaprta poroznost pen omogoča predvsem dobro absorpcijo energije, ki je zelo pomembna za vojaško in avtomobilsko industrijo. Raziskava aluminijeve pene na osnovi AlSi7 je prinesla zanimive podatke o velikosti in porazdelitvi por, gostoti materiala ter porazdelitvi kemijskih elementov. Za karakterizacijo smo uporabili vrstični elektronski mikroskop z analizo tehniko energijskodisperzijska spektroskopija (SEM/EDS) in Augerjevo elektronsko spektroskopijo (AES) za natančno analizo površine.

KM-MR

CORRELATION BETWEEN CREEP RESISTANCE AND HARDNESS OF STEEL PARTS IN THERMAL POWER PLANTS

Fevzi Kafexhiu, Jelena V. Tuma
Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

The correlation between creep resistance and hardness on two different steels, the classical steel X20CrMoV 121 and steel P91 (T91, X10CrMoVNb91) used in parts of thermal power plants was evaluated. Specimens were annealed isothermally from 1 h up to 8760 h at the temperatures of 650 °C and 750 °C. After air cooling, the hardness and the resistance to creep were measured. The creep test consisted of 100 h creep test of specimen stressed with 170 MPa at the temperature 580 °C.

Primary and secondary creep with different rate was recorded with steels annealed at 650 °C with the initial hardness of *HV* 224 and *HV* 223. Primary, secondary and tertiary creep was determined also on steels annealed at 750 °C. The creep resistance of P91 steel was greater for the same hardness compared to the steel X20CrMoV 121. It is confirmed that the hardness could be used as criterion for the evaluation of the residual lifetime of equipment operating at elevated temperature, before more expensive methods of testing are used.

KORELACIJA MED ODPORNOST PROTI LEZENJU IN TRDOTE JEKLENIH DELOV V TERMOELEKTRARNAH

Fevzi Kafexhiu, Jelena V. Tuma
Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija

Korelacija med odpornost proti lezenju in trdote na dveh različnih jeklih, na klasičnem jeklu X20CrMoV 121 in jeklu P91 (T91, X10CrMoVNb91), ki se uporabljata pri termoenergetskih delih, je bila ovrednotena. Vzorci smo izotermno žarili od 1 h do 8760 h pri temperaturah 650 °C in 750 °C. Po ohladitvi na zraku smo opredelili trdoto jekel in odpornost proti deformaciji s 100-urnimi preizkusi lezenja pri statični obremenitvi 170 MPa in temperaturi 580 °C.

Pri izotermnem žarjenju pri 650 °C potekata pri trdoti jekel *HV* 224 in *HV* 223 prva in druga stopnja lezenja. Pri temperaturi žarjenja 750 °C pa potekajo prva, druga in tretja stopnja lezenja, kjer je hitrost deformacije različna. Odpornost proti deformaciji z lezenjem je pri enakih časih izotermnega žarjenja večja pri jeklu P91 kot pri X20CrMoV121. Potrjeni in utemeljeni so cilji raziskave, da lahko trdoto jekla uporabimo kot merilo za oceno stanja komponent termoenergetskih objektov, ki jih je treba zaradi dolgotrajnega obratovanja pri povišanih temperaturah zamenjati in tako zagotoviti zanesljivejše obratovanje. Metoda preiskav je bistveno cenejša od drugih porušnih metod.

KM-MR

USING CHARGE COMPENSATION TO ANALYSE METAL OXIDES

Besnik Poniku, Monika Jenko

Institute of metals and technology, Lepi pot 11, Ljubljana, Slovenia

While analyzing poorly conductive samples using FE-AES method, the analyst often encounters peak shifts in spectra, or spectra that are completely irregular where no information can be derived. This phenomenon happens due to charge accumulation on the sample. In our work where oxide layer formed during the forging process of stainless steels ingot was analyzed. We have shown that though the use of low energy Ar⁺ ions for charge compensation much better spectra can be obtained. This possibility widens the range of materials that can be analyzed by FE-AES method.

KM-MR

INFLUENCE OF AGING ON DELTA FERRITE CONTENT IN Cr-Ni-BASED STEELS

Milan Malešević, J. V. Tuma, F. Tehovnik
Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

Six different cast ingots of Cr-Ni-based alloys were made. These alloys have chemical composition close to CF-8A alloy and delta ferrite content which vary between 3 % and 30 %. Alloys are containing delta ferrite forming elements (e.g. chromium and silicon) and elements which are not delta ferrite forming (e.g. nickel, manganese and nitrogen). Determination of delta ferrite content was processed with Feritscope MP30 before and after short-time aging (isothermal annealing) of all samples (ingots) in heating furnace for 30 min at temperature of 1120 °C. It is proved that the change of delta ferrite content, after heating (aging), is a relatively uniform for all alloys. Distribution of delta ferrite is not very much changed. However, we will chose three alloys, with approximately (3, 15 and 30) % of delta ferrite, for further investigations, i.e., long-time aging, mechanical and metallographic characterization.

VT-MR

UNCERTAINTY CALCULATION OF GAS FLOW MEASUREMENT

Makfir Sefa¹, Janez Šetina²

¹Lotrič d.o.o., Selca 163, 4227 SELCA, Slovenia

²Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

In vacuum technology a gas flow is often expressed as pV flow (q_{pV}) with units (mbar×L/s), defined as the product of the pressure p and volume V of a quantity of gas flowing through a piping element divided by time t : $q_{pV} = p \times V / t$.

Constant gas flow q_{pV} in a closed volume causes calculable pressure increase Δp during time interval Δt : $\Delta p = q_{pV} \times \Delta t / V$ (assuming constant gas temperature). We have constructed a measurement setup for calibration of a gas flow meter device according to this equation.

In my presentation I will describe the measurement setup and detailed uncertainty analysis of generated gas flow according to established methods in metrology (¹). I will also discuss results of calibration of two gas flow meters.

(¹) European Co-operation for Accreditation (EA) Guide EA-4/02 (rev.00) Expressions of the Uncertainty of Measurements in Calibration (1999)

VT-MR

INVESTIGATION OF OXYGEN DIFFUSION IN ST 707 NON-EVAPOABLE GETTER MATERIAL

Sefer Avdiaj¹, Janez Šetina², Barabara Šetina-Batič²

¹Lotrič, d. o. o., Selca 163, 4227 SELCA, Slovenia

²Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

Getters are solid materials capable of chemisorbing gas molecules on their surface: getters are chemical pumps. They are widely used for a variety application such as in ultrahigh vacuum systems of particle accelerators, in sealed vacuum devices such as vacuum tubes, field emission display. Because they exhibit selective pumping they are also used for inert gas purification. We can have evaporable getters (EGs) and nonevaporable getters (NEGs).

During handling of NEGs under usual ambient conditions their surface becomes covered with a passive layer mainly consisting of chemisorbed oxygen and carbon. This passive layer must be eliminated to start gettering action. To accomplish this, the getter is heated under vacuum to a sufficiently high temperature for a short time. During this process, called activation, the passive film diffuses into the bulk, making the clean metallic surface active for sorption.

We have studied oxygen diffusion in samples of commercial NEG St 707 which is an alloy of ZrVFe. Samples were in the form of pills compressed from St 707 powder of typical particle size 50 μm to 100 μm . To get observable amount of oxygen in the bulk material we have loaded the samples at 450 $^{\circ}\text{C}$ and 500 $^{\circ}\text{C}$ with different amount of oxygen, ranging from the mole fraction 0.6 % to almost 18 %. Diffusion of oxygen at temperature 450 $^{\circ}\text{C}$ was too slow to show observable distribution of oxygen inside the getter. Observable effects were obtained at temperature 500 $^{\circ}\text{C}$ and from the literature this is also the minimum temperature needed for the ZrO_2 to be created. Theoretical calculations of diffusion length and concentration profiles were carried out for pure Zr and pure V, and are not completely valid in the case of the alloy St 707 so they can be used only as approximations.

Microstructure of the material has been studied with electron microscope. The EDS analysis confirmed that St 707 is biphasic (grains of pure Zr and Laves phase $\text{Zr}(\text{V}_{0.83}\text{Fe}_{0.17})_2$) before as well as after heating to 500 $^{\circ}\text{C}$. EDS analyses also showed increased oxygen concentration in the Laves phase and particularly at the boundaries of getter particles.

The structural effects caused by gas dissolution are generally limited to some expansion of the lattice, with increase of the lattice parameter. The loading of 18 % of oxygen at temperature of 500 $^{\circ}\text{C}$ was too much, so the sample became brittle and partly disintegrated into dusts.

KM-MR

INFLUENCE OF HOT ROLLING ON ELECTROMAGNETIC PROPERTIES OF ELECTRICAL STEELS

Ažbe Križaj¹, Peter Fajfar², Jelena Vojvodič Tuma¹

¹Institute of Metals and Technology, 1000 Ljubljana, Slovenia

²University of Ljubljana, Faculty of Natural Sciences and Engineering, Aškerceva 12, 1000 Ljubljana, Slovenia

Electrical steels are used in the production of electrical engines and transformers. The main characteristics that are of interest when dealing with electrical steels are energy losses, a consequence of energy needed for the change of magnetization direction. They depend on many influences, amongst which are chemical composition, mechanical strain, size and orientation of grains and surface properties. Another factor that has been reported in the literature is the influence of hot rolling process on the final magnetic properties, as during hot rolling the microstructure and texture form. The desired microstructure of electrical steel is ferrite grains with similar grain sizes. If we want to achieve this microstructure hot rolling must be initiated in the austenite regime and finished in the double phase (austenite and ferrite) regime. Temperature of hot rolling and the chemical composition are the factors that define in which microstructure regime electrical steel is.

The starting temperature of hot rolling is in very close connection with the finishing temperature in pusher-type furnace. If the starting temperature is too high, the grains in microstructure can grow too large. It was found out that the grain size after hot rolling process has a strong influence on the final grain size of electrical steels. If the grain sizes in hot rolled sheets are too large or too small, the final grain sizes are too small as well and thus electrical steel has worse magnetic properties. For this reason an optimal grain size on hot rolled sheets for each chemical composition must be determined.

In our research we used electrical steel produced in Acroni d.o.o.. Three different types of electrical steels with different contents of Si, Al and P were used in experimental work. Using the THERMOCALC software we have drawn the phase diagram for each type of electrical steel. Using this data, we established the hot rolling temperature regions.

P-MR

THE TECHNOLOGY OF THE MICROENCAPSULATION OF INSECTICIDES

¹Marko Soderžnik, ²Janvit Golob

¹Jožef Stefan Institute, Ljubljana, Slovenia

²Faculty of Chemistry and Chemical Technology, University of Ljubljana, Slovenia

Microcapsules are spherical particles consisting of two parts, the shell and core. The latter is the internal part of the capsule and it contains a certain active component, while the shell, a thin layer of polymer, temporarily or permanently protects the core from the surroundings. The shell is a thin nano-layer of polymer in this case. Our microcapsules were of the order of 5 μm , so sophisticated fabrication procedures were needed. The shell thickness was calculated at around 50-100 nm. A thin shell is important as this allows the active component to diffuse through the wall. Technologies for microencapsulation processes were introduced and different averages of the microcapsules were measured and calculated. In the literature, chemical procedures are very often in situ polymerizations, that is why in this case the microcapsules with permethrin were formed using this method. Analysis procedures are an indispensable part of product engineering, so that is why diffusion tests were made, where the active component part from the capsule was visible. Zeta potential was sufficiently low, so that the microcapsules did not coagulate. With special techniques and additives we achieved a product that is comparable with the best products available.

NN-MR

SURFACE CHARACTERISTICS OF DIGESTIVE GLAND EPITHELIUM OF A TERRESTRIAL ISOPODA PORCELLIO SCABER STUDIED BY SEM

Milaku A.¹, Lešer V.², Drobne D.², Godec M.¹, Torkar M.¹, Jenko M.¹, Marziale Milani³, Francesco Tatti⁴

¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, SI-1000 Ljubljana, Slovenija

²Biotehniška fakulteta, Oddelek za biologijo, Univerza v Ljubljani, Večna pot 111, Slovenija

³Materials Science Department and Laboratory FIB/SEM "Bombay", University of Milano-Bicocca, Via Cozzi 53, I-20125 Milano, Italy

⁴FEI Italia, Viale Bianca Maria 21, I-20122 Milano, Italy

This work reports the use of scanning electron microscope (SEM) to study the surface characteristics of digestive gland epithelium (hepatopancreas) of terrestrial isopods. Epithelial surface was investigated by conventional scanning electron microscopy (SEM), focused ion beam (FIB)/SEM and light microscopy. We investigated shape of cells, extrusion of lipid droplets, shape and distribution of microvilli, presence of bacteria on the cell surface and intracellular infection. All together 22 animals were investigated. The majority of them (17 animals) had digestive gland epithelial cells of regular shape. The dome shaped cells were densely and homogenously covered by microvilli. The epithelium of these animals differs in the portion of cells which were extruding lipid droplets. On the surface of microvilli we regularly observed scarcely distributed bacterial cells of different shapes. We classify such epithelium as normal gland epithelium. Abnormal appearance was detected in five of 22 animals. Here we found animals with significantly altered shape of epithelial cells. In three animals, cells were either significantly smaller, partly or completely flat and sometimes pyramid like. On the microvillous border a thick layer of bacteria was detected. In places, the shape and size of microvilli was altered. In two other animals, the some epithelial cells were extremely large. Light micrographs reveal, that these cells contain large vacuoles filled with bacteria what is a characteristic of intracellular infection. We conclude that SEM investigation of morphological characteristics of digestive gland epithelium surface provides valuable information on surface morphology of biological samples.

ZNAČILNOSTI POVRŠINE EPITELIJA PREBAVNE ŽLEZE ORGANIZMA PORCELLIO SCABER PREISKOVANE S SEM

Milaku A.¹, Lešer V.², Drobne D.², Godec M.¹, Torkar M.¹, Jenko M.¹, Marziale Milani³, Francesco Tatti⁴

¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, SI-1000 Ljubljana, Slovenija

²Biotehniška fakulteta, Oddelek za biologijo, Univerza v Ljubljani, Večna pot 111, Slovenija

³Materials Science Department and Laboratory FIB/SEM "Bombay", University of Milano-Bicocca, Via Cozzi 53, I-20125 Milano, Italy

⁴FEI Italia, Viale Bianca Maria 21, I-20122 Milano, Italy

To delo predstavlja uporabo vrstičnega elektronskega mikroskopa (SEM) za študij značilnosti površine epitelijskega (hepatopancreas) prebavne žleze preskusnega organizma. Površina epitelijskega je bila preiskovana z običajnim vrstičnim elektronskim mikroskopom (SEM), s fokusiranim ionskim snopom (FIB)/SEM in s svetlobno mikroskopijo. Preiskovali smo obliko celic, izločanje kapljic maščobe, obliko in razporeditev microvilli, prisotnost bakterij na površini celic in medcelično infekcijo. Skupaj je bilo preiskanih 22 živali. Večina od njih (17 živali) je imela običajno obliko celic prebavnega epitela. Površina kupolasto oblikovanih celic je bila na gosto in enakomerno pokrita z microvilli. Epitelij pri teh živalih se je razlikoval v deležu celic, iz katerih so bile iztisnjene maščobne kapljice. Na površini microvilli smo redno opazili redko posejane celice bakterij, različnih oblik. Tak epitelij smo opisali kot kot običajen epitelij prebavnega organa. Neobičajne pojave smo opazili pri petih živalih od 22. Našli smo živali z občutno spremenjeno obliko epitelnih celic. Pri treh živalih so bile celice ali občutno manjše, delno ali popolnoma sploščene in včasih oblike piramide. Na meji z microvilli je bila prisotna debela plast bakterij. Na posameznih mestih je bila spremenjena oblika in velikost microvilli. Pri dveh živalih so bile epitelne celice ekstremno velike. Svetlobna mikroskopija je odkrila, da te celice vsebujejo velike vacuole, kiso napolnjene z bakterijami, kar je značilnost medcelične infekcije. Lahko zaključimo, da SEM preiskave morfoloških značilnosti površine epitelijskega prebavne žleze omogočajo pridobitev pomembnih informacij o morfologiji površine bioloških vzorcev.

KM-MR

THE USE OF ELECTROCHEMICAL NOISE, ACOUSTIC EMISSION AND COMPLEMENTARY MEASURING TECHNIQUES FOR DETECTION AND CHARACTERIZATION OF INTERGRANULAR SCC

Jaka Kovač¹, Edvard Govekar², Andraž Legat¹

¹Slovenian National Civil Building and Engineering Institute, Dimičeva 12, SI-1000 Ljubljana, Slovenia

²Faculty of Mechanical Engineering, University of Ljubljana, Aškerčeva 6, SI-1000 Ljubljana, Slovenia

Stress-corrosion cracking (SCC) is one of the most dangerous corrosion processes as it can cause unexpected failure of vital construction elements. Various SCC mechanisms have been proposed in the past few decades, but despite good agreement of these models with specific parameters obtained in selected corrosion systems the exact pattern of individual dissolution events and cracking steps has not been yet determined.

Tensile specimens, made from thermally sensitized austenitic stainless steel type AISI 304, were constantly loaded and exposed to the aqueous solution of sodium thiosulphate. Intergranular SCC process was monitored simultaneously by means of three different techniques: electrochemical noise, acoustic emission and elongation measurements. In order to follow the development of stress-corrosion cracks, a section of specimen, where cracks were expected, was monitored by the digital imaging system.

It was observed that electrochemical noise and elongation are associated with crack propagation from the early stages of crack initiation, whereas acoustic emission is only associated with the final stages of fracture. Correlations among the signals from the different techniques were also observed. An attempt to relate certain characteristics of the measured signals of electrochemical noise, acoustic emission, and elongation with the SCC process, particularly with the individual events, was also successfully accomplished.

UPORABA ELEKTROKEMIJSKEGA ŠUMA, AKUSTIČNE EMISIJE IN KOMPLEMENTARNIH METOD ZA ZAZNAVANJE IN KARAKTERIZACIJO INTERKRISTALNEGA NKP

Napetostno-korzijsko pokanje (NKP) je ena izmed najnevarnejših oblik korozijski procesov, ker lahko povzroči nepričakovano porušitev vitalnih konstrukcijskih elementov. V preteklih desetletjih je bilo predlaganih več mehanizmov za opis NKP. Kljub dobremu ujemanju posameznih modelov s specifičnimi parametri v posameznih korozijskih sistemih, natančen vzorec dogodkov odtapljajnja in pokanja še vedno ni določen.

V predstavljenem delu smo natezne vzorce, narejene iz toplotno obdelanega nerjavnega avstenitnega jekla tipa AISI 304, izpostavili konstantni obtežbi in vodni raztopini natrijevega tiosulfata. Proces interkristalnega NKP smo sočasno spremljali s tremi različnimi metodami: elektrokemijskim šumom, akustično emisijo in merjenjem raztezka vzorca. Z namenom sledenja razvoja napetostno-korozijskih razpok, smo vzorec na stanjšanem delu, kjer smo pričakovali razpoke, spremljali s sistemom za zajem digitalnih slik.

Ugotovljeno je bilo, da sta elektrokemijski šum in raztezek povezana z rastjo razpoke že v njeni zgodnji fazi, medtem ko je akustična emisija prisotna le v kasnejših obdobjih rasti razpoke. Najdene so bile korelacije med merjenimi signali zajetimi z različnimi metodami. Značilnosti signalov elektrokemijskega šuma, akustične emisije in raztezka smo uspeli povezati z NKP in s posameznimi dogodki znotraj omenjenega procesa.

NN-MR

ELECTRODEPOSITION AND CHARACTERIZATION OF Fe-Pd MAGNETIC THIN FILMS

Darja Pečko¹, Kristina Rožman Žužek¹, Boris Pihlar², Spomenka Kobe¹

¹Jožef Stefan Institute, Ljubljana, Slovenia

²Faculty of Chemistry and Chemical Technology, University of Ljubljana, Slovenia

Fe-Pd alloys recently attracted extensive attention because of their unique properties. In this work 200 nm thick equiatomic magnetic Fe₅₀Pd₅₀ thin films were synthesized with an ordered L1₀ phase, which was achieved upon annealing. This phase has a large magneto-crystalline anisotropy along c-axis direction of its tetragonal crystal structure, which makes this alloy a promising material for ultra high density perpendicular storage media and for micro-electro-mechanical-system (MEMS). Fe-Pd thin films were deposited from ammonium citrate complex baths onto glass-based Au coated substrates using the electrodeposition method. The deposition process was analyzed using cyclic voltammetry measurements. The deposition of palladium starts at potential -0,6 V, measured against Ag/AgCl electrode and at potential -0,9 V continues with the deposition of both metals. From the potential lower than -0,8 V there is a co-deposition of hydrogen observed, which is catalyzed by palladium. The composition of thin films was analyzed with EDS and the optimal film composition was found for the films deposited at -1,2 V. These films were annealed at temperatures 400 °C, 500 °C and 600 °C for 1 h in reductive environment (Ar +7 % H₂) and in vacuum (10⁻⁵ mbar). The phase formation, microstructure, hydrogen influence and the magnetic properties were analyzed. The hydrogen from reductive atmosphere promotes the phase transformation into L1₀. The highest coercivity was found 870 Oe for the sample annealed at 400 °C in reductive atmosphere. Above 500 °C there was decrease in coercivity observed due to a change in microstructure and interdiffusion, which were analyzed with EDS and XRD, since hydrogen also promotes the process of grain growth and interdiffusion. In vacuum these processes, because of the absence of hydrogen, happened at higher temperature, but the highest coercivity was lower than the highest coercivity achieved in reductive atmosphere.

KM-MR

ROLL THERMAL FATIGUE

Borut Žužek¹, Milan Terčelj², Ladislav Kosec², Peter Fajfar²

¹Institute of metals and technology, Ljubljana, Slovenia

²University of Ljubljana, Faculty of Natural Sciences and Engineering, Slovenia

The surface of the rolls for hot rolling is exposed to very rapid alternating heating due to contact with hot rolled material and cooling with water sprays. Experiment for thermal fatigue of rolls with thermo-mechanical simulator of metallurgical processes Gleeble 1500 was prepared. Specimens were made out from the roll cast in the company Valji d. o. o. and tested at similar conditions, as the surface of roll it is exposed during hot rolling. Samples have been made from an indefinite chill roll, quality CIN-N-80. Specimens were warmed up to four different temperatures, 400 °C, 500 °C, 600 °C and 700 °C and then rapidly cooled with water. Two series of experiments with 500 and 1000 cycle repetitions were carried out. Thermal fatigue cracks appear in all specimens after testing. With a higher thermal fatigue temperature and a greater number of cycles cracks becomes wider and deeper, but they appear in smaller number. Several computer simulations were designed using the finite element method (FEM), through which changing of stress conditions on the surface of the specimens at different temperatures and dimensions were observed. The results of simulations showed that for a given geometry and selected test conditions, the maximum tensile stresses on the cooled surface achieve the region of a tensile strength of steel under investigation.

TEMPERTURNO UTRUJANJE VALJEV

Borut Žužek¹, Milan Terčelj², Ladislav Kosec², Peter Fajfar²

¹Inštitut za kovinske materiale in tehnologije, Ljubljana, Slovenija

²Univerza v Ljubljani, Naravoslovnotehniška fakulteta, Slovenija

Površina valjev pri vročem valjanju je izpostavljena zelo hitremu izmeničnemu ogrevanju in ohlajanju zaradi kontakta z vročim valjancem ter hlajenja z vodnimi prhami. Test za temperaturno utrujanje valjev je bil izveden na termo-mehanskem simulatorju metalurških procesov Gleeble 1500. Preizkušanci so bili izrezani iz valja ulitega v podjetju Valji d. o. o.. Pogoji utrujanja s termošoki so bili podobni pogojem ki jim je izpostavljena površina valja med vročim valjanjem. Preizkušanci so bili izdelani iz valja z nedoločeno trdo plastjo oznake CIN-N-80. Preizkušance se je med utrujanjem ogrevalo na štiri različne temperature, 400 °C, 500 °C, 600 °C in 700 °C ter jih nato hitro ohlajalo z vodo. Opravljeni sta bili dve seriji preizkusov s 500 in 1000 ponovljenimi cikli. Na vseh preizkušancih so po utrujanju nastale razpoke, ki so z večjo temperaturo utrujanja in večjim številom ciklov postajale širše in daljše, vendar so se pojavile v manjšem številu. Izdelanih je bilo tudi več računalniških simulacij z uporabo metode končnih elementov (MKE), s katerimi se je opazovalo spreminjanje napetostnih stanj na površini preizkušancev pri različnih temperaturah in dimenzijah. Rezultati simulacij so pokazali, da pri danih geometrijskih izmerah in izbranih robnih pogojih testiranja, največje natezne napetosti na hlajeni površini dosežejo območje natezne trdnosti preiskovanega jekla.

NN-MR

HYDROTHERMAL SYNTHESIS OF DIFFERENT SHAPES OF NANOANATASE TiO₂

Barbara Horvat, Aleksander Rečnik, Goran Dražič
Institut Jožef Stefan, Jamova cesta 39, SI-1000 Ljubljana, Slovenija

Titania occurs in nature in three different modifications that is as anatase, brookite and most stable rutile. Anatase is the most photocatalytic among all titania modification. However, proper mixture of rutile and anatase, that is Degussa powder, shows even bigger photocatalytic effect than pure anatase. But anatase nanotubes are even more photocatalytic than Degussa powder. Their weakness is aggregation in a way that photocatalytic effect drops due to lowering fraction between surface and volume. Anyway, solution is building fractal-like structures which are already aggregated due to diffusion limited aggregation (DLA).

Our goal is to prepare different shapes of anatase titania with hydrothermal synthesis. However, the most desired shape is fractal-like. We always started from Ti(IV)isopropoxide and changed different parameters: temperature, time of heating, additives. We prepared spherical, tubular, elongated, plate-like, bipyramidal crystals and anatase twins.

Transformation from elongated into bipyramidal type crystals with prolonged time of heating was observed. Elongated crystals were growing in one preferential direction, on the other hand bipyramidal were growing in all directions with the same rate.

When determining the structure, chemical composition and morphology of particles, TEM, HRTEM, SAED, nanodiffraction were used.

HIDROTHERMALNA SINTEZA NANOANATAZA TiO₂ RAZLIČNIH OBLIK

Barbara Horvat, Aleksander Rečnik, Goran Dražič
Institut "Jožef Stefan", Jamova cesta 39, SI-1000 Ljubljana, Slovenija

Titanov dioksid najdemo v naravi v treh različnih modifikacijah, tj. kot anataz, brukit in, najbolj stabilen med njimi, rutil. Anataz je najbolj fotokatalitična modifikacija, vendar je mešanica rutila ter anataza, Degussa-prah, še bolj fotokatalitična, kot je čisti anataz. Kakor koli že, nanocevke anataza so še bolj fotokatalitične kot Degussa-prah. Njihova slabost pa je agregacija, s čimer se fotokatalitičnost zmanjša na račun razmerja površina – volumen. Rešitev vsekakor so fraktali, strukture, ki so nastale z agregacijo z omejeno difuzijo ("Diffusion limited aggregation" oz. DLA).

Naš cilj je bil s hidrotermalno sintezo pripraviti različne oblike anataza TiO₂, med drugim tudi fraktalne strukture. Vedno smo izhajali iz Ti(IV)izopropoksida. Spreminjali smo več parametrov, tj. temperaturo, čas segrevanja, ter dodajali različne dodatke. Naredili smo sferične, cevaste, podolgovate, ploščate, bipiramidalne kristale ter dvojčke anataza.

Opazili smo transformacijo podolgovatih kristalov v bipiramidalne s časom segrevanja. Podolgovati so rastli predvsem le v eni smeri, bipiramidalni pa v vseh enakomerno.

Pri določanju strukture, kemijske sestave ter morfologije delcev smo si pomagali s TEM, HRTEM, SAED, z nanodifrakcijo in EDXS.

KM-MR

A MICRO-MACRO APPROACH TO MODELLING MULTI-PHASE MATERIALS

Martin Lamut

Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia

Engineering materials are heterogeneous at a certain scale, therefore we can describe them as multi-phase materials. The heterogeneous nature, such as inclusions, pores, fibers and grain boundaries, has a significant impact on the observed macroscopic behaviour of multi-phase materials.

Processing and advanced forming operations force a material to undergo complex loading paths. This results in varying microstructural responses and easily provokes an evolution of the microstructure. Therefore, there is a clear need for modelling strategies that provide a better understanding of micro-macro structure-property relations in multi-phase materials. An effective way of transferring the microscale information to the macroscale analysis is to use a multilevel finite element approach-FE2. Within the FE2 framework one conducts an embedded micro-scale computation in order to extract quantities required at a point of macroscale finite element mesh. The application of FE2 circumvents the need to construct an explicit macroscale constitution formulation, though at an increased computational cost.

In this work a novel method for solving a coupled micro-macro mechanical problems with sensitivity analysis is presented. It enables an efficient approach to problems with complex microstructures, which are used in demanding structural components.

VT-VP

SURFACE MODIFICATION OF MATERIALS BY EXTREMELY NON-EQUILIBRIUM
OXYGEN PLASMA

MODIFIKACIJA POVRŠINE MATERIALOV Z EKSTREMNO NERAVNOVESNO
KISIKOVO PLAZMO

Miran Mozetič

Odsek za tehnologijo površin in optoelektroniko, Institut "Jožef Stefan", Jamova cesta 39, 1000 Ljubljana,
Slovenija

Several technological processes based on interaction of extremely non-equilibrium oxygen plasma are described. Plasma with a low kinetic temperature of heavy particles and extremely high density of neutral oxygen atoms is created in glass plasma reactors by inductively coupled RF discharges. The density of charged particles is kept low at around 10^{16} m^{-3} while the density of neutral oxygen atoms may exceed the value of $1 \cdot 10^{22} \text{ m}^{-3}$. Neutral oxygen atoms are chemically active and readily react with solid materials. Interaction of O atoms with metal samples often cause rapid nucleation of metal oxide isles and spontaneous growth of one- or two-dimensional structures such as nanowires and nanobelts. The nanofeatures are often monocrystalline. Exposure of different carbon-rich materials to oxygen plasma is applied for functionalization with oxygen functional groups as well as for controlled oxidation of various materials. Superhydrophilicity of several polymers and composites can be achieved. The technique is suitable for destruction of bacteria and thus sterilization of delicate materials as well as modification of vascular grafts to prevent platelets agglomeration and thrombosis. Furthermore, the interaction between oxygen atoms and polymer-matrix composites assures an extremely high selectivity of chemical etching and allows for development of techniques for determination of the distribution and orientation of fillings in the polymer matrix.

KM-VP

FERROMAGNETIC (SHAPE-MEMORY) MATERIALS WITH REDUCED DIMENSIONALITY

Kristina Žužek Rožman¹, Sašo Šturm¹, Paul J. McGuiness¹, Zoran Samardžija¹, Darja Pečko¹,
Spomenka Kobe¹, Costas Cefalas²

¹Jožef Stefan Institute, Ljubljana, Slovenia

²National Hellenic Research Foundation, Athens, Greece

Equiatomic, ordered L1₀ Co-Pt and Fe-Pd systems are very promising as magnetic storage media and for micro- and nano-electro-mechanical systems (MEMS and NEMS). MEMS and NEMS devices, for example, often require the integration of high-performance actuators. Ferromagnetic shape-memory alloys (e.g., Fe₇₀Pd₃₀) represent an interesting class of materials, since reversible strains of several percent can be achieved via an austenite-to-martensite phase transformation in moderate fields of below 1T.

Co-Pt-based thin films and tubular nanostructures were successfully synthesized using electrodeposition, which represents a low-cost alternative for preparing nano-engineered materials, and high coercivities of $\mu_0 H_c = 1.2$ T were achieved in thin films. One-dimensional Co-Pt-based nanostructures were prepared via template-assisted electrodeposition into high-aspect-ratio polycarbonate membranes. Tubular nanostructures were obtained directly, without any pore-wall functionalization, as was previously reported in the literature. The mechanism of direct tube formation was attributed to the appropriate relative rates of the deposition and the diffusion of the Co²⁺ and Pt²⁺ ions into partially Au-covered pores. The highest obtained coercivity was $\mu_0 H_c = 0.85$ T, which makes these materials interesting for advanced electronic and magnetic devices, as patterned magneto-recording media, or as potential drug-delivery agents. Furthermore, their large surface-to-volume ratio and Pt content would make them interesting for catalytically driven processes. Another ferromagnetic system, Fe-Pd, was successfully synthesized via the electrodeposition method and thin films with coercivities of up to $\mu_0 H_c = 0.1$ T, as well as one-dimensional tubular nanostructures, were obtained. The reaction regime and stoichiometry were found to be kinetically controlled. This is an extremely important factor, since the Fe₃₀Pd₅₀ composition gives high coercivities, while the Fe₇₀Pd₃₀ composition is a magnetic shape-memory alloy capable of producing strains of 6–10 % in moderate magnetic fields.

In addition to the electrochemical processing, the applications of other techniques, like pulsed-laser deposition (PLD) for the synthesis of nanostructured L1₀ alloys, will be presented as well.

KM-VP

THERMODYNAMIC MODELING FOR THE ALLOY DESIGN OF HIGH SPEED STEELS AND HIGH CHROMIUM CAST IRONS

M. Pellizzari

Department of Materials Engineering and Industrial Technologies, via Mesiano 77, 38050 Trento – ITALY

In recent years, Thermo-Calc was successfully used by the author for the development of as-cast High Speed Steels and High Chromium Irons. The correlation between solidification process and microstructure was studied in view of the influence of the alloying elements introduced to promote carbide precipitation. Two classes of HSS were selected based on variable MC/M₇C₃ and MC/M₂C ratios. The solidification process occurs under non-equilibrium conditions, because of microsegregation phenomena connected with the solidification structure: the liquid between dendrites becomes progressively enriched in solute, so that its composition significantly differs from that predicted by the equilibrium diagram. This behavior can be modeled with good approximation by using the equations proposed by Scheil and Gulliver. In this way it was possible to refine the analysis of phase constitution of High Speed Steels, even if kinetic-related phenomena still limited its correct prediction. Present results also show that microstructural tailoring is possible looking at the correlation existing between the fraction of liquid phase at eutectic MC carbides precipitation. The morphology of V-rich particles changes from a continuous *interdendritic* network to a *globular dissociated eutectic*, showing higher toughness. The composition of HCrI should result as near as possible to the eutectic one, to maximize eutectic carbide amount. Calculations allowed to define the parameter $T_L - T_{Ei}$ (T_L = liquidus temperature; T_{Ei} = eutectic start temperature) as representative of the material hypoeutecticity, and, on the basis of the experimental results, a value of 20 °C was safely established in the development of the new composition. Thermodynamic modeling was also used to optimize the heat treatment of HSS and HiCr irons.

KM-VP

PHYSICAL SIMULATION OF METALLURGICAL PROCESSES

S. T. Mandziej

Advanced Materials Analysis, Enschede, NL

Worldwide demand of better and more and efficient metallurgical processes, leading to low costs of their products, stimulates intensive research to reach these goals. In this respect, any full-scale industrial experiments appear non-acceptable. Cutting off the R&D costs and fast introducing of new technologies is possible when physical and numerical simulations are used. The computer simulation can be only correct when exact data of materials behaviour at processing conditions are known. To obtain the data, physical simulation is needed and it must be executed on multi-purpose thermal-mechanical testing devices accurately reproducing the real industrial processing conditions. For continuous casting or metal forming, individual phases of processes or multi-step operations must be followed, characterized by their time, temperature, and by applied forces, strains and strain rates. Actually the physical simulation, as compared with full-scale industrial testing, allows in a fraction of time for a fraction of cost an improvement of existing technology or development of a new one for modern materials and products. It can be used for solving production problems due to solidification phenomena or deformability limits, which result in hot cracking. In this paper next to examples of physically simulated processes are also highlighted recent developments of physical simulators.

KM-VP

SURFACE MODIFICATIONS OF MARAGING STEELS USED IN MANUFACTURING OF MOULDS AND DIES

Franjo Cajner¹, Darko Landek¹, Vojteh Leskovšek²

¹University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Ivana Lučića 1, Zagreb, Croatia

²Institute of Metals and Technology, Lepi pot 11, Ljubljana, Slovenia

Low carbon high alloyed, precipitation hardenable MARAGING steels have been developed in early sixties of last century as a high strength structural material dedicated to application in aeronautic and missile engineering. Due to excellent properties such as: high hardenability, good toughness, high resistance towards the thermal fatigue, simple heat treatment (“distortionless” and without protective atmosphere) and MARAGING steels are successfully used for the fabrication of various moulds and dies. Despite the listed advantages, the main drawback of these steels is their relatively low wear resistance, particularly if the die is subjected to extensive wear during its service. The paper presents an overview of existing MARAGING steels used in moulds manufacturing and gives their general properties. Also, the results of the applied modification and coating processes are presented with special focus on the increase in wear resistance.

KM-VP

DETERMINATION OF THE HARDNESS – IMPACT TOUGHNESS RELATIONSHIP FOR SHORT-CYCLE HEAT TREATED STEELS

R. Schneider

Upper Austria Univ. of Appl. Sciences – Camus Wels, Austria

Short-cycle heat treatments are typical manufacturing conditions in surface hardening processes such as induction hardening or laser hardening and in the heat affected zone during welding. These conditions are not only characterized by rapid changes of the temperature over the time, usually in the range of seconds, but also by significant local variations of the heat treatment cycles within millimetres. Therefore one can find a wide variety of material properties within quite a short distance.

As for practical applications, the main material properties of concern are strength or hardness on the one hand and toughness on the other. While hardness values and distributions within the material can be determined quite easily on a local scale, the determination of toughness properties under these conditions is quite difficult. As a further obstacle, the short austenitising and tempering durations (e.g. due to multi-layer welding) can lead to microstructures far from equilibrium conditions.

While there are standardized testing procedures for the determination of impact toughness properties in the heat affected zone of welded materials, no such standardized procedures exist for surface hardened material. For this application earlier attempts have been made by using surface hardened samples as a whole. Even so, these standardized testing methods lack a clear correlation between the measured impact toughness values and the local timetemperature- cycle and cover a varying area of property inhomogenities.

To overcome these obstacles, a new testing method, based on an adapted induction hardening device consisting of a quenching dilatometer and the use of micro-impact samples has been developed. Thereby a quite uniform temperature distribution within the critical cross section of the sample can be achieved and measured by thermocouples. Optimized heating and quenching regimes result in a typical scatter range of the results similar to different standard heat treatment cycles. The samples themselves not only provide an impact toughness value and related results from the micro hardness testing, but also possibilities for extensive investigations of the microstructure and fracture surface by means of light optical and electron optical methods as well as X-ray diffraction investigations. This paper gives an overview of the application of these treatment and investigation method as well as of the actual status of results for different quenching and tempering cycles.

KM-VP

COMPUTER SIMULATION OF MECHANICAL PROPERTIES OF QUENCHED AND TEMPERED STEEL

B. Smoljan, D. Iljkić, F. Traven

University of Rijeka, Faculty of Engineering, Department of Materials Science and Engineering,
Vukovarska 58, 51000 Rijeka, Croatia

The algorithm of estimation of yield strength and fracture toughness based on steel hardness, *HV* has been established based on relation between steel hardenability and tempering properties of steel. Hardness of quenched and tempered steel has been expressed as function of maximal hardness of actual steel, hardness of steel with 50 % of martensite in microstructure, according to the time and temperature of tempering. Hardenability properties of steel are predicted by using of Jominy-test results. Experimental investigation has been performed on low alloy steel, first of all on steel 42CrMo4, Ck45 and on 32NiCr54.

The established procedure for estimation of quenched and tempered properties of steel has been applied in computer simulation of mechanical properties of quenched and tempered steel workpiece of complex form.

Numerical modelling of hardness distribution in as-quenched steel specimen was performed by involving the results of simple experimental test, i.e., Jominy-test. After that distribution of other relevant mechanical properties was predicted based on predicted as-quenched hardness of steel.

By experimental work was found out that yield strength and fracture toughness of quenched and tempered steel workpieces can be successfully predicted by proposed method. The proposed computer simulation method could be applied in failure prevention.

KM-VP

METAL-CERAMIC INTERFACES IN DENTAL PRACTICE AND JEWELLERY MANUFACTURING

K. T. Raić¹, R. Rudolf², A. Todorović³, D. Stamenković³, I. Anžel²

¹Faculty of Technology and Metallurgy, Belgrade University, Karnegijeva 4, Belgrade, Serbia

²University of Maribor, Faculty of Mechanical Engineering, Maribor, Slovenia

³University of Belgrade, School of Dentistry, Clinic for Prosthodontics, Belgrade, Serbia

For almost two decades metal-ceramic fusing has been the essential step in obtaining materials that benefit from both ceramic and metal materials, i.e. where the combined properties of metal and ceramic layers are desirable. When considering fusing methods, soldering and active metal brazing are the most effective. These processes involve braze melting and flowing between the two pieces of material. This is commonly referred to as ‘wetting’ and is critical – particularly when brazing ceramics.

In the first part we will discuss the phenomena occurring on the boundary between the ceramics and the active metal filler during metal-ceramics joining. Three interconnected subprocesses will be considered, namely: (1) wetting of ceramic surface, (2) chemical reactions at the interface and (3) diffusion with a moving interface.

In the second part, examples from dental practice and jewellery manufacturing will be used for comparative analysis.

– *Porcelain Fused to Metal Restorations (PFM) – the bond between an alloy (Co-Cr-Mo, Au-Pt) and porcelain veneer.* Although dental alloys have different microalloying elements (Ir, In, Rh, Nb, etc.), which are necessary for the ability to bond ceramics to the metal’s surface, there are still problems in metal-ceramics bonding. There exists a potential for failure through the thick and brittle oxide layer with many alloy systems because the extent of oxide formation cannot readily be controlled.

– *Metal-Stone Joining.* One of the phases in jewellery manufacturing is placing precious stones into metal frames. The stones are initially cut into the desired sizes and shapes, and then polished. The metal frame cast is ground and polished and the stones are joined to it by adhesives, soldering, or by mechanical clamping. The attachment between stone and metal becomes weaker over time because of elastic deformation. If the stone is soldered to the metal frame, the joint between stone and metal is stronger.

Finally, we will discuss the composition of the soldering and brazing alloys used for dental practice and jewellery manufacturing.

MF-VP

STUDY OF MICROSTRUCTURE OF SELECTED AUSTENITIC STEELS FOR COLD ROLLING

Pešlová, F.², Hajdúchová, L.¹

Faculty of Mechanical Engineering, CTU in Prague, Karlovo náměstí 13, Praha 2, 121 35 Czech Republic

From practical experience it is known that individual parts or subassemblies made of austenitic Cr-Ni steels are subject to limit states of strain, failure or surface wear before the end of their life. This process is accelerated by incorrectly preset parameters of the applied technological process. The paper deals with the study of primary structures obtained by cold rolling with various thickness reduction rates which affect grain size and are responsible for related changes of the mechanical properties of austenitic sheets.

KM-GP

FRACTURE CHARACTERISTICS OF THE Cr-V LEDEBURITIC STEEL VANADIS 6

Peter Jurči¹, Borivoj Šuštaršič², Vojteh Leskovšek²

¹Czech Technical University in Prague, Faculty of Mechanical Engineering, Karlovo nám. 13,
121 35 Prague 2, Czech Republic

²Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia

The P/M Vanadis 6 cold work steel was selected for the investigation. The specimens for the three point bending tests and fracture toughness test were austenitized at different temperatures, quenched with or without the sub-zero period and subsequently double tempered. It was found that the bending strength decreased with increased austenitizing temperature and also with the use of sub-zero treatment. The average fracture toughness decreased with increased austenitizing temperature, too, but it increased with the sub-zero treatment. The lowering of bending strength can be considered as natural because of the austenitic grain growth, as well as increased portion of martensite in the case of sub-zero processed samples. In the case of fracture toughness, the situation seems to be more complex. On the one side, the relationship fracture toughness vs. austenitizing temperature behaves in an expected way – the K_{IC} decreases as the austenitizing temperature increases. On the other side, the sub-zero treatment induces rather slight increase of the fracture toughness. The paper presents some details on experiments including possible explanation of the material behaviour and microstructure vs. mechanical properties relationship.

LOMNOMEHANSKE ZNAČILNOSTI Cr-V LEDEBURITNEGA JEKLA VANADIS 6

Peter Jurči¹, Borivoj Šuštaršič², Vojteh Leskovšek²

¹Czech Technical University in Prague, Faculty of Mechanical Engineering, Karlovo nám. 13, 121 35 Praga,
Češka Republika

²Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia

Za preiskave smo izbrali komercialno orodno jeklo za delo v hladnem Vanadis 6, izdelano po postopkih metalurgije prahov (P/M). Preizkušance za določevanje tritočkovne upogibne trdnosti in lomne žilavosti smo toplotno obdelali pri različnih pogojih. Pri tem smo del preizkušancev tudi podhlajevali v tekočem dušiku. Analizirali smo vpliv temperature avstenitizacije in podhlajevanja. Upogibna trdnost se je znižala pri uporabi višje temperature avstenitizacije in tudi podhlajevanja. Medtem ko je povprečna lomna žilavost narasla z uporabo podhlajevanja, je padla s povišanjem temperature avstenitizacije. Zmanjšanje upogibne trdnosti s povišanjem temperature avstenitizacije je naravno zaradi rasti avstenitnih zrn in povečanja deleža martenzita zaradi podhlajevanja. V primeru lomne žilavosti je situacija bolj zapletena. Po eni strani je povezava med lomno žilavostjo K_{IC} in temperaturo avstenitizacije pričakovana (K_{IC} pade z naraščajočo temperaturo avstenitizacije), po drugi pa podhlajevanje nepričakovano rahlo poveča K_{IC} . V prispevku bomo predstavili eksperimentalne rezultate in možne razloge za takšno vedenje materiala v povezavi z njegovo mikrostrukturo.

KM-GP

FABRICATION AND CHARACTERIZATION OF Al-Fe, Ti-Al, Mg-Si AND Mg-Sn INTERMETALLIC MATRIX COMPOSITES REINFORCED WITH CERAMIC PARTICLES

Varužan Kevorkijan¹, Srečo Davor Škapin²

¹Independent Researching plc, Betnavska cesta 6, Maribor, Slovenia

²Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia

Iron aluminides (AlFe, Al₃Fe, AlFe₃), titanium aluminides (TiAl, Ti₃Al, TiAl₃) and intermetallic compounds of magnesium (Mg₂Si and Mg₂Sn) reinforced with ceramic particles represent an advanced class of engineering materials with an excellent potential for numerous applications. However, bringing intermetallic matrix composites reinforced with ceramic particles (IMCs) into commercial usage largely depends upon the availability of practical and sufficiently competitive processing routes that can offer near-net shaping with very little post-fabrication machining required. Essentially, it is of great importance to develop such a universal method of single-step densification and shaping of various IMCs.

As a result, the aim of this study was: (i) to approve (by defining the optimum processing parameters and necessary sintering additives) reactive, pressureless sintering as a cost-effective single-step method of obtaining fully dense IMCs and (ii) to demonstrate the potential of this method in achieving a uniform microstructure and superior mechanical properties of the obtained composite samples.

In the first part of this work AlFe, Al₃Fe, AlFe₃, TiAl, Ti₃Al, TiAl₃, Mg₂Si and Mg₂Sn intermetallic single- and/or multi-phased compounds were synthesized from elements and applied for the preparation of the appropriate intermetallic matrix composites discontinuously reinforced with TiC and TiB₂ ceramic reinforcement. Composites were prepared by the reactive, pressureless sintering of cold-compacted powder blends of the selected intermetallic compound and ceramic reinforcement with or without the addition of sintering additives. The sintering was performed in an Ar+4% H₂-rich environment using a vacuum furnace. The as-synthesized composite samples were cut, machined and polished in accordance with standard procedures. The microstructural characterization was performed by scanning electron microscopy (SEM) with EDS), whereas X-ray diffraction (XRD) measurements were applied to the samples to identify the phases and their crystal structures. The room-temperature tensile properties and the Vickers hardness of various IMCs were also determined and correlated with composite structure and composition.

SINTEZA IN KARAKTERIZACIJA KOMPOZITOV NA OSNOVI INTERMETALNIH SPOJIN Fe-Al, Ti-Al, Mg-Si in Mg-Sn OJAČENIH S KERAMIČNIMI DELCI

Varužan Kevorkijan¹, Srečo Davor Škapin²

¹Zasebni raziskovalec, Betnavska cesta 6, Maribor, Slovenija

²Institut Jožef Stefan, Jamova 39, 1000 Ljubljana, Slovenija

Železovi aluminidi (AlFe, Al₃Fe, AlFe₃), titanovi aluminidi (TiAl, Ti₃Al, TiAl₃) in določene intermetalne spojine magnezija (Mg₂Si in Mg₂Sn) ojačani s keramičnimi delci sodijo v skupino sodobnih inženirskih materialov primernih za najrazličnejše aplikacije. Komercialna uporabnost teh kompozitnih materialov, kjer tvorijo intermetalne spojine matrično faz ojačeno s keramičnimi delci, je odvisna predvsem od razpoložljivosti praktične in zadosti konkurenčne metode njihovega pridobivanja, ki ponuja možnost izdelave končnih izdelkov zelene geometrije ob njihovi minimalni strojni obdelavi. Zato je pri teh materialih zelo pomemben razvoj ustrezne metode, ki omogoča izdelavo produktov v eni fazi, to je sintranje že oblikovanega izdelka.

Namen naše raziskave je bil: (i) določiti pogoje sintranja pri katerih dobimo gosto sintrane kompozitne vzorce in (ii) dobljeni vzorci naj izkazujejo homogeno mikrostrukturo in dobre mehanske lastnosti.

V prvem delu raziskav smo sintetizirali intermetalne spojine Al₃Fe, AlFe₃, TiAl, Ti₃Al, TiAl₃, Mg₂Si in Mg₂Sn iz elementov in jih v nadaljnjem delu uporabili za pripravo kompozitov. Tem spojinam smo dodajali ojačitveno keramično fazo TiC in TiB₂ v obliki finega prahu. Kompozite smo pripravljali z reaktivnim sintranjem hladno stiskanih oblikovancev pri normalnem pritisku, brez oziroma z dodatkom sinter aditivov. Sintrali smo v vakuumski peči v zaščitni atmosferi Ar+4% H₂. Pripravljene vzorce smo razrezali in del le-teh uporabili za pripravo obrusa za mikrostrukturno analizo, ki smo je izvajali s pomočjo vrstičnega elektronskega mikroskopa (SEM-EDS). Del vzorcev smo zdrobili in opravili rentgensko praškovno analizo ter identificirali prisotne faze. Trgalni preiskus in merjenje trdote po Vickersu smo izvajali pri sobni temperaturi. Dobljene rezultate smo nato skušali razložiti na osnovi strukturnih in mikrostrukturnih značilnosti testnih vzorcev kompozitov.

VO-GP

DYNAMICAL CHARACTERIZATION OF THE TRANSFORMER'S CORE MODEL

Robert Cvelbar¹, Borut Bundara¹, Borut Prašnikar², Miha Nastran², Metod Bonča¹, Marjan Suban¹

¹ Inštitut za metalne konstrukcije, Mencingerjeva 7, 1000 Ljubljana

² ETRA 33, Šlandrova 10, 1000 Ljubljana

Power transformer is an electrical device transforming electrical energy between different voltage levels. It is one of the most important parts of electrical power facilities. The crucial characteristics that define quality of the transformer are reliability in operation and efficiency.

Increased environmental awareness in the society resulted in demands for lowering of all kinds of emissions including noise. This demand generates the needs for development and production of transformers with lower noise emissions.

Noise emission of the transformer is mainly result of vibrations of the magnetic core due to magnetostriction, and vibrations of coils due to electromagnetic forces. Vibrations of the magnetic core also depends on its fixation (position, tightness and materials used).

Magnetostriction is a property of the core's material and can be significantly affected by mechanical stress, magnetic flux density and temperature.

In the paper are presented the results of the study that is primarily focused on determination of influence of the mechanical loading on magnetostriction characteristics of the core. For the purpose of study we selected the transformer steel that is commonly used in the production.

KM-GP

PRECIPITATION IN NON-ORIENTED ELECTRICAL STEEL CONTAINING IMPURITY ELEMENTS

D. Steiner Petrovič¹, F. Tehovnik¹, A. Jaklič², J. Medved³

¹Institute of Metals and Technology, 1000 Ljubljana, Slovenia

²ACRONI, d. o. o., 4270 Jesenice, Slovenia

³University of Ljubljana, Faculty of Natural Sciences and Engineering,
Aškerčeva 12, 1000 Ljubljana, Slovenia

Although they are in very small concentrations, the impurity elements in silicon steels can alter the magnetic properties of non-oriented electrical steel sheets. The presence of nano-scale precipitates can influence the movement of magnetic domains which results in increased core loss. The influencing mechanisms of nanoparticles present in the nanostructures of NO electrical steel sheets on the magnetic properties are far from being fully explored and explained.

Precipitation reactions in alloys are thermally activated atomic movements and are induced by the change of temperature of an alloy that has a fixed bulk composition. From a metastable supersaturated solid solution stable or metastable precipitates are formed resulting in a more stable solid solution with a composition closer to the equilibrium.

In this study the precipitation in non-oriented electrical steel made of the mass fractions Fe-2 % Si – 1 % Al containing impurity elements was followed using thermal analysis. A differential scanning calorimetry (DSC) was performed on the hot-rolled samples of electrical steels of the thickness of 2.3 mm. We used the STA 449c Jupiter Netzsch device and protective atmosphere of purified Ar inert gas in order to monitor the precipitation processes during the cooling of the electrical steel. The samples were heated and cooled with a rate 10 K/min all the way to the RT.

It is assumed that optimization of magnetic properties of non-oriented electrical steel can only be obtained by controlling its nanostructure through lowering the content of impurity elements and proper cooling regimes after heat treatment(s).

KM-GP

FORMING FORCE DURING HOT ROLLING OF STAINLESS STEELS

Tehovnik Franc¹, Arzenšek Boris¹, Vode Franci¹, Žužek Borut¹, Pirnar Boštjan², Jaklič Anton², Jakelj Stane²

¹Institute of Metals and Technology, 1000 Ljubljana, Slovenia

²ACRONI, d. o. o., 4270 Jesenice, Slovenia

The effect of restoration and of certain elements, nitrogen, chromium, molybdenum and nickel, on the hot ductility of austenitic, high-alloyed austenitic, duplex stainless steels and nickel alloys have been investigated by means of hot rolling tests. The results of these tests indicated that hot rolling experiments using flat specimens is the most effective way to investigate the relationship between the softening and forming force under hot rolling conditions.

VO-GP

NEW ENVIRONMENTALLY SUSTAINABLE TECHNOLOGICAL PROCESSES FOR PRODUCING BIOGAS FROM ORGANICALLY POLLUTED WASTEWATER AND WASTE

Darko Drev, Goran Đorđić, Jože Panjan, Boris Kompare
IzVRS, EKO GEA d.o.o., FGG Ljubljana

At the present, there exist several commercially viable technologies for producing biogas from organically polluted wastewater and waste. The process of burning the resulting biogas produces energy, but also results in CO₂ emissions and significant quantities of moderately polluted wastewater. However, with technological processes introduced in this paper we propose to solve both side-effects of biogas production and use by employing the resulting wastewater to serve as nutrient for algae formation. This process results in wastewater depollution. In addition, the resulting algae formations can be transformed into useful products directly, or placed into a fermentation reactor. CO₂ emitted as a side product of the biogas burning process will be retained and adsorbed in water, which will then be introduced into the fermentation reactor. In the reactor, algae will capture CO₂ from the water, which will accelerate their growth and formation. In addition, in order to assist CO₂ capture, a source of light will be introduced into the fermentation reactor. Aside from capturing CO₂ emissions and depolluting the wastewater, introducing algae formations into the fermentation reactor also results in increased biogas carbon (CH₄) content. However, even without introducing algae formations into the reactor, the algae can be directly transformed into useful products such as biodiesel or bioethanol. In sum, the technological processes introduced in this paper allow us to use hazardous wastewater and waste to sustainably produce heat and electric energy without emitting greenhouse gases, while also producing a variety of useful energy products (such as biodiesel) as side products. The resulting efficiency coupled with environmental sustainability make this set of technological processes superior to existing technologies.

NOVI OKOLJU PRIJAZEN TEHNOLOŠKI POSTOPEK ZA PROIZVODNJO BIOPLINA IZ ORGANSKO OBREMENJENIH ODPADNIH VODA IN ODPADKOV

Darko Drev, Goran Đorđić, Jože Panjan, Boris Kompare
IzVRS, EKO GEA d.o.o., FGG Ljubljana

Na tržišču je več različnih postopkov predelave organskih nečistoč iz močno organsko onesnaženih odpadnih voda in odpadkov v bioplin ter energijske izrabe nastalega bioplina. Pri sežigu bioplina nastanejo emisije CO₂ v ozračje ter znatne količine precej onesnaženih odpadnih voda. V našem tehnološkem postopku se bo porabljala delno očiščena odpadna voda kot hranilo za rast alg. S tem se bo odpadna voda tudi čistila. Alge se bodo v nadaljevanju predelale v koristne produkte, ali pa vodile v fermentacijski reaktor. CO₂, ki bo nastal pri sežigu CH₄ se bo adsorbiral v vodi, ki se bo nato dovajala v reaktor z algami. Alge bodo vezale v vodi raztopljeni CO₂ in se še intenzivneje razvijale. Za to bodo potrebovale naravno ali umetno svetlobo, ter hraniva iz delno očiščene odpadne vode. Če bomo vodili višek alg v fermentacijski reaktor, bomo povečevali vsebnost ogljika in s tem delež nastalega CH₄ v bioplinu. Alge bomo lahko predelali tudi v proizvode na bazi alg, biodizel ali bioetanol. Takšen tehnološki postopek predelave problematičnih organskih odpadkov bo omogočil: pridobivanje električne in toplotne energije brez nastanka toplogrednih plinov ter proizvodnjo koristnih izdelkov (alge, biodizel, bioetanol, itd.). To je glavna prednost pred obstoječimi postopki proizvodnje bioplina, pri katerih nastajajo precejšnje emisije toplogrednih plinov ter tudi znatne količine onesnažene odpadne vode.

VT-GP

THE IMPROVED PSEUDO GRADIENT ALGORITHM FOR THE RESIDUAL GAS ANALYSIS

Igor Belič

Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia

The work focuses on the qualitative and quantitative residual gas analysis of the vacuum chamber atmosphere. The mass spectra are formalized by the vector annotation. The main problem of the residual gas analysis is its ambiguity (non-orthogonality of the standard fragmentation patterns of the mass spectra) which makes it impossible to achieve the uniform analysis.

The important concept is the virtual environment which contains the mass spectrum generator, the standard fragmentation patterns database, the data space and the database of the various algorithms analysis results, which is necessary for the evaluation of different algorithms performance.

The pseudo-gradient algorithm has been developed, tested, and the results have already been published. It was demonstrated that such algorithm in some cases produces substantial error, and often the convergence rate yields to a very large number of iterations needed to provide the reasonable result.

The basic pseudo-gradient algorithm was improved. The new version of the algorithm provides more accurate analysis of the mass spectra together with the significantly improved convergence rate.

As improved as it is, the algorithm still can not provide the uniform analysis of the mass spectra.

IZBOLJŠANA PSEVDOKRADIJENTNA METODA ZA ANALIZO MASNIH SPEKTROV

V prispevku je opisan način kvalitativne in kvantitativne analize rezidualnih plinov atmosfere v vakuumskem sistemu. Prikazan način pojmuje masne spektre, zapisane v formalni vektorski obliki. Osnovni problem pri analizi masnih spektrov je večličnost (neortogonalnost osnovnih komponent, ki sestavljajo spektre), zaradi katere ni možno enolično določiti sestavo masnega spektra.

Pomemben koncept je virtualno okolje, ki vsebuje generator masnih spektrov, podatkovno bazo standardnih masnih spektrov, podatkovni prostor za hranjenje rezultatov preizkušanj algoritmov, ki omogoča kasnejšo primerjavo delovanja posameznih algoritmov.

Razvita, analizirana in objavljena je bila psevdokradijenta metoda za rezidualno analizo plinov iz masnega spektra. Analiza je pokazala dve slabosti, in sicer: v določenih primerih algoritem naredi precejšnjo napako, pogosto konvergentnost algoritma zahteva veliko število iteracij.

Osnovni psevdokradijenti algoritem je bil dopolnjen. Analiza izboljšane verzije algoritma kaže večjo natančnost analize pri znatno poboljšani konvergenci. Še vedno pa algoritem ne more ponuditi idealno enoličnih rezultatov.

KM-GP

THE INFLUENCE OF ISOTHERMAL ANNEALING ON THE MECHANICAL PROPERTIES OF DUPLEX STAINLESS STEEL 258 TYPE

B. Šuštaršič¹, J. V. Tuma¹, M. Godec¹, A. Kocijan¹, B. Marini², C. Toffolon Masclet², P. Forget²

¹Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia

²DMN/SRMA and DEN-DANS, CEA, Saclay, France

The behavior of cast duplex stainless steel type 258 has been analysed in the frame of IMT and CEA bilateral collaboration. This material is frequently used for the structural parts of nuclear power plants. The steel samples have been aged (isothermally annealed) 10 000 h and 30 000 h at 300 °C and 350 °C. Tensile test specimens have been made from the aged samples and standard tensile test at room temperature was performed. The SEM fractography of fractured surfaces was also performed. Microhardness measurements of ferrite and austenite phase were determined on polished metallographic samples. Simultaneously, ICP-AES bulk chemical analysis of samples, microstructure investigations with LM and SEM, as well as micro chemical analysis with SEM/EDS has been performed. Preliminary phase analysis was also made by SEM/EBSD. The results of mechanical testing and fractographic examinations will be reported and discussed in the present contribution. Microhardness of ferrite is drastically increased with time and temperature of ageing due to spinodal decomposition. But, hardness of austenite remains practically unchanged. Tensile properties changed, similarly. Yield point and tensile strength increased but ductility significantly decreased. In accordance with ductility decrease the nature of fractured surface changed from typical ductile (dimpled) to brittle (cleavage).

VPLIV IZOTERMNEGA ŽARJENJA NA MEHANSKE LASTNOSTI DUPEKSNEGA NERJAVNEGA JEKLA VRSTE 258

B. Šuštaršič¹, J. V. Tuma¹, M. Godec¹, A. Kocijan¹, B. Marini², C. Toffolon Masclet², P. Forget²

¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 10000 Ljubljana, Slovenija

²DMN/SRMA and DEN-DANS, CEA, Saclay, France

V okviru bilateralnega sodelovanja med IMT in CEA smo analizirali vzorce litih dupleksnih feritnih jekel tipa 258, ki se uporabljajo za dele toplotnih izmenjevalnikov v nuklearnih elektrarnah. Preizkušanci so bili starani (izotermno žarjeni) 10 000 h in 30 000 h pri temperaturah 300 °C in 350 °C. Izdelani so bili standardni natezni preizkušanci in izveden je bil standardni natezni preizkus ter fraktografija prelomov na SEM. Z merjenjem mikrotrdote smo določili spremembo mikrotrdote ferita in avstenita zaradi staranja. Izvedena je bila tudi kemijska analiza na ICP-AES, mikrostrukturna analiza na optičnem in SEM ter mikrokemijska analiza s SEM/EDS. Fazna analiza je bila izvedena z SEM/EBSD. V prispevku poročamo predvsem o rezultatih mehanskih in fraktografskih preiskav. Zaradi spinodalne premene se je drastično povečala mikrotrdota ferita, medtem ko je trdota avstenita ostala praktično nespremenjena. Podobno je bilo tudi z mehanskimi lastnostmi: meja tečenja in natezna trdnost sta narasli, medtem ko je duktilnost močno padla. Skladno s poslabšanjem duktilnosti materiala se je spremenila tudi narava preloma iz tipično jamičastega duktilnega v krhkega cepilnega.

KM-GP

CORROSION STABILITY OF BRONZE PATINAS AND ITS VERSATILE PROTECTION

Tadeja Kosec¹, Erika Švara¹, Helena Otmačič Čurkovič², Ema Stupnišek-Lisac², Andraž Legat¹

¹Slovenian National Building and Civil Engineering Institute, Dimičeva 12, SI-1000 Ljubljana, Slovenia

²Faculty for Chemical Engineering and Technology, University of Zagreb, Savska 16, 10000 Zagreb, Croatia

Copper alloy-bronze tends to form an oxide layer in humid air. The patina layer protects bronze from further corrosion process. Patina can be formed as natural process or it can be formed artificially. The artists use special patination procedures for visual effects. In many cases there is a need to postpone the corrosion process. In this case the surface is brushed, sprayed or wiped with natural, synthetic or microcrystalline waxes that are sometimes doped with organic inhibitors.

The aim of the present study is to test the stability of electrochemical and chemically formed patina, together with many possible ways of protection. Different green-to-blue colour patinas were chosen to be tested. Electrochemically formed patina was obtained by potentiostatic polarization during 55h. Green chemically formed patinas were applied with a hot dip technique. Final finishes that were tested were: benzotriazole and healthy less hazardous imidazole type inhibitor, waxes and laquers with added inhibitors. Some organic mixtures, such as Polaroid B44, common finish for bronze sculptures are tested. The mechanism of prevention is compared. The mechanism of aging of bronze is determined in a test solution of acid rain (0.2 g/L Na₂SO₄, 0.2 g NaNO₃ and 0.2 g/L NaHCO₃ acidified to pH5).

A classic electrochemical approach is used to study corrosion behaviour of bronze with a similar compositions as statues nowadays. The untreated and pre-treated surfaces are investigated with different electrochemical techniques: corrosion potential, linear polarization, potentiodynamic measurements and electrochemical impedance spectroscopy. The structures of the patina and corrosion products after electrochemical tests are characterized by scanning electron microscopy (SEM).

The use of different ways of protecting unprotected and pre-patinated surfaces is compared in order to efficiently protect bronze surfaces for outdoor applications.

KOROZIJSKA STABILNOST PATIN IN RAZLIČNIH ZAŠČIT NA BRONU

Bakrove zlitine, kot je bron, na vlažnem zraku spontano tvorijo plast oksida. Plast oksida-patine ščiti bron pred nadaljnji korozijskimi procesi. Patina lahko nastane kot naravni proces ali pa jo tvorimo umetno. Danes številni umetniki nanašajo umetno patino za doseganje vizualnih učinkov na skulpturah. V mnogih primerih potrebujemo zakasni korozijski proces. V ta namen lahko površino zaščitimo s plastjo naravnega, sintetičnega ali mikrokristaliničnega voska, v katerega dodajamo različne organske inhibitorje.

Cilj študije je bilo testiranje obstojnosti elektrokemijsko in kemijsko tvorjenih patin kot tudi njihovih različnih zaščit. Za test so bile izbrane različne modrozelenene patine. Elektrokemijsko patino smo nanegli z anodno polarizacijo, medtem ko smo različni kemijski patini pridobili s tehniko vročega potapljanja. V končnih zaščitnih premazih smo testirali dva različna inhibitorja, benzotriazol ter manj okolju nevaren inhibitor imidazolnega tipa- p-tolil-metil imidazol v različnih topilih: etanol, etilacetat. Testirali smo tudi Carnauba vosek. Mehanizmi zaščit so med seboj primerjani. Staranje bron, patin ter zaščit smo spremljali v testni raztopini simuliranega kislega dežja (0,2 g/L Na₂SO₄, 0,2 g NaNO₃ in 0,2 g/L NaHCO₃ nakisano na pH 5).

Korozijske lastnosti bron, ki ga danes uporabljajo za vlihanje velikih skulptur, smo testirali z različnimi elektrokemijskimi tehnikami na nezaščitenih in zaščitenih površinah: korozijski potencial, linearna polarizacija, potenciodinamske meritve ter elektrokemijska impedančna spektroskopija. Strukturo patine in korozijih produktov smo pregledovali z SEM/EDS tehniko.

Primerjali smo različne načine zaščit ter nezaščite površine za ugotavljanje možnosti uporabe na bronastih površinah, ki jih izpostavljamo atmosferi na prostem.

KM-1

POSSIBILITIES OF CONTROL OF SULPHUR CONTENT IN STEEL IN A LADLE FURNACE

Adolf, Z., Horáková, D.
VŠB-Technical University of Ostrava, Czech Republic

Content of sulphur in steel in a ladle or in ladle furnace depends from thermo-dynamical viewpoint on the following factors:

Activity of oxygen in steel; this is mostly determined by aluminium content in steel – i.e. by the element with the highest affinity to oxygen.

Chemical composition of slag, particularly content of CaO, SiO₂, but also Al₂O₃ and MgO.

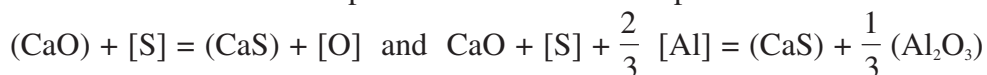
Initial content of sulphur in steel as tapped from BOF.

Steel temperature.

Control of sulphur content can be successfully realised by development of oxygen activity in steel and by control of basicity and also fluidity of slag, i.e. by control of chemical composition and temperature of the system steel – slag.

Due to the fact that desulphurisation of steel in a ladle is performed by slag, both steel and slag must be continuously intensively stirred in order to renew interfacial boundary, so that the system approaches the equilibrium as quickly as possible.

The work demonstrates derived model of calculation for prediction of sulphur content in steel. Relations for calculation of sulphur content in steel comprise the values of reaction equilibrium constants



oxygen activity and aluminium content, as well as data about sulphide capacity of slag, mass of slag and sulphur content in steel before desulphurisation. The model was successfully verified on concrete real heats at desulphurisation of steel in a ladle furnace.

The work was solved within the frame of the projects EUREKA 3580! and IMPULS FI-IM4/110.

KM-2

DEFORMATION ABILITIES OF LEAN DUPLEX STAINLESS STEEL

Boris Arzenšek¹, Franc Tehovnik¹, Franci Vode¹, Jurij Gontarev¹, Iztok Naglič¹, Borut Žužek¹, Mitja Kmetič¹,
Boštjan Pirnar², Anton Jaklič², Stane Jakelj², Gorazd Kosec², Jure Bernetič²

¹Institute of Metals and Technology Ljubljana, Slovenia

²ACRONI, d. o. o., Jesenice, Slovenia

The aim of the work was to establish deformation abilities of Lean duplex stainless steel to get an information for its deformability at industrial rolling conditions at Acroni Jesenice and to make the comparison with another stainless steels. The deformability of the steel was established by hot tensile tests, rolling tests of flat and wedged specimens and metallografycal investigations of a rolled steel. The rolling temperatures were in the rolling range of steels in Acroni Jesenice, between 950 °C to 1250 °C. In the work the part of ferrite and austenite was also stated in dependence of temperature and deformation degree. The deformation degree at flat specimens was $3 \times 18 \%$ ($\varepsilon_s = 44 \%$) and at wedged specimens up to $\varepsilon_s = 65 \%$.

From the results it was established that the steel has the best deformation abilities in temperature range of 1100 °C and 1250 °C and in the range 1100 °C to 1000 °C a little less. The ferrite contain increases by rising of rolling temperature from 38 % to 58 % and hardness of the rolling steel decreases from *HV* 290 to *HV* 250. The impact toughness of rolled steel is between 50 J and 100 J and after annealing 300 J to 350 J. Annealed steel contain 50 % to 55 % of ferrite and the rest is austenite.

UGOTAVLJANJE PREOBLIKOVALNIH SPOSOBNOSTI DUPLEKSNEGA
NERJAVNEGA JEKLA VRSTE LEAN

Boris Arzenšek¹, Franc Tehovnik¹, Franci Vode¹, Jurij Gontarev¹, Iztok Naglič¹, Borut Žužek¹, Mitja Kmetič¹,
Boštjan Pirnar², Anton Jaklič², Stane Jakelj², Gorazd Kosec², Jure Bernetič²

¹Inštitut za kovinske materiale in tehnologije Ljubljana, Slovenija

²ACRONI, d. o. o., Jesenice, Slovenija

Cilj raziskave je bil ugotoviti preoblikovalne sposobnosti dupleksnega nerjavnega jekla vrste Lean, iz katerih lahko sklepamo na njegovo preoblikovalnost pri industrijskem valjanju jekla v Acroniju, Jesenice, ter narediti primerjavo preoblikovalnosti z drugimi nerjavnimi jekli. Preoblikovalnost jekla smo ugotavljali z vročimi nateznimi preskusi, s preskusi valjanja ploščatega jekla in klinastih preskušancev ter z metalografskimi preiskavami. Temperature valjanja so bile v območju valjanja jekel v Acroniju med 950 °C in 1250 °C, v presledkih po 50 °C. V raziskavi smo ugotavljali tudi spreminjanje deleža ferit/avstenit v odvisnosti od temperature valjanja in stopnje deformacije. Stopnje deformacije pri ploščatem valjanju jekla so bile $3 \times 18 \%$ (s skupno deformacijo $\varepsilon_s = 44 \%$), pri klinastih preskušancih pa do $\varepsilon_s = 65 \%$.

Iz rezultatov preiskav smo ugotovili, da ima jeklo najboljše preoblikovalne sposobnosti v temperaturnem območju med 1100 °C in 1250 °C, v območju od 1100 °C do 1000 °C pa nekoliko slabše. Njegova preoblikovalnost je nekoliko slabša kot pri dupleksnem jeklu SAF2205. Med valjanjem delež ferita v jeklu z naraščajočo temperaturo valjanja in velikostjo deformacije narašča od 38 % do 58 %, trdota pa pada od *HV* 290 do *HV* 250. Žilavost valjanega jekla je med 50 J in 100 J, po topilnem žarjenju pa med 300 J in 350 J. Po topilnem žarjenju je v jeklu od 50 % do 55 % ferita, drugo pa je avstenit.

KM-3

THE CHANGES OF CHEMICAL COMPOSITION OF THE CAPILLARIES OF THE OXIDE CERAMIC FILTERS DURING STEEL FILTRATION

Jiří Bažan¹, Karel Stránský², Dana Horáková¹

¹VŠB-TU Ostrava, 17. listopadu 15,708 33 Ostrava, Czech Republic

²Brno University of Technology, Technická 2, 616 69 Brno, Czech Republic

The present paper deals about chemical and physical reactions between the filtrated liquid steel and the surfaces of the basic oxides of the used ceramic filters. This effect was studied on the series of eight ceramic filters with direct capillaries (small channels) and different oxides basis. The filtrated unalloyed steels was melted in the acid induction furnaces and was deoxidized by means both aluminum and manganese. The special experimental ceramic series of the filters – Cr_2O_3 , TiO_2 , SiO_2 , ZrO_2 , Al_2O_3 , $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$, $\text{MgO} \cdot \text{Al}_2\text{O}_3$ and filter RK5 (mullite ceramic for steel filtration) were produced in the factory KERAMTECH. By means of experiments were established the following new findings – on the surfaces of the capillaries of each from the series experimental ceramic filters generated a new ceramic coating; – comparing with the basic ceramic filters it was founded that these coatings contained the smaller proportion of the oxides of basic ceramics and the higher proportion of manganese and iron oxides; – the decreasing of the oxide of this basic ceramic is inversely proportional to the thermo–dynamical stability (free Gibbs energy) of the corresponding basic oxide; – this effect is also a function of melting point and porosity of the used ceramic filter. The work was solved within the frame of the grant projects of reg. No. EUREKA E!4092 MICROST and MPO CR reg. No. FR-TI1/222.

KM-4

DETERMINATION OF WELDING PARAMETERS FOR 890 MPa HIGH STRENGTH STEEL

¹Roman Celin, ¹Jelena Vojvodič Tuma, ²Jure Bernetič, ¹Boris Arzenšek
¹Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia
²Acroni, d. o. o., Cesta Borisa Kidriča 44, 4270 Jesenice, Slovenia

Developments in steel making technologies in terms of metallurgical advances, rolling and heat treatment have resulted in high strength steels which offer higher performance in tensile strength, toughness, weldability compared to the traditionally used steel grades. The high strength steels and new design rules for weight saving in construction demands more reliable welds in term of strength, fatigue resistance and resistance against brittle fracture. The welded joints have inhomogeneous structure. The microstructure varies in different regions of welded joints in the weld metal and heat affected zone. One of the influential parameter on weld microstructure is the temperature – time cycle during welding. The temperature-time cycles during welding have influence on the properties of a welded joint. Generally the cooling time $t_{8/5}$ between 800 °C and 500 °C is used to describe the single weld pass temperature-time cycle during welding. Reduction of the impact energy of the weld heat affected zone is usually caused by increased values of $t_{8/5}$. The relationship between welding parameters and $t_{8/5}$ can be described by welding heat conductivity equations for two and three-dimensional heat flow. In this presentation, the use of $t_{8/5}$ criterion for calculation of welding parameters using equations of welding heat conductivity will be presented.

KM-5

ORIENTATION RELATIONSHIP OF δ -FERRITE AND AUSTENITE PHASE IN Cr-Ni-Mo BASED STAINLESS-STEEL ANALYZED BY EBSD TECHNIQUEM. Godec¹, B. Šuštaršič¹, M. Jenko¹, B. Marini²¹Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia²Commissariat à l'Energie Atomique, DMN/SRMA, 91191 Gif-sur-Yvette, Saclely, France

High-alloyed Cr-Ni-based stainless-steel cast alloys are frequently used in thermoelectric installations such as conventional and nuclear power plants. Many years of exploitation of mechanical equipment in these objects have shown that the toughness of these alloys decreases with the operating time and temperature. These alloys have a characteristic duplex structure consisting of austenite and δ -ferrite. The aim of our investigation was to determine the microstructure, to estimate the amount of austenite and δ -ferrite and last but not least to determine the orientation relationship between delta ferrite and austenite phase. There are four well known orientation relationship between BCC ferrite and FCC austenite phases: Bain, Kurdjumov-Sachs, Nishiiama-Wassermann and Pitsch. Using EBSD analytical techniques it has been found that the most dense (111) plane of austenite is parallel to the most dense (110) plane of ferrite and [112] direction of austenite is parallel to [110] direction of ferrite, which is specific for Kurdjumov-Sachs orientation relationship.

ORIENTACIJSKA ODVISNOST FAZE δ -FERITA IN AVSTENITA V Cr-Ni-Mo NERJAVNIH JEKLIH DOLOČENA Z ANALITSKO METODO EBSDM. Godec¹, B. Šuštaršič¹, M. Jenko¹, and B. Marini²¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija²Commissariat à l'Energie Atomique, DMN/SRMA, 91191 Gif-sur-Yvette, Saclely, Francija

Visoko legirane nerjavne jeklene litine Cr-Ni se pogosto uporabljajo v termoelektričnih postavitvah, kot so konvencionalne in jedrske elektrarne. Večletna izkoriščanja mehanskih naprav v teh objektih so pokazala, da se trdnost teh zlitin zmanjšuje s časom obratovanja in temperaturo. Te zlitine imajo tipično dupleksno strukturo, ki sestoji iz avstenita in δ -ferita. Namen naše raziskave je bila analiza mikrostrukture, določitev deleža avstenita in δ -ferita in navsezadnje določitev orientacijske odvisnosti avstenitne in δ -feritne faze. Med BCC-feritom in FCC-avstenitom so poznane štiri orientacijske odvisnosti: Bainova, Kurdjumov-Sachsova, Nishiiama-Wassermannova in Pitscheva. Na osnovi analitske tehnike EBSD smo ugotovili, da je najgostejša (111) ravnina avstenita vzporedna najgostejši (110) ravnini ferita in smer [112] avstenita vzporedna smeri [110] ferita, kar pa je značilno za Kurdjumov-Sachsovo orientacijsko odvisnost.

KM-6

INVESTIGATION OF THE ASEPTIC LOOSENING OF AISI 316L HIP PROSTHESIS

Matjaž Godec¹, Aleksandra Kocijan¹, Drago Dolinar², Djordje Mandrino¹, Monika Jenko¹, Vane Antolič²

¹Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

²Orthopaedic Clinic Ljubljana, Zaloška 9, 1000 Ljubljana, Slovenia

The total replacement of joints by the implantation of permanently indwelling prosthetic components has been one of the major successes of modern surgery in terms of relieving pain and correcting deformity. However, the aseptic loosening of a prosthetic joint component is the most common reason for joint revision surgery. It is considered that wear particles are one of the major contributors to the development and perpetuation of aseptic loosening. The aim of the present study was to identify the factors for the aseptic loosening of AISI 316L total hip prosthesis. The stem was evaluated by XPS, where polished and rough regions were analyzed in order to establish differences in chemical composition of both regions. Specific areas were examined using SEM/EDS and light microscopy.

RAZISKAVA VZROKA ASEPTIČNEGA OMAJANJA KOLČNE PROTEZE IZ JEKLA KVALITETE AISI 316L

Matjaž Godec¹, Aleksandra Kocijan¹, Drago Dolinar², Djordje Mandrino¹, Monika Jenko¹, Vane Antolič²

¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija

²Ortopedska klinika Ljubljana, Zaloška 9, 1000 Ljubljana, Slovenija

Eden največjih uspehov moderne kirurgije, predvsem v smislu olajšanja bolečin in korekcije deformiranosti, je popolna zamenjava sklepov z implantacijo trajno zamenljivih protetičnih komponent. Vendar pa se kot najpogostejši vzrok za ponovno operacijo pojavlja aseptično omajanje protetičnih sklepnih komponent. Delci, ki nastanejo zaradi obrabe, so najpogostejši vzrok za razvoj in napredovanje aseptičnega omajanja. Namen raziskave je bil določitev faktorjev, ki vplivajo na aseptično omajanje celotne kolčne proteze iz jekla kvalitete AISI 316L. Narejena je bila primerjalna XPS-analiza polirane in grobe površine kolčne proteze z namenom ugotoviti razliko v kemijski sestavi obeh področij. Specifična mesta smo pregledali tudi z SEM/EDS in svetlobno mikroskopijo.

KM-7

FOAMING Al_p -BASED PRECURSORS WITH A $CaCO_3$ FOAMING AGENTVaružan Kevorkijan¹, Srečo Davor Škapin²¹Independent Researching plc, Betnavska cesta 6, Maribor, Slovenia²Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia

Aluminium foams are a prospective class of structural materials that offer a variety of applications in fields such as lightweight construction or crash-energy management. The main preparation methods for aluminium foams include casting and foaming metallic precursors (powder metallurgy by foaming of aluminium powders with foaming agents, foaming thixo-cast precursors or ingots containing foaming agent). Among these the powder metallurgical (PM) route is a simple and promising preparation method, especially for the production of net-shape parts, providing excellent quality of the end products. The production process begins with mixing the Al powder with a powdered foaming agent, after which the mix is compacted to yield a dense, semi-finished product. By far the most commonly used foaming agents are metal-hydride powders such as TiH_2 and ZrH_2 .

However, TiH_2 and ZrH_2 foaming agents are very expensive and also rapidly decompose below the melting point of aluminium, resulting in difficult control of the foaming process, especially when applied to the casting or thixo-casting procedures. Therefore, developing a novel, cost-effective and universal substitution for TiH_2 and ZrH_2 (also suitable for casting) is crucial to the future mass production of foaming aluminium.

The use of the carbonate decomposition mechanism to achieve foams by the PM route was proposed in some early patents and in several recent research studies. However, the influence of the nature of the calcium carbonate, the morphology and the content on the foam-processing variables and foam characteristics needs to be additionally explored.

In this paper, the suitability of a calcium carbonate foaming agent used in the foaming of aluminium powders and the effects of the main processing parameters, such as the nature of the foaming agent, the morphology and the content as well as foaming temperature and time on the porosity and the structure of aluminium foams were experimentally investigated.

IZDELAVA PEN IZ Al_p PREDOBNIK Z DODATKOM $CaCO_3$ KOT SREDSTVA ZA PENJENJEVaružan Kevorkijan¹, Srečo Davor Škapin²¹Zasebni raziskovalec, Betnavska cesta 6, Maribor, Slovenija²Institut Jožef Stefan, Jamova 39, 1000 Ljubljana, Slovenija

Aluminijeve pene so vrsta inženirskih materialov, ki bi se jih v prihodnje dalo uspešno uporabljati kot lahek konstrukcijski material in kot sredstvo za absorpcijo energije trkov. Najpomembnejši metodi izdelave Al pen sta penjenje taline ali predobnik, kar dosežemo z dodatkom sredstva za penjenje. Predobnike s homogeno razporejenim sredstvom za penjenje lahko pripravimo s pomočjo prašne metalurgije, tikso litjem ali klasičnim litjem. Med naštetimi postopki je metoda prašne metalurgije najbolj enostavna in obetavna, še posebej za izdelavo kakovostnih izdelkov zahtevne geometrije, ki jih po penjenju ni potrebno naknadno obdelovati.

V prvi fazi priprave izdelkov na osnovi Al pen se Al prahu ustrezno primeša sredstvo za penjenje, nakar se prašna zmes stisne v kalup z želeno obliko. Stiskanje prašne zmesi mora potekati tako, da je sredstvo za penjenje homogeno porazdeljen v Al prahu in da ni preostale odprte poroznosti. Za tovrstne namene sta se do sedaj najpogosteje uporabljala TiH_2 in ZrH_2 prahova. Pomanjkljivost le-teh je njuna visoka cena in razkroj pod temperaturo tališča Al. Zaradi tega je otežena kontrola procesa penjenja, še posebej pri litju oziroma litju v testnem stanju.

Zato obstaja velik interes, predvsem pri množični proizvodnji izdelkov iz penastega Al, po nadomeščanju TiH_2 in ZrH_2 s cenejšimi sredstvi za penjenje, ki bi se jih dalo uporabljati enako dobro pri penjenju taline in predobnik. Uporabo kalcijevega karbonata kot sredstva za penjenje so v preteklosti opisali številni avtorji, ki so postopek tudi patentirali. Vendar pa je še premalo sistematično urejenih podatkov o vplivu sestave, koncentracije in morfologije karbonatnih delcev na lastnosti končnih izdelkov.

V delu smo se omejili na uporabo kalcijevega karbonata kot sredstva za penjenje. Raziskali smo vpliv procesnih parametrov, kot koncentracija in morfologija delcev $CaCO_3$, ter režim penjenja (temperatura, čas) na poroznost in strukturo pripravljenih Al pen.

KM-8

ELECTROCHEMICAL AND SURFACE CHARACTERISATION OF NiTi SHAPE MEMORY ALLOY IN ARTIFICIAL SALIVA AND FLUORIDE SOLUTION

Aleksandra Kocijan, Matjaž Godec, Monika Jenko
Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia

Titanium alloys such as NiTi shape memory alloys are the most commonly used materials for making orthodontic wires because of their interesting physical properties. The elasticity and shape memory of these types of wires means that they can be used in different orthodontic treatment stages to correct numerous clinical conditions. The shape memory effect and the pseudoelasticity of NiTi alloys were developed in the early 1960s and later introduced into orthodontic applications. The pseudoelastic property allows the orthodontist to apply an almost light force with greater activation. The use of fluoride mouthwashes in population drastically increased in the last decade due to positive effect on preventing teeth from dental caries. Fluoride promotes the formation of calcium fluoride globules that adhere to the teeth and stimulate remineralization while protecting against acid attack. Fluoride mouthwashes thus help prevent the development of caries and protect dental enamel. The deterioration of the corrosion resistance of orthodontic wires has two consequences: the first is a loss of the physical properties which play in the success of the clinical treatment; the second is the release of Ni ions, which have potential toxic and allergic consequences. Furthermore, an increase in the release of Ti ions indicates the deterioration of the protective surface film on NiTi alloys which can lead to a simultaneous increase in Ni ion release.

The aim of the present study was to compare the electrochemical properties of the commercial binary NiTi dental alloy in artificial saliva and with the addition of sodium fluoride, in order to assess the influence of fluoride mouthwash products on the corrosion resistance of orthodontic wires. The surface characterization was also performed using SEM/EDS/EBSD.

KM-9

FRACTURE TOUGHNESS OF NITRIDED LAYERS

Vojteh Leskovšek¹, Monika Jenko¹, Jelena Tuma¹, David Nolan²

¹Institute of Metals and Technology, Ljubljana, Slovenia

²Faculty of Engineering, University of Wollongong, NSW Australia 2522

Nitriding and nitrocarburising treatments are established methods of improving the wear performance of tool and die steels. However, our understanding of the relationship between nitriding process parameters, and microstructure and fracture behaviour of the surface layers is far from complete. Vickers hardness indentations generate radial fractures in brittle surface layers, and it has been shown that the length of these cracks can be used to provide valuable information about the fracture toughness of these layers. This paper describes an investigation of the application of indentation fracture testing to nitrided and nitrocarburized H11 hot work tool steel. The results suggest that where a sufficiently thick compound layer has formed, this method has the potential to be applied as a pseudo non-destructive method of monitoring the fracture properties of treated surfaces on actual tool parts. However, the validity of the method appears to be a function of the presence and thickness of the compound layer, and possibly the mechanical properties of the diffusion layer. The effect of such factors has not been quantified and further work is required to establish the sensitivity of the method for fracture toughness calculations.

LOMNA ŽILAVOST NITRIRANIH PLASTI

Nitriranje in nitrocementiranje sta priznana postopka za izboljšanje obrabnih lastnosti orodnih jekel. Kakor koli že, razumevanje odnosov med parametri nitriranja, mikrostrukture in loma modificiranih površin pa še ni povsem pojasnjeno. Opisana je uporaba odtisa Vickersove piramide pri preizkušanju loma nitrirane in nitrocementirane površine orodnega jekla za delo v vročem AISI H11. Pri karakterizaciji mikrostrukture in mehanskih lastnosti spojinske in difuzijske plasti smo uporabili svetlobni mikroskop in merilnik trdote Vickers. Rezultati kažejo, da je to potencialna metoda, ki jo lahko uporabimo kot psevdodestruktivno metodo za ugotavljanje lomnih lastnosti nitriranih in nitrocementiranih spojinskih plasti na delih po nitriranju. Veljavnost metode je odvisna od prisotnosti in debeline spojinske plasti ter mehanskih lastnosti difuzijske plasti, zato so potrebne še nadaljnje raziskave, s katerimi bomo ugotovili in potrdili zanesljivost in občutljivost predlagane metode za izračunavanje lomne žilavosti nitriranih plasti.

KM-10

QUANTITATIVE METALLOGRAPHIC ANALYSIS OF FERRITE-PERLITE
MICROSTRUCTURE

N. Lipovšek, M. Godec, M. Jenko
Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

In metallography it is frequently very important to be able to determine the amount of certain microstructure component with a high degree of precision. Quantitative measurements on a crack shaft, produced from 36MnVS4 steel where ferrite-perlite microstructure with no more than 30 % of ferrite phase must be obtained by proper heat treatment, will be demonstrated. The problem of using automatic computer phase volume determination will be discussed as well as different approaches for determination of ferrite phase volume fraction in ferrite-perlite structure will be demonstrated. In such a microstructure as ferrite-perlite it is usually very difficult or even impossible to very precisely analyse the amount of ferrite phase due to the fact that eutectoid perlite phase also consists of ferrite and cementite, therefore ferrite between the cementite lamellas will remain white during nital etching. However, using manual counting according to standards ASTM E562, it is shown that by choosing an appropriate field of view and a sufficiently dense grid the measurement uncertainty is very low.

KM-11

DETERMINATION OF DELTA FERRITE CONTENT IN STAINLESS STEELS

Milan Malešević¹, J. V. Tuma¹, B. Šuštaršič¹, B. Marini²

¹Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

²French Atomic Energy Commission, 91191 Gif-sur-Yvette, France

The samples of Cr-Ni-based cast alloys with six characteristically different δ -ferrite contents were prepared. The delta ferrite content was determined with three different methods: i.e., empirical on the basis of chemical composition, magnetic-induction-based and metallographic. Also the basic principles of individual procedures were explained. We concluded that the most suitable method is magnetic-induction-based method. It can be easily used on the field, also it is non-destructive and very fast. Metallographic method is very sensitive procedure. Too much etching lead to incorrect results. In our case we had two-phase (austenite-ferrite) steel. In the ideal case etching media attacks only ferritic phase. However, it attacks also grain boundaries and some of austenite phase. Due to that you can obtain higher values of delta ferrite content. Empirical method is very reliable but procedure for chemical analysis is complex and expensive compared to other two methods. It is recommended to use this method only when chemical composition has to be made as a controlling parameter in production phase.

KM-12

AES AND XPS CHARACTERIZATION OF TITANIUM HYDRIDE POWDER

Dj. Mandrino, I. Paulin, Č. Donik, M. Jenko
Institute of Metals and Technology, Lepi pot 11 , 1000 Ljubljana, Slovenia

Titanium hydride powder was produced by ball milling titanium in hydrogen atmosphere down to micron sized particles. XPS of the TiH_x powder was performed, however strong titanium oxide signal was also measured which decreased somewhat after intense sputtering of the sample but was impossible to get completely rid of. This was probably due to high surface / volume ratio of each TiH_x particle which contributes to substantial titanium oxide / TiH_x ratio and due to the surface morphology of the powder sample which leaves considerable part of the oxide layer shaded during the sputtering. AES was then employed and some characteristic differences in shape of Ti LMM spectra between TiH_x and Ti were observed, however, it is not unambiguous whether they are due to TiH_x or titanium oxide. Another XPS measurement was performed with TiH_x powder and Ti powder of the same particle size. Peaks were fitted with oxide and metallic components and increased half-width of metallic component at TiH_x (since hydride and metallic component are only 0.2 eV apart) checked for.

PREISKAVE PRAŠKASTEGA TITANOVEGA HIDRIDA S SPEKTROSKOPIJO
AUGERJEVIH ELEKTRONOV IN RENTGENSKO FOTOELEKTRONSKO
SPEKTROSKOPIJO

Dj. Mandrino, I. Paulin, Č. Donik, M. Jenko
Inštitut za kovinske materiale in tehnologije, Lepi pot 1, 1000 Ljubljana, Slovenija

Praškasti titanov hidrid smo sintetizirali z mletjem titana v krogličnem mlinu pod vodikovo atmosfero do mikrometrskih velikosti delcev. Sintetizirani praškasti TiH_x smo analizirali z rentgensko fotoelektronsko spektroskopijo (XPS). Pri tem smo izmerili močan signal titanovega oksida, ki je sicer upadel po intenzivnem ionskem jedkanju površine vzorca, ni pa izginil. Razlog za to je verjetno visoko razmerje površina / volumen posameznih delcev TiH_x , ki prispeva k znatnemu razmerju titanov oksid / TiH_x , kakor tudi morfologija površine praškastega vzorca, zaradi katere je del oksida zasnečen med ionskim jedkanjem. S spektroskopijo Augerjevih elektronov (AES) smo opazili nekatere karakteristične razlike v obliki Ti LMM-spektrov med TiH_x in Ti, vendar ni bilo mogoče nedvoumno potrditi, da se pojavijo zaradi TiH_x in ne zaradi nepopolno očiščenega titanovega oksida. Nadaljnjo meritev XPS smo opravili na prašku TiH_x in prašku Ti enake velikosti delcev. Določili smo oksidne in kovinske komponente vrhov in primerjali širine kovinskih komponent pri TiH_x in Ti (hidridna in kovinska komponenta sta le 0,2 eV narazen, pričakujemo torej razširitev pri TiH_x).

KM-13

ANALYSING OF MACRO-INCLUSIONS ON FORGING SURFACES MADE OF
42 CrMo4 GRADE STEEL

Sulejman Muhamedagić, Mirsada Oruč

Univerzitet u Zenici, Fakultet za metalurgiju i materijale, Travnička cesta 1, Zenica, BiH
Univerzitet u Zenici, Metalurški institut "Kemal Kapetanović" Travnička cesta 7, Zenica, BiH

Ultrasonic examination of forging made of steel 42CrMo4 indicated the presence of the defects that indicated the presence of macro-inclusions. That initiated slicing of the samples of forgings and their metallographic examination.

This paper gives observation of macro-inclusions on forging surfaces, 2 samples of 42CrMo4 grade from different heats. This study consists in analysing by SEM/EDX the macro-inclusions observed at the samples surfaces under a beam voltage of 15 kV and with a back-scattered electrons detector. EDX analyses have revealed the same kind of inclusions for all the heats. Usually, aluminium killed steels are characterised by (Al_2O_3 or MgO) type inclusions. However, the macro-inclusions are mainly made of $\text{Al}_2\text{O}_3\text{-MnO-SiO}_2$. The amount of MnO and SiO_2 show that the origin of these defects are likely to be due to a re-oxidation of the metal in the steelshop.

KM-14

FADING OF AlTi5B1 GRIN REFINER IN Al-Fe ALLOY DURING HOLDING

Iztok Naglič

Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija

Al-Fe alloy, melted in induction furnace with graphite crucible, was grain refined with AlTi5B1 grain refiner. Melt was stirred after the addition of grain refiner. First sample was cast two minutes after addition of grain refiner and the second sample fifteen minutes after the addition of grain refiner. Melt was stirred again before the third sample was cast. It was found that grain size increases with holding time as expected. Grain size decreases to similar size as in the first sample after stirring. Results indicate that stirring of grain refined melt can restore grain refinement effect lost with fading.

ZMANJŠEVANJE UČINKA SREDSTVA ZA ZMANJŠEVANJE ZRN AlTi5B1 V ZLITINI Al-Fe S KONTAKTNIM ČASOM

Taline zlitine Al-Fe, staljeni v indukcijski peči z grafitnim loncem, smo dodali sredstvo za zmanjševanje zrna AlTi5B1. Po dodatku sredstva smo talino premešali. Prvi vzorec smo ulili dve minuti po dodatku sredstva AlTi5B1, drugi vzorec pa petnajst minut po dodatku sredstva. Preden smo ulili tretji vzorec, smo talino ponovno premešali. Rezultati kažejo, da se s kontaktnim časom velikost kristalnega zrna povečuje. Po premešanju taline se velikost kristalnega zrna zmanjša na približno enako velikost kot pri prvem vzorcu. Ugotovitve kažejo, da premešanje taline povrne prvotni učinek sredstva za zmanjševanje zrn AlTi5B1, izgubljenim z daljšim kontaktnim časom.

KM-15

PRODUCTION OF FENI HOT/COLD ROLLED SHEETS

Pavel Podaný¹⁾, Michal Zemko¹⁾, Jaroslav Tuček²⁾

¹⁾COMTES FHT a. s., Průmyslová 995, 334 41 Dobřany, Czech Republic

²⁾Kovohutě Rokycany, a. s., Zeyerova 285, 337 01 Rokycany, Czech Republic

The poster deals with production of hot and cold rolled sheets. These materials are widely used in electric industry for their high magnetic properties. Production of these products consists of few production steps – casting (atmospheric and vacuum furnace), hot rolling of ingots and cold rolling of sheets. Each step is followed by wide spectra of possible problems – non-metallic inclusions in ingots, cracking during rolling, welding of cold rolled sheets etc. Various analyses were done on modern laboratory equipment to assess the cause of defects. Light microscopy, scanning electron microscopy and DEFORM 3D software were used for solving of this project.

Project Eureka FeNi OE234 is supported by EU and Czech Ministry of Education Youth and Sport.

KM-16

INFLUENCES ON ARC EXTINGUISHING IN GAS ARRESTERS

Andrej Pregelj, Leopold Južina, Robert Rozman, France Breclj, Aleš Štagoj
Iskra Zaščite doo, Stegne 35, Ljubljana, Slovenia

Gas arrester action is based on gas discharge in electric arc. There are two steps very important: the initial and final phase of plasma burning. The initial phase determines spark-over voltage and the decay phase determines selfextinguishing of the arc in a cell. Selfextinguishing is a property that arc in a gas arrester declines in a very short time (some msec to 20 msec) after lightning. This capability becomes more and more interesting for customers because at the overvoltage stroke it diminishes disturbances in network and reduces damages in a gas arrester cell.

The arc arising phenomena, initiated by overvoltage plasma formation is good investigated - but there are not so much data and publications attainable on plasma extinguishing. Similar problems are partially treated mostly by circuit breaker producers who intend to diminish the arc formed at disjoin operation of the contacts.

At developing the gas arresters with optimised selfextinguishing function many experiments and measurements were performed and some new possibilities were studied. Electrodes and inner surfaces construction and the material choice are – besides electric charge and eventual external electric elements – the only grips which can be used to influence on ceasing and stopping the plasma »burning«. We have come by some statements, which still need to be convinced; so we plan to continue our investigations. In our contribution there are presented the mentioned experiments and developing steps.

VPLIVI NA UGASNITEV OBLOKA V PLINSKEM ODVODNIKU

Delovanje plinskega odvodnika temelji na plinski razelektritvi v električnem obloku. Pri tem sta predvsem pomembni začetna in zaključna faza »gorenja« plazme. S fazo nastajanja obloka je definirana vžigna napetost, s fazo ugasnitve obloka pa samougasnost. Samougasnost pri plinskih odvodnikih je lastnost, da vzpostavljeni oblok ugasne v čim krajšem času (nekaj msec do cca 20 msec) po vžigu. Ta sposobnost postaja vse bolj zanimiva za uporabnike, kajti ob pojavu prenapetosti odpravlja motnje v omrežju in zmanjšuje poškodbe v celici plinskega odvodnika.

Pojav ionizacije plina, tj vzpostavljanja plazme z visoko napetostjo, je dobro raziskan, o ugašanju plazme pa je zelo malo podatkov in objav. Še največ se s tem problemom ukvarjajo proizvajalci močnostnih stikal (circuit breakers) z namenom, da bi čim bolj preprečili oziroma izničili oblok, ki se pojavi ob razklapljanju kontaktov.

Za razvoj plinskih odvodnikov z izboljšano samougasnostjo smo naredili več poskusov in meritev ter študirali nove možnosti. Oblikovanje elektrod, notranjih površin celice in izbira materialov so – poleg poleg izvora elektrenine in morebitnih dodatnih zunanjih električnih elementov – edini prijemi, s katerimi se da vplivati na njenje in prekinitev "gorenja" plazme. Prišli smo do nekaterih ugotovitev, ki so skupaj z razvojnimi potezami predstavljene v prispevku.

KM-17

EFFECT OF TEMPERING TEMPERATURES ON THE MECHANICAL PROPERTIES AND MICROSTRUCTURES OF STRUCTURAL STEEL MICRAL 690

Danijela Anica Skobir¹, Matjaž Godec¹, Jure Bernetič², Monika Jenko¹
¹Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
²ACRONI, d. o. o., c. Borisa Kidriča 44, 4270 Jesenice, Slovenia

Heat treatment of the structural steel consists of quenching in water and tempering. To study the effect of tempering temperature on the microstructure and mechanical properties, the as-quenched steel was tempered at different temperatures (from 250 °C to 670 °C). Tensile strength decreases with increasing tempering temperature. The impact toughness is highest in the tempering temperature range of 550–600 °C. The microstructure of the as-quenched steel consists of martensite and some bainite. With increasing the tempering temperature tempering effects appear and the martensite microstructure starts disappearing.

VPLIV TEMPERATURE POPUŠČANJA NA MEHANSKE LASTNOSTI IN MIKROSTRUKTURO KONSTRUKCIJSKEGA JEKLA MICRAL 690

Danijela Anica Skobir¹, Matjaž Godec¹, Jure Bernetič², Monika Jenko¹
¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija
²ACRONI, d.o.o., c. Borisa Kidriča 44, 4270 Jesenice, Slovenija

Konstruktivno jeklo Micral 690 dobi končne mehanske lastnosti s kaljenjem v vodi in popuščanjem. Da bi ugotovili vpliv toplotne obdelave na mehanske lastnosti in mikrostrukturo jekla, so bile narejene mehanske preiskave jekla, kaljenega pri 900 °C in popuščanega pri različnih temperaturah (od 250 °C do 670 °C). Na istih vzorcih je bila narejena tudi mikrostrukturna karakterizacija jekla. Natezna trdnost se z višanjem temperature popuščanja znižuje, udarna žilavost pa je najvišja v temperaturnem območju popuščanja med 550 °C in 600 °C. Mikrostruktura kaljenega vzorca je iz martenzita in delno bainita. Z višanjem temperature popuščanja prihaja do popuščnih efektov, martenzitna mikrostruktura pa je vedno bolj zbrisana.

KM-18

THE IMPACT OF STAGNANT WATER ON THE CORROSION PROCESSES IN PIPELINE

Marjan Suban, Robert Cvelbar, Borut Bundara
Institute of metal constructions, Mencingerjeva 7, 1001 Ljubljana, Slovenia

The occurrence of stagnant water is often the result of incomplete or improper hydrotesting procedure of pipelines (e.g. water installation in buildings) or improper design and construction of a pipeline that results in the blind ends. Phenomenon of stagnant water can also be observed in sprinkler fire protection systems. Potable water, which is not additionally chemically treated, is commonly used for execution of the hydrotest or as a medium in fire protection systems. Water therefore contains bacteria that cause microbiological influenced corrosion. This relatively unusual form of corrosion results from interactions of bacteria with various metals and their alloys and can be manifested in corrosion rate that is up to 100-times higher than conventional types of corrosion. The article described in detail causes for the formation and progress of microbiologically influenced corrosion and its consequences in the case of galvanized water pipes. Some recommendations for reduction of risk concerning the microbiologically influenced corrosion in water pipes are stated in the conclusion.

VPLIV ZASTAJAJOČIH VODA V CEVOVODIH NA KOROZIJSKE PROCESSE

Marjan Suban, Robert Cvelbar, Borut Bundara
Inštitut za metalne konstrukcije, Mencingerjeva 7, 1001 Ljubljana, Slovenija

Pojav zastajajočih ali mirujočih voda je pogosto posledica neupoštevanje celotnega postopka izvedbe tlačnega preizkusa cevovodov (npr. vodovodne instalacije v zgradbah) ali nepravilnega projektiranja in izvedbe cevovoda, kjer se pojavljajo slepi odcepi. Zastajajoče vode je mogoče najti tudi v sprinklerskih sistemih protipožarne zaščite. Za potrebe izvedbe tlačnega preizkusa ali kot medij v protipožarnih sistemih se pogosto uporablja pitna voda, ki ni dodatno kemijsko obdelana in zato vsebuje tudi bakterije, ki povzročajo mikrobiološko vplivano korozijo cevovoda. Ta dokaj nenavadna oblika korozije je rezultat interakcije med bakterijami in raznimi kovinami ter njihovimi zlitinami, zanjo pa je značilna tudi do 100-krat večja hitrost napredovanja kot pri navadnih tipih korozije. V članku so podrobneje opisani vzroki za nastanek ter potek mikrobiološko vplivane korozije ter njene posledice pri vroče cinkanih vodovodnih ceveh. V sklepu je podanih tudi nekaj priporočil za zmanjševanje tveganja pojava mikrobiološko vplivane korozije v vodovodnih ceveh.

KM-19

THESIS OF CAST STAINLESS STEELS WITH DIFFERENT CONTENT OF δ -FERRITEB. Šuštaršič¹, F. Tehovnik¹, J. Gontarev¹, M. Malešević¹, B. Marini², C. Toffolon Masclet²¹Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia²DMN/SRMA and DEN-DANS, CEA, Saclay, France

The sample blocks of cast stainless steels with different content of δ -ferrite have been prepared in the frame of IMT and CEA bilateral collaboration. In the frame of former investigations its influence has already been investigated. However, the prepared steels have contained Mo besides Ni and Cr as main alloying elements. Practical tests and Thermo-Calc calculations have shown that the Mo strongly broadens the δ -ferrite region. The presence of Mo is generally desirable in this type of alloys. It improves casting properties, as well as steels thermal and corrosive resistance. On the other side, its presence is undesired due to the spinodal decomposition of δ -ferrite related to the decrease of toughness and ductility of steel during application at elevated temperatures. Therefore, it would be desirable to continue our investigations with Mo-free cast stainless steels which can be also potentially used for structural parts of nuclear power plants and other thermoenergetics objects. Four different steel compositions with different Cr to Ni ratio but without Mo have been selected on the basis of empirical and ThermoCalc calculations. Cast alloys have been then prepared in an induction melting furnace. Casting under the controlled solidification conditions into metal moulds was carried out. Annealing and water quenching tests of alloys were also performed. The prepared alloys were then chemically (AES), microstructurally (LM, SEM) and micro-chemically (SEM/EDS) analysed. The δ -ferrite content along to the cross section was determined with magnetic induction based method, as well as metallographically. The design and synthesis of alloys and results of their characterization will be reported and discussed in the present contribution.

SINTEZA LITIH NERJAVNIH JEKEL Z RAZLIČNO VSEBNOSTJO δ -FERITAB. Šuštaršič¹, F. Tehovnik¹, J. Gontarev¹, M. Malešević¹, B. Marini², C. Toffolon Masclet²

Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 10000 Ljubljana, Slovenija

²DMN/SRMA and DEN-DANS, CEA, Saclay, France

V okviru bilateralnega sodelovanja med IMT in CEA smo pripravili vzorce litih nerjavnih jekel z različno vsebnostjo δ -ferita. V predhodnih raziskavah smo že raziskovali vpliv vsebnosti δ -ferita na mehanske lastnosti jekel, ki poleg Ni in Cr vsebujejo tudi Mo. Praktični preizkusi in Thermo-Calc-izračuni so pokazali, da le-ta močno razširja njegovo področje, kar je neželjeno, saj se med obratovanjem žilavost in duktilnost jekla zaradi spinodalnega razpada δ -ferita močno zmanjša. Po drugi strani pa je njegova prisotnost zelena, ker izboljšuje livne lastnosti ter termično in korozijsko stabilnost te vrste jekel. V nadaljevanju naših raziskav želimo preiskave razširiti na litine, ki ne vsebujejo Mo in so tudi potencialno uporabne za strojne in strukturne dele v nuklearnih elektrarnah. Na osnovi empiričnih korelacij in ThermoCalc-izračunov smo izbrali štiri sestave z različno vsebnostjo Ni in Cr, vendar brez Mo, ki naj bi po litju dale različne vsebnosti δ -ferita. Litine smo izdelali v vakuumski indukcijski talilni peči. Litje smo izvedli v kovinskih kokilah z definirano hitrostjo ohlajanja. Litine smo nato preizkusno tudi homogenizacijsko žarili in gasili v vodi. Sledila je kemijska (AES), mikrostrukturna in mikrokemijska fazna analiza po preseku gredic. Fazno analizo in določitev vsebnosti δ -ferita smo izvedli na metalografskih obrusih z LM, SEM/EDS in merilnikom magnetne indukcije. V prispevku poročamo o postopkih načrtovanja in izdelave litin ter njihovih preiskavah.

KM-20

FEM BASED LIFE-TIME PREDICTION OF LEAF SPRINGS

Borivoj Šuštaršič¹, Bojan Senčič², Robert Kunc³

¹Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia

²Štore Steel, Železarska cesta 3, 3220 Štore, Slovenia

³Faculty of Mechanical Engineering, University of Ljubljana

The finite element based method (FEM) has been used for the numerical simulation of stress and strain distribution in V-notched specimens. This has also enabled the calculation of stress concentration and notch-sensitivity factors. FEM simulation of fatigue was used for the prediction of life time of springs, taking into the 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 a good agreement with its real life time obtained with the structural testing of real leaf springs for trucks. At the conference, determination of fatigue strength of spring steels, as well as FEM numerical based simulation of the notch effect in V-notched specimens and fatigue life-time prediction of leaf springs will be presented.

NAPOVEDOVANJE DOBE TRAJANJA LISTNATIH VZMETI NA OSNOVI MKE METODE

Borivoj Šuštaršič¹, Bojan Senčič², Robert Kunc³

¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 10000 Ljubljana, Slovenija

²Štore Steel, Železarska cesta 3, 3220 Štore, Slovenija

³Fakulteta za strojništvo, Univerza v Ljubljani

Za numerično simulacijo porazdelitve napetosti in deformacij v zarezanih vzorcih smo uporabili metodo končnih elementov (MKE). Ta pristop nam omogoča izračun koncentracije napetosti in faktorja zarezne občutljivosti. MKE smo uporabili tudi za simulacijo utrujanja izbranega vzmetnega jekla in za napoved dobe trajanja listnate vzmeti izbrane geometrije. Za simulacije smo uporabili eksperimentalno določene mehanske lastnosti izbranega vzmetnega jekla upoštevajoč tudi specifične pogoje njegovega utrujanja. Izračunana doba trajanja vzmeti se dobro ujema z dejansko dobo trajanja vzmeti, ki je dobljena s strukturnim testiranjem vzmeti za težke tovornjake. Na konferenci bomo predstavili koncept določevanja trajne nihajne trdnosti vzmetnih jekel, kakor tudi MKE simulacije zarezanih preizkušancev in napovedovanje dobe trajanja vzmeti z realno geometrijo.

KM-21

PRECIPITATION OF PHASE σ IN SUPERAUSTENITIC STAINLESS STEEL UHB 904L

Franc Tehovnik¹, Boris Arzenšek¹, Darja Steiner Petrovič¹, Boštjan Pirnar²

¹Institute of Metals and Technology, Lepi pot 11, 10000 Ljubljana, Slovenia

²ACRONI, d. o. o., c. Borisa Kidriča 44, 4270 Jesenice, Slovenia

Austenitic stainless steels are commonly known for their toughness and corrosion resistance. Of these steels, UHB 904L is commonly referred to as a "super austenitic" stainless steel with a high Ni content (24 %) and, importantly, it contains a significant amount of Mo (4 %) in addition to the level of Cr (20–21 %) typical of austenitic grades. Given certain thermal histories, some stainless steels may be susceptible to the formation of potentially detrimental intermetallic phases, such as sigma phase. The key to the formation of sigma is the presence of high levels of Cr and Mo. The relatively high levels of Cr and Mo in the UHB 904L alloy suggest the possibility of rejection of these elements to the interdendritic regions during the solidification process.

KM-22

SYNTHESIS OF ALUMINIDES ON METALLIC SUBSTRATE

M. Torkar, M. Godec, M. Lamut

Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana

Different surfacing techniques are used for improvement of properties of surfaces of materials and tools, like increased corrosion protection or increased hardness. Aluminides are due their good oxidation and corrosion resistance promising materials for different high temperature applications.

It is well established that aluminides possesses excellent oxidation properties and a high thermal conductivity. These desirable characteristics and thermal modelling also suggests that they can remain effective under the high-heat-flux conditions. For instance Ni-aluminide is an advanced material, displays a lower density ($\approx 30\%$ less) and a higher thermal conductivity (4- to 8 times greater) than conventional superalloys. Fe-aluminide has 7 times better oxidation resistance than stainless steel, and high resistance to sulphidation process. Aluminium from the aluminide oxidize forms very resistant Al_2O_3 scale that protects at higher temperatures, because it does not volatilize above $950\text{ }^\circ\text{C}$ like Cr_2O_3 scale.

The main disadvantage of aluminides is relatively high brittleness that confines their application for structural parts. Sometimes it is possible to solve this problem by a formation of thin layer of protective aluminide on metallic substrate. The capability of spark alloying technique for in situ aluminides synthesis was checked. The specific of this technique is rapid solidification that influences the properties of rapid solidified layer. Characterisation of the microstructure and the properties of rapid solidified thin layer of aluminide will be presented.

SINTEZA ALUMINIDA NA KOVINSKI PODLAGI

M. Torkar, M. Godec, M. Lamut

Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana

Za izboljšanje lastnosti površine, kot sta povečanje korozijske odpornosti ali povečanje trdote materialov in orodij, se uporabljajo različne tehnike oplemenitenja površine. Aluminidi so zaradi dobre odpornosti proti oksidaciji in koroziji obetajoči materiali za uporabo na visokotemperaturnem področju. Poznano je, da imajo aluminidi tudi dobro toplotno prevodnost. Ta lastnost in dobra odpornost proti oksidaciji kaže pri termičnem modeliranju na možnost, da ostanejo učinkoviti tudi pri velikih toplotnih tokovih. Na primer Ni-aluminid je napreden material, ima nižjo gostoto (30 % manjšo) in večjo toplotno prevodnost (4- do 8-krat večjo) kot navadne superzlitine. Fe-aluminid ima 7-krat boljšo odpornost proti oksidaciji kot nerjavno jeklo in veliko odpornost proti pojavu sulfidacije. Aluminij iz aluminida se oksidira in tvori odporno Al_2O_3 -plast, ki varuje površino pred visokimi temperaturami, ker ne izpareva nad $950\text{ }^\circ\text{C}$, kot je to v primeru plasti Cr_2O_3 .

Največja pomanjkljivost aluminidov je njihova relativno velika krhkost, kar omejuje njihovo uporabo za strojne dele. Včasih je mogoče ta problem rešiti s tvorbo tankega sloja aluminida na kovinski podlagi. Preskušene so bile zmogljivosti tehnike legiranja v obloku za *in situ* nastanek aluminida. Posebnost te tehnike je hitro strjevanje, kar vpliva na lastnosti hitro strjenega sloja. Predstavljeni bodo rezultati karakterizacije hitro strjenega sloja aluminidov.

KM-23

INDUSTRIAL TEST OF PROTECTIVE COATING

M. Torkar¹, V. Uršič², T. Marolt³

¹Inštitut za kovinske materiale in tehnologije, Ljubljana

²TERMIT d. d., Drtija pri Moravčah

³Štore Steel d. o. o., Štore

Springs are sensitive to the quality of steel surface that should not be decarburised. Protective coating was developed for diminution of scaling and decarburisation of steel billets during heating. Presented are results of industrial test of protective coating on steel 51CrMoV4 for springs. For industrial test two billets 180 x 180 mm with grinded surface were protected by coating, the third billet with grinded surface was not protected. The billets were charged into reheating furnace and after heating rolled into profile 145 x 145 mm. From rolled profile the samples were cut for metallography. Investigations revealed that the surface of profile, rolled from billet with grinded surface was decarburised on all four surfaces. Comparison with profile rolled from grinded and protected billets revealed that surface was not decarburised, only traces of ferrite on grain boundaries were observed. That means the protective coating diminished decarburisation of steel surface.

Industrial tests on grinded billets of 51CrMoV4 steel without and with protective coating confirmed beneficial influence of protective coating on diminution of decarburisation of billets during reheating process. Similar effect was observed in profile hot rolled from 180 x 180 mm billet to 145 x 145 mm profile. Based on successful trials steelwork Štore Steel decided to establish industrial device for application of protective coating during regular production process.

INDUSTRIJSKI PRESKUS VAROVALNEGA PREMAZA

M. Torkar¹, V. Uršič², T. Marolt³

¹Inštitut za kovinske materiale in tehnologije, Ljubljana

²TERMIT d. d., Drtija pri Moravčah

³Štore Steel d. o. o., Štore

Vzmeti so posebno občutljive na stanje površine jekla iz katerega so izdelane. Zaželjeno je, da površina ni razogljíčena. V ta namen smo razvili posebni premaz za zmanjšanje pojava škajanja in razogljíčenja površine gredic med ogrevanjem za vročo predelavo. Opisani so rezultati industrijskega preskusa varovalnega premaza na jeklu 51CrMoV4, za vzmeti. Za industrijski preskus sta bili premazani dve gredici 180 x 180 mm z brušeno površino, tretja gredica z brušeno površino pa je bila brez premaza. Gredice so bile nato založene v ogrevno peč in izvaljane v kvadratni profil 145 x 145 mm. Iz vsake gredice so bili odrezani vzorci za metalografsko preiskavo. Pokazalo se je, da ima valjanec iz gredice, ki je bila samo brušena, vse štiri stranice razogljíčene. Primerjava z valjancem iz gredic, ki sta bili brušeni in premazani, pa pokaže, da površina ni razogljíčena, opazi se le posamezne sledove ferita po mejah zrn. Torej je premaz učinkovito opravil svojo nalogo pri preprečevanju razogljíčenja površine.

Industrijski preskus na brušenih gredicah iz jekla 51CrMoV4, brez premaza in s premazom, je potrdil, da se ugoden učinek premaza na zmanjšanje razogljíčenja gredic med ogrevanjem za vroče valjanje, pokaže tudi na valjancu 145 x 145 mm izvaljanem iz gredice 180 x 180 mm. Zato so se v Železarni Štore Steel odločili za uvedbo premaza v redno proizvodnjo in v ta namen postavili industrijsko napravo za nanos premaza na gredice, pred vstopom v koračno peč.

KM-24

SHORTENING REHEATING AFTER STOPPAGES IN PUSHER-TYPE FURNACE

Franci Vode¹, Franc Tehovnik¹, Anton Jaklič², Franci Perko²

¹-Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenija

²-ACRONI, d. o. o., c. Borisa Kidriča 44, 4270 Jesenice, Slovenija

In hot-rolling plant of ACRONI, d.o.o., steelwork steel slabs are reheated in a pusher-type furnace prior the hot rolling process. In the production chain (reheating furnace-rougher mill-finishing mill) planned and unplanned stoppages may occur. This poster presents a way, how to efficiently use such delays for faster reheating of subsequent slabs.

All the slabs during such stoppages are longer time in the furnace as without stoppages. Longer reheating time causes several bad side effects such as greater fuel consumption, higher amount of scale, deeper decarburized layer etc. On the other hand, such stoppages can be efficiently used for shortening of reheating time of subsequent slabs. This can be done for slabs, for which rolling mills need less time for rolling than it is a required time for reheating in the furnace. This means that after a stoppage of e.g. 20 min, drop out periods of multiple subsequent slabs can be shorten for up to a sum of 20 min. Distribution of shortenings to subsequent slabs starts immediately after the slab of stoppage. Maximum value of shortening for a selected slab is limited with difference of reheating time of a slab and rolling time of a forerunner slab. Algorithms for determination of shortening of drop-out time are presented as well as a short presentation of integration into furnace control system.

KM-25

YIELD STRESS OF STEELS WITH THE MICROSTRUCTURE OF TEMPERED MARTENSITE AND ACCELERATED CREEP RATE

F. Vodopivec, J. Vojvodič Tuma, M. Jenko
Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenija

Yield stress and accelerated creep rate of steels with the microstructure of tempered martensite are related to the carbide particles spacing. Efficient are only those particles that are not sheared by the moving dislocation line, while, creep rate depends also on the stability of particles at creep temperature. Modern works transforming fossil to electrical energy operate in slow creep temperature range and slow change of size and distribution of carbide particles that lower the creep strength of steels. Two steels with the microstructure of tempered martensite were annealed for up to 17520 h at 650 °C resp. 8760 h at 750 °C. Creep rate was determined at 580 °C and yield stress at room temperature and a numerical mutual dependence evolved. For the decrease of yield stress from 650 MPa to 350 MPa, creep rate increased for two orders of magnitude from $5 \cdot 10^{-9} \text{ s}^{-1}$ to $8 \cdot 10^{-7} \text{ s}^{-1}$. The experimental dependence was verified with the solution of theoretical equations for both properties. The established dependence can be used as simple method for the verification of the increase of creep rate of steels after operation time.

MEJA PLASTIČNOSTI JEKEL Z MIKROSTRUKTURO IZ POPUŠČENEGA MARTENZITA IN HITROST POSPEŠENEGA LEZENJA

Meja plastičnosti in hitrost lezenja sta pri jeklih z mikrostrukturo iz popuščenega martenzita odvisni od razdalje med karbidnimi izločki. Učinkovit je vpliv le tistih izločkov, ki jih premikajoča dislokacijska črta na preseka, na hitrost lezenja pa vplivajo le izločki karbidnih faz, ki so stabilne pri temperaturi lezenja. Moderne naprave za proizvodnjo električne energije iz fosilnih goriv so zgrajene iz varivih jekel z mikrostrukturo iz popuščenega martenzita in obratujejo pri temperaturah počasnega lezenja, kjer nastaja počasna sprememba začetne velikosti in porazdelitve karbidnih izločkov, kar zmanjšuje odpornost feritne matice proti premikanju dislokacij.

Dve jekli z mikrostrukturo iz popuščenega martenzita smo žarili do 17 520 h pri 650 °C oz. 8760 h pri 750 °C in določili hitrost lezenja pri 580 °C ter mejo plastičnosti pri sobni temperaturi. Rezultati niso pokazali, da je med obema lastnostima relativno enostavna odvisnost in da se pri zmanjšanju meje plastičnosti od 650 MPa na 350 MPa hitrost lezenja poveča za dva reda velikosti od $5 \cdot 10^{-9} \text{ s}^{-1}$ na $8 \cdot 10^{-7} \text{ s}^{-1}$. Eksperimentalno odvisnost smo preverili z rešitvijo teoretičnih enačb, ki povezujejo obe lastnosti z razdaljo med izločki in fizikalnimi konstantami. Odvisnost je uporabna kot preprosta metoda za preverjanje, koliko se je zaradi večletnega delovanja v območju sprememb mikrostrukture zmanjšala odpornost jekla proti lezenju.

KM-26

THE CONSTRUCTION OF TERMINAL FOR ALCOHOL IN PORTO OF KOPER

Jelena Vojvodič Tuma¹, Štefan Hozjan²¹Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia²Nafta Strojna d.o.o., Mlinska 5, 9220 Lendava, Slovenia

At the liquid cargo pier I in the Port of Koper the terminal for alcohol storage tanks of total capacity of a 32.000 m³ is under construction. All storage tanks will be constructed with double shell, double bottom and with inner diameter of a 22.000 mm, shell height of a 17.200 mm, the diameter of the double shell of a 27.000 mm and a double shell height of a 11.500 mm. The double shell and double bottom are protective measures against storage alcohol spill. The base material used for construction is steel S 235 JRG2 according to EN 10025.

Corrosion protection of storage tanks and pipelines is going to be realized with polyurethane and acrylic isocyanide protective paint systems.

Each of the storage tanks will have self-supporting dome roof made of aluminium members and internal floating cover. The aluminium dome roof will be supported by sliding supports on the tank rim. The design of the connection between sliding roof support and storage tank rim is such that together with an integral tension roof ring minimizes radial forces transferred on the tank shell. The three-dimensional space frame of the dome roof will be manufactured from aluminium AA6061-T6 alloy and triangular roof panels from 3003-H16 alloy. The dome roof will have attachments and vent elements which will assure the storage tank ventilation, electrical grounding cables of aluminium dome roof members and sliding roof supports, anti-rotating ropes, media sampling roof hatches and internal cover steel ropes fixing points.

The purpose of the internal floating cover is to reduce evaporative emissions of storage alcohol. The internal floating cover will consist of a thin aluminium sheet, which is going to be fixed on a grid framework of the same material and supported by a tubular buoyancy chambers. When the storage tank will be empty internal cover will hang on steel ropes which are fixed on the storage tank dome roof. The design of the all storage tanks, aluminium dome roofs and internal floating covers are in accordance with EUROCODES.

IZGRADNJA TERMINALA ZA ALKOHOL V LUKI KOPER

Jelena Vojvodič Tuma¹, Štefan Hozjan²¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija²Nafta Strojna d.o.o., Mlinska 5, 9220 Lendava, Slovenija

Na terminalu tekočih tovorov na pomolu I v Luki Koper poteka gradnja rezervoarjev za alkohole skupne kapacitete 32.000 m³. Rezervoarji imajo lovilni bazen in dvojno dno, notranji premerom 22.000 mm, višino plašča 17.200 mm, premer lovilnega bazena 27.000 mm in višino lovilnega bazena 11.500 mm. Lovilni bazen skupaj s kontroliranim medprostorom dvojnega dna predstavlja zanesljivo varovanje proti iztekanju medija iz rezervoarjev v okolico. Osnovni material rezervoarjev je S235 JRG2 po EN 10025.

Protikorozijsko so rezervoarji in pripadajoči cevovodi zaščiteni s poliuretanskim akril-izocianatnim premazom. Rezervoarji imajo aluminijaste samonosilne strehe.

V rezervoarje pa so vgrajene plavajoče membrane. Aluminijasta konstrukcija strehe je na vrhni vetrovni ojačitveni profil pritrjena z drsnimi podporami, ki v kombinaciji z integriranim napetostnim obročem minimalizirajo radialne obremenitve na plašč rezervoarja. Aluminijasti profili prostorske konstrukcije so iz materiala AA 6061-T6, trikotne pločevine strehe pa so iz materiala 3003-H16. Streha rezervoarja je opremljena še s priključki in dihalnimi elementi, ki zagotavljajo ventilacijo rezervoarja, ozemljitvenimi kabli aluminijastih nosilnih profilov in posameznih drsnih podpor, anti-rotacijskimi vrvmi, priključki za jemanje vzorcev in priključki, ki so potrebni za pritrditev nosilnih vrvi plavajoče membrane.

Plavajoča membrana je namenjena zmanjševanju emisij skladiščenih alkoholov zaradi izparevanja. Sestavljena je iz aluminijastih plavajočih komor medsebojno povezanih v nosilno konstrukcijo, ki je prekrita z aluminijasto folijo. Plavajoča membrana je v praznem rezervoarju obešena na jeklenih vrveh, ki so s posebnim sistemom vpetja pritrjene na streho rezervoarja. Konstrukcija rezervoarjev in aluminijastih streh v celoti ustreza zahtevam predpisov EVROCODE.

KM-27

CORROSION LEAKINGS OF BOTTON OF VESSELS FOR HYDROCARBONS

Jelena Vojvodič Tuma

Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia

Vessels for liquid hydrocarbons, the biggest in Slovenia has the volume of 60.000 m³, are welded from structural or microalloyed steels. These steels are corrosion resistant to hydrocarbons, however, corrosion may be induced by impurities. A special form of stress corrosion was observed in the case of presence of hydrogen sulfide (H₂S). This compound reacts with iron, atomic hydrogen is dissolved in steel, it diffuses to areas of tensile stresses, increases the local brittleness and causes local transgranular cracks. Especially, welding areas are prone to such damage.

Different damages have been observed on corrosion not protected bottoms or with damaged protection layer. Water present as impurity is sedimented on the bottom and it is incompletely drained. Local steel corrosion may start on bottom points with increased corrosion potential. The corrosion rate is greater because the anodic area is small and the cathodic much greater and its rate is increasing because of the increasing difference in oxygen between the pit surface and vessel bottom. In this way, leakage points of size of some mm are formed. Much greater leakages of diameter of some cm may be formed if a greater current by several orders of magnitude than the standard corrosion current, is generated by an external source and it is conducted to the bottom through the legs of the moving vessel roofing.

KOROZIJSKI PRODORI DNA JEKLENIH REZERVOARJEV ZA OGLJIKOVODIKE

Jelena Vojvodič Tuma

Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija

Rezervoarji za tekoče ogljikovodike so velike posode, v Sloveniji je prostornina največjega 60.000 m³, zvarjene iz konstrukcijskih ali mikrolegiranih jekel. Tekoči ogljikovodi ne povzročajo korozije teh jekel, pač pa lahko nastanejo korozijske poškodbe zaradi nečistoč in vode, ki ima povečano elektroprevodnost, ker vsebuje elektrolite. Posebna oblika napetostne korozije se lahko pojavi, če ogljikovodik vsebuje vodikov sulfid (H₂S). Ta reagira s površino jekla pri temperaturi ambience, nastali atomarni vodik se raztopi v jeklu, difundira v področja nateznih napetosti, lokalno poveča krhkost in povzroča transkristalne razpoke. Za to vrsto korozije so posebno občutljiva krhka področja zvarov.

Drugačne poškodbe povzroča elektrokemična korozija, redkeje nek zunanji vir elektrin. Pri dosedanjih nadzorih stanja rezervoarjev smo srečali dve vrsti korozije, lokalno korozijo nezaščitenega in zaščitenega poškodovanega dna. Voda, ki vsebuje ione natrijevega klorida, se useda na dno in je drenaža ne odstrani popolnoma. Na nezaščitem dnu se korozija začne na mestih z lokalnim korozijskim potencialom, ki je večji od potenciala okolice. Lokalni proces elektrokemične korozije je hiter zato, ker je majhno anodno mesto, katoda pa zelo velika. Z naraščanjem globine nastale zajede se proces korozije pospešuje zaradi rasti razlike v koncentraciji kisika med površino in dnem zajede. Tako nastajajo prodori dna s premerom več mm. Večja poškodba s premerom nekaj cm lahko nastane pod nogo premične strehe posode, če nek zunanji vir generira elektenino, ki je za več redov velikosti večja od tiste, ki jo generira elektrokemična korozija.

KM-28

ENERGIJA VETRNIH TURBIN

Jelena Vojvodič Tuma¹, M. Jenko¹, Fevzi Kafexhiu¹, S. Ažman²

¹Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana

²Rikljeva cesta 11, Bled, Slovenija

Evropsko združenje za vetrno energijo EWEA (European Wind Energy Association) je objavilo, da je imela v letu 2008 vetrna energija 43 % delež vseh na novo postavljenih zmogljivosti za proizvodnjo električne energije in je tako prehitela vire kot so plin, nafta, premog in jedrska energija. Lansko leto je bilo v državah Evropske unije zgrajenih za 19,651 gigavatov novih zmogljivosti za proizvodnjo električne energije, od tega je 8,481 gigavatov odpadlo na vetrno energijo. V povprečju je bilo v lanskem letu vsak delovni dan postavljenih 20 vetrnih turbin. Ker je načrtovana gradnja vetrnih turbin tudi na področju jugovzhodnega Balkana, bodo v prispevku podane značilnosti vetrnih turbin, ki pridobivajo tako kot vodne turbine, koristno energijo iz obnovljivih energetskega virov. Vetrne turbine so energetske pogonske stroje, v katerih se kinetična energija vetra spreminja v mehansko delo in naprej v električno energijo. Razložene bodo hitrostne razmere okoli vetrnice, največja teoretična moč vetrnice in dejanska moč vetrnice, prikazani pa bodo tudi najpomembnejši konstrukcijski deli vetrne turbine.

WIND TURBINES ENERGY

European Wind Energy Association (EWEA) has announced that in 2008, wind power rate was 43% of all newly installed capacity of electricity generation and is overtaking other energy sources such as gas, oil, coal and nuclear energy. Last year in the European Union were built 19,651 gigawatts new capacities for electricity generation, of which 8481 gigawatts accounted on wind power. On the average in last year, 20 wind turbines were installed for each working day. Since the construction of wind turbines were also planned in the area of south-eastern Balkans, as a contribution, the characteristics of wind turbines will be given, that provide the same way as water turbines - usable energy from renewable energy sources. Wind turbines are power production facilities, where the kinetic energy of wind is converted into mechanical work and further in electric energy. The velocity conditions around the windmills, the maximum theoretical power and the actual power of wind turbines will be explained. Also, the most important structural parts of wind turbines will be shown.

KM-29

WEDGE TEST

Borut Žužek¹, Peter Fajfar², Franc Tehovnik¹, Boris Arzenšek¹, Matevž Mužan²

¹Institute of metals and technology, Ljubljana, Slovenia

²University of Ljubljana, Faculty of Natural Sciences and Engineering, Slovenia

With purpose to determine workability and development of microstructure while rolling of stainless steel quality X2CrNiMo 17-12-3 the wedge tests were performed. These tests are rarely used because of more complicated determining of thermodynamical parameters of working, which are changing trough length and height of wedge while rolling. A mathematical model for determining the course of deformation trough length of rolled wedge was prepared. The model considers the undeformed length of wedge, when the thickness of wedge is smaller than the roll gap. When the geometry of wedge does not assure the two-dimensional state of stress while rolling, the spreading of wedge is also taken in account. The deformation distribution, movement of individual particles into wedge and temperature development along longitudinal cross-section were determined using the finite element method (FEM). By tracking the movement of particles and metallographic analysis the calculated values of deformation field was confirmed. Used method determines the fields of required deformations with high probability.

KLINASTI PREIZKUS

Borut Žužek¹, Peter Fajfar², Franc Tehovnik¹, Boris Arzenšek¹, Matevž Mužan²

¹Inštitut za kovinske materiale in tehnologije, Ljubljana, Slovenija

²Univerza v Ljubljani, Naravoslovnotehniška fakulteta, Slovenija

Z namenom določevanja preoblikovalnih lastnosti in razvoja mikrostrukture med valjanjem nerjavnega jekla X2CrNiMo 17-12-3 se je valjalo klinaste preizkušance. Zaradi zahtevnejšega določevanja termomehanskih parametrov preoblikovanja, ki se med valjanjem klina spreminjajo tako po dolžini kot tudi po višini preizkušanca se ta vrsta preizkusa redkeje uporablja. Izdelan je bil matematični model za določevanje poteka deformacij po dolžini zvaljanega klina. Model upošteva tudi dolžino nedeformiranega dela klina, kadar je debelina klina manjša od višine aktivne valjčne reže. V primeru, ko geometrija klina ne zagotavlja ravninskih pogojev valjanja, se upošteva tudi stopnja širjenja po dolžini zvaljanega klina. Z numerično metodo končnih elementov se je določilo porazdelitev deformacij, pomik posameznih delcev v klinu in razvoj temperature po vzdolžnem prerezu zvaljanega klina. Z zasledovanjem pomika delcev in metalografsko analizo se je potrdilo izračunane vrednosti deformacijskega polja. Uporabljena metoda z veliko verjetnostjo določa področja želenih deformacij.

KM-30

CARBIDE IDENTIFICATION IN SEMI-HSS WITH EDS AND EBSD TECHNIQUES

J. Gontarev¹, M. Doberšek², I. Naglič²

¹Valji d.o.o. Štore

²Institute of metals and technology

The microstructural difference of different HSS steels such as the matrix, distribution of carbides, type, the size, the volume of retained austenite *etc.*, will affect the performance of the end products. The main features of the as cast microstructure are the distribution and morphology of eutectic carbides that have been obtained through the progress in alloy design concerning the type, morphology, and volume fraction of the eutectic carbides. 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 V_4C_3 and Mo_2C are present in this steel.

EBSK IN EDS KARAKTERIZACIJA KARBIDOV V NADEVTEKTOIDNI NIZKO LEGIRANI JEKLO LITINI

J. Gontarev¹, M. Doberšek², I. Naglič²

¹Valji d.o.o. Štore

²Inštitut za kovinske materiale in tehnologije

Mikrostruktorna raznolikost različnih HSS jekel, ki se kaže v lastnosti matrice, porazdelitve, vrste in velikosti karbidov, obsega zadržanega avstenita itd., bo vplivala na učinkovitost končnih izdelkov. Glavne značilnosti lite mikrostrukture so porazdelitev in morfologija evtektičnih karbidov, ki so prisotni v končni mikrostrukturi in dobljeni preko procesov načrtovanja zlitine. V nadevtektoidni nizko legirani jeklo litini legirani s kromom, molibdenom, vanadijem in nikljem so prisotne različne vrste karbidov. Karbidi prisotni v tej jeklo litini so bili opredeljene z EBSD in EDS tehniko. Obe metodi so potrdili, da so v tem jeklu prisotni V_4C_3 in Mo_2C tip karbida.

AM-1

INFLUENCE OF VARIOUS FILLERS ON THE PROPERTIES OF FIBRE-CEMENT COMPOSITES

Kristoffer Krnel¹, Franc Švegl², Krunoslav Vidovič^{1,3}, Tomaž Kosmač¹

¹ Jožef Stefan Institute, Jamova 39, Ljubljana, SI-1000

² Zavod za gradbeništvo Slovenije, Dimičeva 1, SI-1000 Ljubljana

³ ESAL d.o.o., Anhovo 9, SI-5210 Deskle

The fibre-cement composite (FCC) is a composite material that consists of hydrated Portland cement as a matrix, free water, air, small amounts of additives (fillers, pigments, etc.), and different kinds of natural or synthetic reinforcing fibres. In the company Esal d.o.o. Anhovo corrugated roofing sheets made of FCC with polyvinyl-alcohol (PVA) fibres are produced by the Hatzscek wet winding procedure. The important mineral filler used in the regular production is silica fume. The addition of silica fume has two aspects: 1) it improves the rheological properties of the green material and enables their forming into a corrugated shape, 2) it increases the bending strength and density of the composites because of its pozzolanic activity. However an appropriate alternative material needs to be found due to limited availability and relatively high price of silica fume. New filler should retain or possibly improve the good rheological properties of the green material and also the mechanical properties of the final products.

In this work we investigated the influence of the various fillers (silica fume, metakaolin and fly ash) on the mechanical properties of hardened FCC materials. Special attention has been devoted to the use of fly ash in the preparation of the composites, since it is a secondary raw material that is available from Slovenian sources – thermonuclear plants. The results indicate, that regarding the mechanical properties all of the fillers can be used without major deterioration of the mechanical properties, however in the future their influence on the rheological properties need to be evaluated. The results of the industrial experiment using fly-ash as filler will also be presented.

AM-2

HABITATE USE AND ROOST SELECTION OF THE NOCTULE BAT (*NYCTALUS NOCTULA*) IN URBAN ENVIRONMENT

Matej Hočevar^{1,2}, Peter Trontelj¹, Maja Zgmajster¹

¹Oddelek za biologijo, Biotehniška fakulteta, Univerza v Ljubljani, Slovenija

²Inštitut za kovinske materiale in tehnologije, Ljubljana, Slovenija

Habitat use and roost site selection of the noctule bat (*Nyctalus noctula*) in urban environment of the city of Ljubljana was studied. Characteristics of roost sites of *N. noctula* were recorded. Additionally, at four roost sites evening emergence of noctules were observed. Habitat use was studied with the use of bat detectors on 12 linear transects, sorted into five habitat categories. Noctules were found in buildings throughout the year, multistory buildings were preferred. The most numerous colonies were found in the hibernation period (100 to 200 individuals per roost). Emergence of bats was observed from April till the end of October, with one exception on Aškerčeva cesta 6, where emerging was noted twice during hibernation. The emergence of noctules from the roosts started on average 11 to 21 minutes after sunset and up to 134 minutes before the sunset in late summer and autumn. Time of sunset and ambient temperature were found correlated with emergence time, whereas other environmental factors showed smaller contribution. Highest activity in terms of flight passes and feeding buzzes, was recorded in the vicinity of water bodies (river Ljubljanica) and multistory buildings (Glinškova ploščad). On the other hand, activity was very low in city park, residential areas of houses, low story buildings, city forrest and its forrest edge. No significant correlation between activity recorded on transects and selected environmental factors was found. Even during this study, we could witness the destruction of summer and winter roost sites in multistory building in Ljubljana due to renovation works. However, urban environment do not offer only roosts sites for bats. Especially river Ljubljanica and illuminated parking places offer foraging sites as well.

AM-3

THERMAL TREATMENT AND VITRIFICATION OF MUNICIPAL SOLID WASTE INCINERATOR FLY ASH

Natalija Orešek¹, Franc Berk[†], Niko Samec¹, Franc Zupanič¹

¹Univerza v Mariboru, Fakulteta za strojništvo, Smetanova 17, 2000 Maribor, Slovenia

[†]Javno podjetje za komunalne storitve Rogaška Slatina, d. o. o., Rogaška Slatina, Slovenia

During the incineration of municipal waste, large amounts of residues are formed. They have to be safely disposed due to serious environmental impact on people and animals. Among these residues, electrostatic fly ash and boiler ash have the same composition – they contain large amounts of heavy metals and undesired elements (As, Pb, Sb, Sn, Sr) as well as traces of organic pollutants (polychlorodibenzo-dioxins and furans). Because of high environmental standards and strict regulations in force fly ash is considered to be a dangerous waste and should consequently be landfilled under strict conditions or in dormant chambers as fillers.

The chemical composition and physical properties of fly ash depend mainly on the composition of the input waste which varies and depends on the season and composition of the waste material. Fly ash mainly contains such components as SiO₂, Al₂O₃, CaO and variable amounts of MgO, Na₂O, K₂O, sulphur (as SO₃) which are the same as those in the glass producing industry. The main aim was therefore to study the possibility of the heat treatment of fly ash issuing from the incineration plant in Augsburg, Germany, and the manufacturing of compact solid material for landfilling. Three different methods for thermal and heat treatment of fly ash were applied (melting + crystallization, melting + grinding + pressing + sintering and pressing + sintering), and also the possibility of inertization of fly ash with local waste glass cullet was studied in order to obtain products with the most optimal properties. A massive, glassy-like amorphous product was formed, fly ash melted and became glassy (vitrified). If glass produced by this procedure is subsequently heat treated in order to obtain better chemical resistivity and higher compressive strength, it crystallizes (is devitrified) and glass-ceramics is formed.

The relationships between the melting temperature, heat-treatment temperature and pressure were analysed and discussed.

By measuring different physical and chemical properties of the produced material, we studied the best technology for obtaining a chemically durable material with a high compressive strength. This technology would allow a safe and harmful landfilling of the produced material and its usage in practical applications (for example as a landfilling, embankment or paving material).

TERMIČNA PREDELAVA IN ZASTEKLITEV LETEČEGA PEPELA IZ SEŽIGA KOMUNALNIH ODPADKOV

Pri sežigu komunalnih odpadkov nastajajo večje količine produktov, ki jih moramo ustrezno zajeti in obdelati do take stopnje, da ne bodo negativno vplivali na okolje in ljudi. Med temi produkti sta zelo pomembna leteči pepel in pepel iz zadnjega dela kotla, ki sta si po sestavi podobna. Vsebujeta namreč velike količine težkih kovin in nevarnih kemikalij (As, Pb, Sb, Sn, Sr), pa tudi sledi organskih polutantov (poliklordibenzo-dioksini in furani). Teh odpadkov ni mogoče odlagati v okolje ali jih koristno in varno za okolje in ljudi uporabiti za druge uporabne produkte brez stabilizacije ali celo inertizacije. Zelo različna sestava teh odpadkov naredi problematiko še zahtevnejšo, saj je njihova sestava odvisna od sestave komunalnih odpadkov in primesi pri sežigu.

Kemijska sestava in fizikalne lastnosti letečega pepela so odvisne predvsem od sestave vhodnega materiala – torej od komunalnih odpadkov, ki pa variira in se spreminja v odvisnosti od sezone in sestave odpada. V splošnem pa leteči pepel vsebuje SiO₂, Al₂O₃, CaO in spremenljive količine MgO, Na₂O, K₂O, žvepla (kot SO₃),... – podobne sestavine, kot se uporabljajo v steklarski industriji za pripravo stekla. Zato je bil osnovni cilj preveriti zmožnost visokotemperaturnega taljenja letečega pepela sežigalnice v Augsburgu, Nemčija, in iz prašnega pepela izdelati kompaktne masivne dele po različnih postopkih (taljenje + kasnejša kristalizacija vzorca; taljenje + mletje materiala + stiskanje +

sintranje vzorca in stiskanje + sintranje vzorca), hkrati pa raziskati možnost stabilizacije oz. celo inertizacije letečega pepela z lokalnim – slovenskim odpadnim, pretežno komunalnim steklom do take kvalitete, da bi ga bilo mogoče uporabiti za predelavo v koristne izdelke. Pri taljenju se tvori steklu podobna amorfna snov; leteči pepel se zatali, postane steklast oz. se vitrificira. Če nastalo steklo kasneje toplotno obdelamo – z namenom pridobitve boljše kemijske obstojnosti in višje tlačne trdnosti –, nastalo steklo kristalizira (se razstekli oz. devitrificira), nastane steklokeramika.

Raziskane so bile relacije in odvisnosti med temperaturo taljenja letečega pepela, tlaka, s katerim stisnemo vzorec pred sintranjem, in temperaturo toplotne obdelave dobljenega produkta z namenom pridobiti izdelek z najoptimalnejšimi lastnostmi.

Na podlagi meritev različnih fizikalnih in kemijskih lastnosti izdelanih vzorcev smo ugotavljali, po kateri od teh tehnologij lahko iz prašnega letečega pepela izdelamo kompaktne dele s primerno trdnostjo in kemijsko obstojnostjo, kar bi omogočilo njihovo varno in neškodljivo odstranjevanje na odlagališče za nenevarne odpadke oziroma uporabo v praktične namene (kot npr. nasipni material oz. kot material za tlakovanje).

P-1

KINETICS AND MASS TRANSFER OF TRANSESTERIFICATION OF RAPESEED AND WASTE SUNFLOWER OILS

¹B. Klofutar, ²J. Golob, ²B. Likozar, ³C. Klofutar, ⁴E. Žagar, ⁴I. Poljanšek
¹ZORD Slovenija, 1000 Ljubljana, Slovenia

²University of Ljubljana, Faculty of Chemistry and Chemical Technology, 1000 Ljubljana, Slovenia

³University of Ljubljana, Biotechnical Faculty, Department of Food Technology, 1000 Ljubljana, Slovenia

⁴National Institute of Chemistry Slovenia, 1001 Ljubljana, Slovenia

The transesterification of rapeseed and waste sunflower oils with methanol in the presence of potassium hydroxide as a catalyst was investigated. The transesterification of the investigated tri-acylglycerols was conducted in a batch reactor. The effect of the temperature (40 °C and 50 °C) on the rates of the reactions was studied at a constant molar ratio of alcohol to tri-acylglycerols (6 : 1) and at a constant concentration of the catalyst (the mass fraction 1.0 %). Size exclusion chromatography (SEC) was used to quantitatively monitor the transesterification reaction of rapeseed and waste sunflower oils to mono-alkyl esters. The results were correlated with the results obtained by ¹H NMR spectroscopy. Three stepwise and reversible reactions were assumed to occur. Mass transfer limitations were considered for various temperatures. The reaction rate constants for the transesterification of tri-, di- and mono-acylglycerols were determined based on a mathematical model, describing the kinetics of transesterification. The activation energies of particular reactions were evaluated from the reaction rate constants, determined at two temperatures. The parameters extracted from the laboratory data were applied for an industrial setup.

VT-1

IMPROVED STATIC GAS-SORPTION METHOD FOR CHARACTERIZING NON-EVAPORABLE GETTERS

Bojan Erjavec, Janez Šetina

Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

Non-evaporable getters (NEGs) based on Ti- and Zr-alloys, which exhibit large sorption capacity for H₂ and simultaneously high pumping speed for chemically active gases (H₂O, CO, N₂, O₂, CO₂), are used for maintaining ultrahigh vacuum conditions in small static vacuum systems (hermetically encapsulated devices). Porous thick-film NEGs are incorporated in Dewar flasks, plasma displays, field-emission displays, image intensifiers, photomultipliers, micro-electro-mechanical systems (MEMS), etc. Due to miniaturization of some of the mentioned devices, such as channel photomultipliers (CPMs) and MEMS, there exists a need for incorporating structured thin-film NEGs produced by vacuum sputtering.

The main characteristics of the improved static gas-sorption method, developed at IMT, are constant gas flow and variable pressure above the getter surface. It is essential that inert vacuum gauges such as the capacitance diaphragm gauge (CDG) and the spinning rotor gauge (SRG) are used for adjusting and *in situ* calibrating gas flow by the rate of pressure rise method as well as the same SRG for measuring pressure above the getter surface. For the static gas-sorption method, it is characteristic that during the sorption test non-getterable gases (noble gases and CH₄) may accumulate in the test chamber. Therefore, the test gas flow is few times interrupted in order to measure the change in background pressure.

There are several advantages of the improved static gas-sorption method over the widely used standard dynamic gas-sorption method, since total pressure measurements are performed using the inert CDG and SRG in static mode without poisoning NEGs under test. The improved static method enables discrete monitoring the background pressure rise due to accumulation of inert gases throughout the sorption test and, at the end of test, analysis of non-getterable gas composition by the gas-burst method using RGA. In addition, the composition of residual atmosphere during the activation process is controlled using RGA in dynamic mode.

IZBOLJŠANA STATIČNA SORPCIJSKA METODA ZA KARAKTERIZACIJO NENAPARLJIVIH GETROV

Bojan Erjavec, Janez Šetina

Inštitut za kovinske materiale in tehnologije, Lepi pot 11, 1000 Ljubljana, Slovenija

Nenaparljivi getri (NEG) na osnovi Ti- in Zr-zlitin, ki izkazujejo veliko sorpcijsko kapaciteto za vodik in hkrati veliko črpalno hitrost za kemijsko aktivne pline (voda, ogljikov monoksid, dušik, kisik, ogljikov dioksid), se uporabljajo za vzdrževanje ultravisokega vakuumu do ekstremnega visokega vakuumu v majhnih statičnih vakuumskih sistemih (hermetično inkapsuliranih napravah). Tako se porozni debelo-plastni NEG vgrajujejo v posebne Dewar posode, plazemske prikazalnike, poljsko-emisijske prikazalnike, slikovne ojačevalnike in fotopomnoževalke, mikro-elektro-mehanske sisteme (MEMS) itd. Z nadaljnjo miniaturizacijo nekaterih naštetih naprav, kot so kanalne fotopomnoževalke in MEMS, se je nedavno pojavila potreba po vgrajevanju strukturiranih tanko-plastnih NEG, na osnovi Ti- in Zr-zlitin, izdelanih z vakuumskim naprševanjem.

Za izboljšano statično sorpcijsko metodo, ki je bila razvita na IMT, je značilen konstanten plinski pretok in spremenljiv tlak nad getsko površino. Bistvena je uporaba inertnih merilnikov, kot sta kapacitivni membranski merilnik (CDG) in viskoznostni merilnik z lebdečo kroglico (SRG), ki sta namenjena za nastavitev ter *in situ* kalibracijo plinskega pretoka z metodo hitrosti naraščanja tlaka, in uporaba istega SRG za merjenje tlaka nad getsko površino. Pri statični metodi lahko v merilni komori poteka akumulacija inertnih plinov (žlahtnih plinov in CH₄). Zato se med preskusom plinski pretok nekajkrat prekine, kar omogoča meritev spremembe rezidualnega tlaka.

Prednost izboljšane statične sorpcijske metode v primerjavi s standardno dinamično sorpcijsko metodo je v uporabi inertnih CDG in SRG v statičnem načinu, ki med testom ne zastrupljata površino NEG. Izboljšana statična sorpcijska metoda omogoča diskretno spremljanje naraščanja rezidualnega tlaka zaradi akumulacije inertnih plinov. Na koncu sorpcijskega testa je omogočena tudi analiza sestave akumuliranih plinov s plinsko sunkovno metodo uporabljajoč kvadrupolni masni spektrometer (QMS). Dodatno je tudi omogočena kontrola rezidualne atmosfere med aktivacijskim postopkom uporabljajoč QMS v dinamičnem načinu.

VT-2

NUMERICAL SOLVING OF POISSON EQUATION IN 3D BY FINITE DIFFERENCE METHOD (FDM)

Sefer Avdiaj¹, Janez Šetina², Albert Januzaj³

¹Lotrič, d. o. o., Selca 163, 4227 SELCA, Slovenia

²Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

³University of Prishtina, Mother Teresa av, 10000 Prishtina, Kosovo

Scientists and engineers use several techniques in solving continuum or field problems. Loosely speaking, these techniques can be classified as experimental, analytical, or numerical. Experiments are expensive, time consuming, sometimes hazardous, and usually do not allow much flexibility in parameter variation. However, every numerical method, as we shall see, involves an analytic simplification to the point where it is easy to apply the numerical method. In spite of this fact, the following methods are among the most commonly used in electromagnetism (EM). In general these methods could be divided in: Analytical Methods and Numerical Methods.

Application of these methods is not limited to EM-related problems; they find applications in other continuum problems such as in fluid, heat transfer, and acoustics.

The aim of this work is to be able in the future to be used to solve the diffusion equation (Fick's Second Law) which is very useful in vacuum system.

In this work the FDM has been elaborated. In the beginning approximate methods in general have been elaborated.

The main problem of electrostatics is solving Poisson equation. In the regions where there is no charges, the Poisson equation transforms into Laplace equation. The most common situations are when the potential on the surface that surrounds the area of interest is known.

The finite difference techniques are based upon approximations which permit replacing differential equations by finite difference equations. These finite difference approximations are algebraic in form; they relate the value of the dependent variable at a point in the solution region to the values at some neighboring points. From the results we can see that the accuracy increases with increasing the number of grid points and iterations.

VT-3

SITHEYS OF MAGNETIC LIPOSOMES

A. Vesel¹, K. Eleršič¹, M. Mozetič¹, Janez Pavlič², Aleš Igljč²

¹Institut "Jožef Stefan", Jamova 39, 1000 Ljubljana, Slovenija

²Fakulteta za elektrotehniko, Tržaška 25, 1000 Ljubljana, Slovenija

In this contribution we present procedure for synthesis of magnetic liposomes. Liposomes which are composed of phospholipid vesicles ($\approx 1 \mu\text{m}$) are formed by electroformation. Electric field enables easy formation of liposomes from a mixture of nonpolar solvents, lipids, cholesterol, sucrose and nanoparticles. Superparamagnetic nanoparticles $\gamma\text{-Fe}_2\text{O}_3$ are trapped between the phospholipids double-layer. This type of magnetic liposomes can be very easy handled by a suitable external magnetic field. Therefore they can found potential application in medicine for therapeutic purposes: e.g. drug delivery or for use in immuno assays for the isolation and detection of specific molecules of interest.

SINTEZA MAGNETNIH LIPOSOMOV

V prispevku predstavljamo postopek sinteze magnetnih liposomov. Ti so sestavljeni iz fosfolipidnega mehurčka ($\approx 1 \mu\text{m}$), v katerem so superparamagnetni nanodelci železovega oksida ujeti v fosfolipidni dvoslojni mehurček. Ker lahko tovrstne magnetne liposome s primernim zunanjim magnetnim poljem vodimo, so zanimivi za uporabo v medicini v terapevtske namene, kot npr. nosilci zdravil na specifična mesta obolenja, ali pa za uporabo v imunskih preizkusih za izolacijo in detekcijo specifičnih molekul iz raztopin. Za sintezo fosfolipidnih mehurčkov smo uporabili metodo elektroformacije. Električno polje pospeši in omogoči formacijo magnetnih liposomov iz mešanice nepolarnega topila, lipidov, holesterola, saharoze in nanodelcev.

VT-4

IMPEDANCE MATCHING NETWORK FOR INDUCTIVELY COUPLED PLASMA SYSTEMS

R. Zaplotnik^{1,2}, A. Vesel¹, M. Mozetič¹

¹Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia

²Induktio, d. o. o., Litostrojska 44 d, 1000 Ljubljana, Slovenia

Impedance matching network provides that the maximum power is transferred from the source to the load and if the source and the load are connected with transmission line, matching network enables that electromagnetic waves do not reflect from the load.

Our coil for inductively coupled plasma and the high frequency generator (8 kW, 27.12 MHz) are connected with a coaxial cable. To prevent standing waves and reflected power in the cable and to provide maximum power in the coil we need to install matching network between the cable and the coil. We have chosen the second order L-matching network, and because the plasma system is inductively coupled, the plasma impedance is inductive and therefore we need L network with two capacitors. These two capacitors need to be variable. Each time the plasma parameters are changed, plasma impedance also changes and then the capacitance of the matching capacitors also needs to be changed.

With the use of Smith charts we calculated the approximate capacitance of the two variable vacuum capacitors. We confirmed these values with computer simulations. Variable capacitance also helps with the ignition of the plasma and makes it possible to use different coils. This network will soon be tested on a real plasma system.

NN-1

POLYMER-FIBER COMPOSITES BUILT FROM NEW MoO_{3-x} NANOWIRE MATERIALS

M. Conradi¹, M. Remškar², A. Mrzel², M. Chambers^{1,3}, V. Domenici⁴, B. Zalar²

¹Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana

²J. Stefan Institute, Jamova 39, SI-1000 Ljubljana

³Krško Nuclear Power Plant, Vrbina 12, SI-8270 Krško, Slovenia

⁴Dipartimento di Chimica e Chimica Industriale, Università degli studi di Pisa, via Risorgimento 35, 56126 Pisa, Italy

Low dimensional materials often show exceptional properties compared to those of the corresponding macroscopic compounds, especially beyond the linear regime of the force-deformation curve. The MoO_{3-x} nanowires belong to photocromic materials and are promising candidates for lithium intercalation, hydrogen sensing, and smart windows. Currently, a development of nanomaterials promotes in a direction of multi-functional polymer composite structures, which prevent release of nanoparticles into atmosphere and eliminates a possible health effects of nanowires.

We report on a successful preparation of liquid single crystal elastomers (LSCE) containing MoO_{3-x} nanowires, mostly the conductive Mo_5O_{14} phase. LSCE was made of commercial polysiloxane chain PMS, mesogen M1 (85 %), and non-mesogenic crosslinker V1 (7.5 %).

This particular combination of molybdenum based nanowires and LSCE enables functionalization of single-crystal elastomers preventing the pristine mechanical and optical properties of the host matrix. Polarized optical microscopy has been used for revealing a tendency of nanowire orientation along the director of the LSCE, while the surface topography was studied with atomic force microscopy in a tapping mode.

NN-2

PREPARATION OF THIN SECTION SAMPLES FOR TEM USING Ar ION SLICING

Darja Jenko, Črtomir Donik, Borivoj Šuštaršič, Monika Jenko
Institute of metals and technology, Lepi pot 11, p.p. 431, SI-1000 Ljubljana, Slovenia

Ion milling, electrolytic polishing and focused ion beam (FIB) processing are techniques used for specimen preparation for transmission electron microscopy (TEM) analysis. A new alternative approach to these kind of specimen preparations is presented using a Jeol EM-09100IS Ion Slicer. The instrument irradiates an argon ion beam on the specimen and thins it.

Specimens of silicon wafer and different duplex stainless steels (DSS), thickness of around 500 μm , were cut out of a bulk material in rectangular area of 0.5–1.0 mm \times 2.8 mm (bulk cross section preparation) or 1.0 mm \times 2.0 mm (plane surface preparation). The specimens were thinned to less than 100 μm with Jeol Handy Lap, mounted on an Ion Slicer specimen holder, partially masked with a shield belt (bulk cross section preparation) or specimen support ring (plane surface preparation), and further thinned with an argon ion beam. The beam was tilted to 1.2° or 1.4°. The slicing process started at the pressure of 10^{-4} Pa and alternated between the front and the backside or just the frontside of the specimens. Accelerating voltage of 6 kV, argon gas flow rate of 7.2 or 7.3 and side change interval of 30 s were chosen. After a large thin area of the specimens up to 300 μm \times 700 μm was obtained, a small hole was generated in the thinnest region of the specimens. Polishing was used with a tilt angle of 0.5°, at accelerating voltage of 2 kV and side change interval of 15 s or 40 s. The total time of slicing was 3 h and 48 min for Si and 1 h and 15 min or 9 h and 40 min for DSS.

The specimens were after slicing further analyzed on atomic level by high resolution TEM using Jeol JEM-2100 at 200 kV.

NN-3

TEM CHARACTERIZATION OF Si THIN SECTION SAMPLE PREPARED USING Ar
ION SLICING

Darja Jenko, Monika Jenko

Institute of metals and technology, Lepi pot 11, p.p. 431, SI-1000 Ljubljana, Slovenia

The preparation of silicon thin section sample for transmission electron microscopy (TEM) by argon ion slicing using Jeol EM-09100IS Ion Slicer is presented. Thin section of Si sample was further analyzed by HRTEM (high-resolution TEM) using Jeol JEM-2100 at 200 kV. The preparation of thin section samples using Ar ion slicing leads to high quality TEM pre-treatment. Minimal surface damage is present. Large thin electron transparent areas are still surrounded by thick sample parts which enhance the stability of the sample.

NN-5

DEGRADATION OF ORGANIC DYES – A METHOD FOR THE EVALUATION OF PHOTO-CATALYTIC ACTIVITY

Vladimira Petrovič¹, Vilma Ducman¹, Srečo D. Škapin²

¹ Zavod za gradbeništvo Slovenije, Dimičeva 12, 1000 Ljubljana

² Institut Jožef Stefan, Jamova 39, 1000 Ljubljana

Self-cleaning photo-catalytic coatings based on nanotitania are applied to outdoor building surfaces to suppress deterioration processes. This photocatalytic agent chemically decomposes organic pollutants when exposed to UV light and transform them to harmless components.

In order to evaluate self-cleaning effectiveness many experimental methods have been developed; one of the most commonly used is discoloration of methylen blue dye (MB). The method is based on discolouring (change of the concentration) of the MB in de-ionized water when the solution is in contact with photo-catalysts and exposed to UV light. The suitability of the method for the evaluation of self-cleaning building products was verified on samples prepared in-lab as well as on commercially available samples.

Our results show that the following parameters are important when establishing the method: i) applied UV light spectrum, ii) light intensity, iii) time of pre-adsorption, and iv) quantity of test solution. Since MB is not stable under visible light, some other organic dyes were used instead of MB.

RAZPAD ORGANSKIH BARVIL – METODA ZA DOLOČITEV UČINKOVITOSTI FOTOKATALITSKEGA EFEKTA

Za zaščito zunanjih gradbenih površin se uporabljajo samočistilni fotokatalitski nanosi na osnovi nano delcev TiO₂. Ta fotokatalitski agent pod vplivom UV svetlobe kemijsko razgradi organske onesnaževalce v neškodljive snovi.

Za določevanje fotokatalitske učinkovitosti je bilo razvitih več metod; ena najpogosteje uporabljenih je razpad organskega barvila metilen modro (MM). Metoda temelji na razbarvanju (zmanjšanju koncentracije) MM v de-ionizirani vodi, ko je raztopina v stiku s fotokatalizatorjem in izpostavljena UV svetlobi.

Primernost oziroma ustreznost te metode za ovrednotenje samočistilnih gradbenih proizvodov smo preverjali na laboratorijsko pripravljenih in komercialno dostopnih vzorcih. Ugotovili smo, da na končne rezultate vplivajo naslednji parametri: i) uporabljen spekter UV svetlobe, ii) intenziteta svetlobe, iii) čas predadsorpcije in iv) količina preskusne raztopine. Ker MM ni stabilen pod delovanjem vidne svetlobe, smo uporabili tudi druga organska barvila.

NN-5

DETERMINATION OF PHOTOCATALYTIC ACTIVITY OF NANOTITANIA-CONTAINING SAMPLES

Erika Švara¹, Luka Škrlep¹, Janez Bernard¹, Petra Živec², Andrijana Sever Škapin¹¹Slovenian National Building and Civil Engineering Institute, Dimičeva 12, 1000 Ljubljana, Slovenia²TRC JUB, d.o.o., Dol pri Ljubljani 28, 1262 Dol pri Ljubljani, Slovenia

In the last two decades, photocatalysis has been subject not only numerous scientific papers but also of real applications. The most commonly used catalyst is a semiconducting nanosized TiO₂, which under UV radiation triggers specific physical-chemical processes. The resulting highly reactive species cause degradation of many organic compounds, performing the so-called-self-cleaning effect. Addition of photocatalytically active materials into outdoor coatings or films helps decrease the level of dirt deposited on exposed surfaces. Visible-light-sensitive photocatalysts are necessary as coating additive for indoor walls, where the UV part of sun radiation is not present.

We have synthesized undoped titania nanoparticles using thermolysis. In order to decrease the activation energy for photocatalysis and thus make photocatalysts already active under visible light, various dopants (silver, carbon, sulfur and cerium) have been incorporated into the nanotitania. The synthesized nanosized titania samples were used in preparation of self-cleaning coatings for selected building surfaces.

We have measured the synthesized nanotitania, selected nanotitania samples available on the market and several real samples (different self-cleaning façade coatings and roofing tiles) by means of photocatalytic activity. The effect of using different nano-TiO₂ on the photocatalytic activity of the respective coatings, under UV and visible light, was quantitatively evaluated by determination of the rate of the degradation of model organic pollutant isopropanol in gas-solid system by FTIR.

DOLOČEVANJE FOTOKATALITSKE AKTIVNOSTI NANO-TiO₂ VZORCEVErika Švara¹, Luka Škrlep¹, Janez Bernard¹, Petra Živec², Andrijana Sever Škapin¹¹Zavod za gradbeništvo Slovenije, Dimičeva 12, 1000 Ljubljana, Slovenija²TRC JUB, d.o.o., Dol pri Ljubljani 28, 1262 Dol pri Ljubljani, Slovenija

Zanimanje za raziskave in uporabo fotokatalize se je v zadnjih desetletjih izrazito povečalo. Ponavadi se kot fotokatalizator uporablja polprevodnik TiO₂ v nanometrskih dimenzijah. Pod vplivom UV sevanja ta povzroči posebne fizikalno-kemijske procese, ki vodijo do razpada mnogih organskih spojin, kar povzroči t.i. samo-čistilni efekt. Fotokatalitsko aktivni materiali v zunanjih premazih in filmih razgrajujejo nečistoče, ki se nalagajo na izpostavljene površine. Za notranje površine, kjer UV del sončnega spektra ni prisoten, je potrebno uporabiti fotokatalizatorje, občutljive na vidno svetlobo. Z uporabo termolize smo sintetizirali nedopirane nanodelce TiO₂. Pripravili smo tudi TiO₂, dopiran z različnimi elementi (srebro, ogljik, dušik, žveplo in cerij) z namenom zmanjšati aktivacijsko energijo za fotokatalizo in tako narediti fotokatalizator aktiven tudi pod vplivom vidne svetlobe. Nanodimenzijski TiO₂ smo uporabili pri pripravi samočistilnih premazov za izbrane gradbene površine.

Izmerili smo fotokatalitsko aktivnost sintetiziranih in komercialnih nanodelcev TiO₂ ter nekaterih realnih vzorcev (različnih samočistilnih fasadnih premazov in strešnikov). Vpliv uporabe različnih nanodelcev TiO₂ na fotokatalitsko aktivnost premazov smo kvantitativno ovrednotili z določevanjem hitrosti degradacije modelne organske nečistoče izopropanola v sistemu plin-trdno s pomočjo FTIR.

VO-1

SOME ASPECTS OF ADVANCED APPLICATION FOR FRACTIONAL WAVELET
TRANSFORM IN THE REAL LIFE APPLICATIONS

Lazarević, M.P.¹, Vasić, V.¹, Cvelbar, R.², Suban, M.²

¹ Katedra za primenjenu mehaniku, Mašinski fakultet Univerziteta u Beogradu, Kraljice Marije 36, 11020
Beograd 35, Srbija

² IMK - Inštitut za metalne konstrukcije, Mencingerjeva 7, SI-1000 Ljubljana

The principle of intelligent material or construction diagnosis and its application prospects in structural properties detection (e.g. damage, fatigue, damping) is based on the on structural dynamic characteristic parameters. The system response is evaluated by vibro-acoustic signals and is usually very short and noisy. The new recently developed fractional wavelet transform technique offers very handy tool to perform the signal analysis for pattern, feature search - especially in denoising, spike removal and compression of data set. Presented are the advantages of the fractional wavelet over the rest of the conventional (Fourier transformation) signal analysis techniques as well as other wavelet analysis techniques in the real life applications (e.g. constructions, material crack, and damping).

AVTORSKO KAZALO – AUTHORS INDEX

A

Adolf Z. 74
 Antolič V. 79
 Anžel I. 63
 Arzenšek B. 69, 75, 77, 94, 102
 Avdijaj S. 47, 110
 Ažman S. 101

B

Bažan J. 76
 Belič I. 71
 Berk F. 106
 Bernard J. 117
 Bernetič J. 75, 77, 90
 Bernstorff S. 37
 Bitenc M. 37
 Bonča M. 67
 Breclj F. 89
 Brulc B. 36
 Bundara B. 67, 91
 Bytyqi A. 41

C

Cajner F. 60
 Cefalas C. 57
 Celin R. 77
 Chambers M. 113
 Conradi M. 113
 Crnjak Orel Z. 37
 Cvelbar R. 67, 91, 118

D

Dakskobler A. 33
 Doberšek M. 103
 Dolinar D. 79
 Domenici V. 113
 Donik Č. 42, 85, 114
 Dražič G. 30, 37, 54
 Drev D. 70
 Drobne D. 50
 Dubček P. 37
 Ducman V. 116

Đ

Đorđić G. 70

E

Eichlseder W. 26
 Eleršič K. 111
 Erjavec B. 109

Č

Čuk N. 39

F

Fajfar P. 48, 53, 102
 Forget P. 23, 72
 Frank P. 21

G

Godec M. 50, 72, 78, 79, 81, 83, 90, 95
 Golob J. 49, 108
 Gontarev J. 75, 92, 103
 Govekar E. 51

H

Hajdúchová L. 64
 Hájková P. 31
 Hočevar M. 105
 Holc J. 35
 Horáková D. 74, 76
 Horvat B. 54
 Hozjan Š. 99
 Hrovat M. 35

I

Iglič A. 111
 Iljkić D. 62
 Ivekovič A. 30

J

Jagodič M. 30
 Jakelj S. 69, 75
 Jaklič A. 68, 97
 Jaklič A. 69, 75
 Januzaj A. 110
 Jenko B. 24
 Jenko D. 114, 115
 Jenko M. 29, 41, 42, 44, 50, 78, 79, 81, 82, 83, 85, 90, 98, 101, 114, 115
 Jurči P. 32, 65
 Južina L. 89

K

Kafexhiu F. 43, 101
 Kevorkijan V. 42, 66, 80
 Klofutar B. 108
 Klofutar C. 108
 Kmetič D. 75
 Kobe S. 27, 52, 57
 Kocijan A. 72, 79, 81
 Kocjan A. 27
 Kompare B. 70
 König K. 30
 Kosec G. 75
 Kosec L. 53

Kosec M. 34, 35
 Kosec T. 73
 Kosmač T. 33, 38, 104
 Kovač J. 51
 Križaj A. 48
 Krnel K. 38, 104
 Krum S. 32
 Kunaver M. 39
 Kunc R. 93
 Kuščer D. 34

L

Lamut M. 55, 95
 Landek D. 60
 Lazarevič M.P. 118
 Legat A. 51, 73
 Leisch M. 21
 Leskovšek V. 60, 65, 82
 Lešer V. 50
 Likozar B. 108
 Lipovšek N. 83

M

Maglica A. 38
 Malešević M. 45, 92
 Malič B. 34
 Mandrino Dj. 79, 85
 Mandziej S.T. 59
 Marini B. 23, 72, 78, 92
 Marinšek M. 37
 Marolt T. 96
 Marziale M. 50
 Matolín V. 22
 McGuinness P.J. 27, 57
 Medved J. 68
 Medved S. 39
 Milaku A. 50
 Mozetič M. 56, 111, 112
 Mrzel A. 113
 Muhamedagić S. 86
 Mužan M. 102

N

Naglič I. 87
 Naglič I. 75, 103
 Nastran M. 67
 Nolan D. 82
 Novak S. 30

O

Orešek N. 106
 Oruč M. 86
 Otmačić Čurković H. 73

P

Pahovnik D. 40
 Panjan J. 70
 Paulin I. 42, 85
 Pavlič J. 111
 Pečko D. 52, 57
 Pellizzari M. 58
 Perko F. 97
 Perko S. 33
 Pešlová F. 64
 Petrovič V. 116
 Pihlar B. 52
 Pirnar B. 69, 75, 94
 Podaný P. 88
 Podbršček P. 37
 Poljanšek I. 108
 Poniku B. 44
 Prašnikar B. 67
 Pregelj A. 89

R

Raić K. 63
 Rečnik A. 54
 Remškar M. 113
 Rozman R. 89
 Rudolf R. 63

S

Samardžoja Z. 57
 Samec N. 106
 Santo Zarnik M. 35
 Schneider R. 61
 Sefa M. 46
 Senčič B. 93

Sever Škapin A. 117

Skobir D. A. 90
 Smoljan B. 62
 Sobotová J. 32
 Soderžnik M. 49
 Stamenković D. 63
 Steiner Petrovič D. 68
 Steiner Petrovič D. 94
 Stránský K. 76
 Stupnišek-Lisac E. 73
 Suban M. 67, 91, 118

Š

Šetina J. 46, 47, 109, 110
 Šetina-Batič B. 29, 47
 Škapin S.D. 66, 80, 116
 Škrlep L. 117
 Štagoj A. 89
 Šturm S. 57
 Šuštaršič B. 65, 72, 78, 92, 93, 114
 Švara E. 73, 117
 Švegl F. 104

T

Tatti F. 50
 Tehovnik F. 45, 68, 69, 75, 92, 94,
 97, 102
 Terčelj M. 53
 Todorović A. 63
 Toffolon C. 23
 Toffolon Masclet C. 72, 92
 Torkar M. 50, 95, 96
 Traven F. 62

Trefalt G. 34
 Trontelj P. 105
 Tuček J. 88

U

Uršič H. 35
 Uršič V. 96
 Uskoković D. 25

V

Vasić V. 118
 Vesel A. 111, 112
 Vidovič K. 104
 Vode F. 69, 75, 97
 Vodopivec F. 98
 Vohlidal J. 40
 Vojvodič Tuma J. 43, 45, 48, 72,
 77, 82, 98, 99, 100, 101

W

Westerberg L. 21

Z

Zagmajster M. 105
 Zalar B. 113
 Zaplotnik R. 112
 Zemko M. 88
 Zupanič F. 106

Ž

Žagar E. 36, 40, 108
 Žigon M. 36, 40
 Živec P. 117
 Žužek B. 53, 75, 102
 Žužek Rožman K. 52, 57

Beležke / Remarks

