DEPARTMENT FOR NANOSTRUCTURED MATERIALS K-7

The department is carrying out basic and applied research on ceramic materials, intermetallic alloys and minerals. It encompasses conventional processing as well as the development of technologies and methods for preparing new materials with novel properties. It includes experimental and theoretical investigations of structures, analyses of chemical composition at the atomic level, and measurements and calculations of physical properties, all of which help to improve the properties of micro- and nanostructured materials.

Head:
Asst. Prof. Spomenka Kobe

Various ceramic materials (ZnO, SiC_f/SiC, $BaTiO_3$ and $Sr(Ti,Fe)O_3$, functionally graded materials) have been prepared and characterized, and permanent magnets, quasicrystals and materials for hydrogen storage have been studied.

In the past year our basic research on **ZnO ceramics** was focused on the influence of small amounts (< 0.1 mol.%) of selected dopants (Bi_2O_3, Sb_2O_3, Al_2O_3) on sintering, grain growth and microstructure development. Preliminary results showed that the influence of small amounts of dopants is very complex. We were able to produce dense polycrystalline ZnO ceramics and varistor ceramics with a defined size of ZnO grains, and hence the required breakdown-voltage, with significantly reduced amounts of secondary phases at the grain boundaries. Studies of the phases of $BaBi_xO_y$-type materials, as precursors for ZnO-based ceramics with added Bi_2O_3, showed the influence of the Bi_2O_3:BaO ratio on microstructure development, which opens up new possibilities for the preparation of varistor ceramics. Investigations of ZnO-based varistor ceramics doped with metal oxides (MOs) that form a spinel phase in a reaction with ZnO, and also result in the formation of inversion boundaries (IBs) in ZnO grains, showed that in compositions with a Bi_2O_3:MO ratio < 1 the grain growth is predominantly controlled by an IB-induced mechanism. The spinel phase influences the grain growth only in varistor compositions with a Bi_2O_3:MO ratio < 1; the primary spinel forms in a direct reaction between MO and ZnO at temperatures above 800°C. We showed that the same IB-induced grain-growth mechanism in samples doped with Sb_2O_3 results in the fine-grained microstructure of high-voltage varistor ceramics while, with TiO_2-doping, the coarse-grained microstructure of low-voltage varistor ceramics is obtained. R&D activities within the project "Integrated varistor" in collaboration with industrial partners resulted in the prototype of a new current-voltage protection element that combines the characteristics of a ZnO-based varistor and a standard fuse. Within the 5FP of a CRAFT project we collaborated on the development of miniaturized varistor blocks as the active elements of a novel surge arrester.

A prototype of a new current-voltage protection element was designed that combines the characteristics of a ZnO-based varistor and a standard fuse.
100-µm-thick Nd–Fe–B magnets with coercivities of up to 1000 kAm^{-1} were developed for MAGMAS applications.
A new method was developed for quantitative HAADF-STEM analyses of chemical composition on the atomic level.

We joined the European fusion research area with two projects in FP6 Euratom/Fusion. The research involved the development of advanced materials for a future fusion reactor and focused on improvements to a **SiC_f/SiC composite** as a possible candidate for the reactor's first wall. Our main tasks were the development of alternative methods for coating, infiltration and densification of the SiC_f/SiC composites at moderate temperatures, using a nano-sized ceramic slip based on low-activation constituents.

In collaboration with the Faculty of Mechanical Engineering, University of Ljubljana, we continued our study of the **wear behaviour of ceramic materials** as a function of the chemical and electrochemical effects in aqueous media. Based on analyses of the wear scars and wear debris created during the sliding of zirconia ceramics we explained the observed significant effect of pH on wear rate, friction coefficient and the surface roughness. In aqueous media, due to locally increased

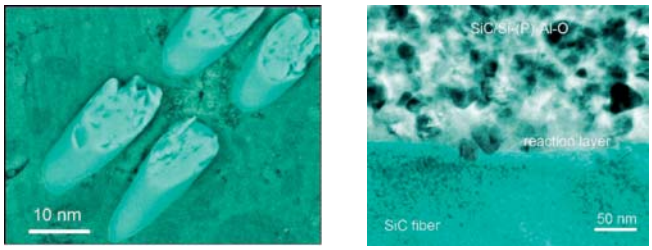

Figure 1: a) Scanning electron micrograph of SiC ceramics with nanosized SiC powder and SiC fibres sintered at 1400 °C in nitrogen, b) Transmission electron micrograph of the interface between the SiC fibre and the nano-structured SiC matrix.

temperature, the transformation into amorphous, monoclinic and cubic phases was the wear-determining mechanism. Further, tribological analysis of step-graded Al_2O_3-ZTA samples confirmed that residual compressive stresses in the surface layer beneficially affect the wear behaviour of the graded composites.

In the field of **rare-earth–transition-metal** (RE-TM) permanent magnets based on Sm–Fe and Sm–Fe–Ta, we studied the kinetics of the disproportionation reaction in H_2 using a vibrating sample magnetometer (VSM) equipped with high-temperature unit. We

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developed a simple, probability-based mathematical model to explain the observed multi-dimensional disproportionation reaction for the binary alloy and the one-dimensional reaction of the ternary alloy. From different solid targets of Sm-Fe-(Ta) we processed – with our partners from NHRF, Athens – and analyzed, using magnetic measurements and high-resolution transmission electron microscopy (HRTEM), thin (10–500 nm) magnetic films. The highest coercivity achieved so far was 5 kAm^{-1}, obtained in a N_2 atmosphere. Such films could be used in MEMS (micro-electro-mechanical systems) or MAGMAS (magnetic micro-actuators and systems) applications. Magnetic MEMS devices require 100-μm-thick Nd–Fe–B magnets with a high energy product. Producing such magnets with a conventional composition and conventional techniques has proved impossible, but we have managed to develop 100-μm-thick Nd–Fe–B magnets with coercivities of up to 1000 kAm^{-1} by using a conventional powder-metallurgy technique in combination with an innovative compositional modification. We also studied the influence of Ga additions on the microstructure of Nd–Fe–B magnetic material using analytical electron microscopy (EM). From high-resolution STEM/HAADF (scanning–transmission electron microscope/high-angle annular dark-field) images, we observed that, at low-angle grain boundaries, a 1-nm-thick amorphous layer is formed. EDXS (energy-dispersive X-ray spectroscopy) spectra from the grain-boundary regions revealed an increase in the amount of Ga. Z-contrast images revealed that the terminal crystal plane in a $Nd_2Fe_{14}B$ grain exhibits a very dark contrast. We concluded that Ga is present in an amorphous phase, while the terminal crystal plane is most probably enriched in oxygen.

The most important achievements in our theoretical research were in the investigation of the anisotropy of the orbital magnetic moment and in the magnetic dipole term in the half-metal CrO_2, the investigation of the nonlinear magneto-elastic coupling in epitaxial films, and the investigation of magnetism in two-dimensional uranium systems. We also contributed to the analytical description and **numerical simulations of the phase transformations** during the synthesis of permanent magnet materials.

We studied the nucleation and crystallization of nanometer-sized particles prepared by the sol-gel method in the systems CeO_2/CuO and TiO_2. Using high-resolution transmission electron microscopy we could not confirm the hypothesis that a thin layer of CuO is coated on the CeO_2 particle, as described in the literature. As a result, we proposed a model where Cu ions form a solid solution with the CeO_2 matrix particle. In the TiO_2 system we found that 2–3-nm-sized anatase particles are embedded in an amorphous matrix phase, which has not been described in the literature.

The variations in the intensities of the ratios between the atomic columns in the perovskites $CaTiO_3$, $SrTiO_3$ and PZT, which are due to distorted crystal structures and/or planar faults in the crystal lattice, were studied by Z-contrast microscopy (HAADF-STEM). We found that the intensities in the atomic columns in the experimental images are largely dependent on local lattice distortions and that they should be included in the HAADF-STEM simulations in order to minimize the errors in **quantitative HAADF-STEM**. Conventional TEM, high-resolution TEM and HAADF-STEM were also used to study the chemical composition and the structure of interfaces between a PZT monocrystal and a polycrystalline PZT matrix. We found that the exaggerated growth of the PZT monocrystal, which is initiated by the seed $BaTiO_3$ crystal, is promoted by the existing liquid phase at the grain boundaries. The interface between the PZT and $BaTiO_3$ is topotactical and coherent. In a **$Sr(Ti,Fe)O_3$-based oxygen sensor** we determined the structure and chemical composition of oxygen-deficient planar faults, which appear in the material as a consequence of iron doping.

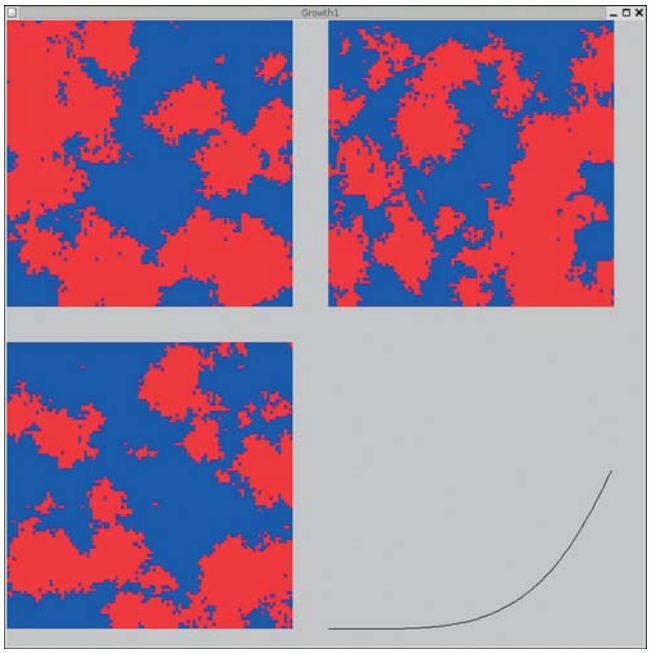

Figure 2: Screen snapshot of the computer simulation of the phase transition in a homogeneous material during isotropic grain growth.

As part of a bilateral collaboration with IMIM Krakow, the electron backscattered diffraction (EBSD) method was applied to study crystallographic orientation in polycrystalline perovskite ceramics. EBSD analysis was performed in an environmental scanning electron microscope (ESEM), which operates under a controlled low pressure in certain gases. This allowed us to observe ceramic samples without conductive coatings on the surface. With optimized EBSD-ESEM settings, the orientation image maps (OIMs) of the PLZT polycrystalline ceramic sample (figure-example) were recorded. Grains with different crystallographic orientations are in different colours. The OIM image confirmed the random orientation of the grains in the sample.

We also carried out numerous **EM analyses of inorganic and organic materials** for various customers.

Some outstanding publications in the past three years

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TECHNICAL REPORTS

1. Miran Čeh
Microstructural analysis of perovskite-based electroceramic materials
(JSI report, 9025, confidential), 2004.
2. Miran Čeh
Resistive exhaust gas sensors on the basis of temperature-independent semiconducting
(JSI report, 9020, confidential), 2004.
3. Miran Čeh, Sašo Šturm
Microstructural analysis of perovskite-based electroceramic materials: anisotropic grain growth in $CaTiO_3$ and $SrTiO_3$ perovskites
(JSI report, 9022, confidential), 2004.
4. Miran Čeh, Sašo Šturm
STEM and EDXS analysis of $Sr(Ti_{0.65}Fe_{0.35}O_3$ samples: M. Čeh, S. Šturm
(JSI report, 9021, confidential), 2004.
5. Katja Mejak, Saša Novak, S. Veskovič-Bukudur
Hidrofobizacija keramičnega prahu (Hidrofobisation of ceramic powder)
(JSI report, 8986), 2004.

6. Saša Novak, Sabina Beranič, Natalija Petkovič, Tomislav Pustotnik
   Increasing the performance of total hip replacement prosthesis through functionally graded material innovation and design: dip coating technique: 4th report, project: BIOGRAD-DIP, G5RD-CT2000-00354
   (JSI report, 8923, confidential), 2004.
7. Saša Novak, Sabina Beranič, Tomislav Pustotnik
   Increasing the performance of total hip replacement prosthesis through functionally graded material innovation and design: dip coating technique: 5th report
   (BIOGRAD-DIP, G5RD-CT2000-00354, confidential).
8. Saša Novak, Goran Dražić, Katja Mejak, Nina Daneu, Spomenka Kobe
   Gas impermeable coatings for SiC_f/SiC: final 12-month report
   (JSI report, 9085, confidential), 2004.
9. Saša Novak, Goran Dražić, Katja Mejak, Nina Daneu, Spomenka Kobe
   Novel processing of SiC/SiC by slip-infiltration of SiC fibre pre-forms with SiC under vacuum: final 12-month report
   (JSI report, 9084, confidential), 2004.

LECTURES - GUEST LECTURES AT FOREIGN UNIVERSITIES

1. Miran Čeh
   Atomic resolution HAADF-STEM: from experimental imaging to quantitative interpretation: invited talk
   Berlin, Germany, International Center for Advanced Materials and Electron Microscopy, 6 Oct. 2004.
2. Miran Čeh
   Atomic resolution STEM applications in materials sciences: invited talk
   Shanghai, China, Shanghai Institute of Ceramics, Chinese Academy of Sciences, 24 Sep. 2004.
3. Miran Čeh
   Atomic resolution STEM imaging: applications in materials sciences: invited talk
   Kiel, Germany, Technische Fakultät der Christian-Albrechts-Universität, 9 Dec. 2004.
4. Miran Čeh
   The use of electron microscopy in studies of exaggerated and anisotropic grain growth phenomena in perovskites $ATiO_3$ (A=Ca,Sr,Ba): invited talk
   Chang Won, Korea Institute of Machinery & Materials, 1 Oct. 2004.
5. Nina Daneu
   Twins in natural spinel crystals from Burma: invited talk
   Bonn, Institut für Anorganische Chemie, Anorganische Materialforschung, 28 Oct. 2004.
6. Aleksander Rečnik
   Chemical twinning and abnormal growth of twinned crystals: invited talk
   Golden, Colorado, USA, Colorado School of Mines, Department of Metallurgical and Materials Engineering, 16 Sept. 2004.
7. Aleksander Rečnik
   Structure and chemistry of inversion boundaries in Sb_2O_3-doped zinc oxide: invited talk
   Kyoto, Japan, Kyoto Institute of Technology, 3 June 2004.
8. Sašo Šturm
   Quantitative Z-contrast imaging of (CaO, SrO, BaO) planar faults in $SrTiO_3$: invited talk
   Shanghai, China, Shanghai Institute of Ceramics, Chinese Academy of Sciences, 24 Sep. 2004.

PATENTS

Patent granted

1. Patent No.: PCT/EP03/11086
   Paul John McGuiness, Gregor Geršak, Spomenka Kobe
   Permeameter for measuring magnetic properties at high temperatures
   GAGEL Patentanwaltskanzlei, München, Germany, 2004.

Technical improvement

1. Paul John McGuiness, Benjamin Podmiljšak, Kristina Žužek Rožman, Spomenka Kobe
   Modification of the vibrating sample magnetometer for the investigation of rare-earth magnets
   Ljubljana: Jožef Stefan Institute, 2004.

THESES

B. Sc. Thesis

1. Benjamin Podmiljšak: Study of Magnetic Properties of Powders Based on Sm-Fe and Sm-Fe-Ta Nitrides (Prof. Stanko Pejovnik, Asst. Prof. Spomenka Kobe)

M. Sc. Thesis

1. Sergej Knez: The Influence of the Magnetic Field on the Properties of Precipitated Calcium Carbonate (Prof. Janez Stražišar, Asst. Prof. Spomenka Kobe)

Ph. D. Theses

1. Kristina Žužek Rožman: The Synthesis and Characterization of Sm-Fe-based Magnetic Materials (Prof. Ladislav Kosec, Asst. Prof. Spomenka Kobe, Dr. Paul McGuiness)
2. Vesna Šrot: Twin Boundaries And Polymorphic Phase Transformations in Sphalerite (Prof. Breda Mirtič, Dr. Aleksander Rečnik)
3. Matej Cimerman: Microstructural Analysis of Interface Between the Bone and Hidroxy Apatite Coated Metal Implants (Prof. Martin Tonin, Asst. Prof. Miran Čeh)

MESS SUPPORTED RESEARCH AND DEVELOPMENT GRANTS AND CONTRACTS

1. Layered ceramic nanostructures and 2D nanoparticles arrays
   Asst. Prof. Miran Čeh
2. Nanostructural investigations of special boundaries in minerals
   Dr. Nina Daneu, Prof. Tadej Dolenec
3. Qualitative Z-contrast microscopy of functional ceramics
   Asst. Prof. Spomenka Kobe, Dr. Sašo Šturm
4. Exploration and preservation of Slovenian mineralogical heritage
   Dr. Aleksander Rečnik
5. Application of new technologies to prevent scaling in industrial flow systems
   Asst. Prof. Spomenka Kobe
6. Rare-earth-transition-metal alloys for high-energy permanent magnets and metal-hydride batteries
   Dr. Paul John McGuiness
7. Development of tissue engineered bone for use in periodontology, traumatology and orthopaedic surgery
   Asst. Prof. Miran Čeh
8. Development of Graetzl-type photo-electrochemical cells
   Dr. Goran Dražič
9. Magnetic materials and intermetallic alloys (CoE Materials for electronics of next generation and other emerging technologies)
   Asst. Prof. Spomenka Kobe
10. New generation of elements and devices for protection against transient surges (CoE Materials for electronics of next generation and other emerging technologies)
    Dr. Slavko Bernik
11. Characterization on the nanometric scale (CoE Nanosciences and nanotechnologies)
    Asst. Prof. Miran Čeh
12. Nanostructured surfaces and interfaces (CoE Nanosciences and nanotechnologies)
    Dr. Goran Dražič

Research program

1. Nanostructured materials
   Asst. Prof. Spomenka Kobe

INTERNATIONAL PROJECTS

1. Development of Advanced Materials: Novel Processing of SiC/SiC by Slip-Infiltration of SiC Fibre Pre-Forms with SiC Under Vacuum
   SINF
   6. FP, EURATOM
   FU06-CT-2003-00323
   EC: Dr. Saša Novak, Jožef Stefan Institute, Ljubljana, Slovenia
   Asst. Prof. Spomenka Kobe
2. Development of Advanced Materials: Gas Impermeable Coatings for SiC/SiC
   SICOAT
   6. FP, EURATOM
   FU06-CT-2003-00322
   EC: Dr. Saša Novak, Jožef Stefan Institute, Ljubljana, Slovenia
   Dr. Saša Novak Krmpotič
3. Increasing the Performance of Total Hip Replacement Prostheses through Functionally Graded Material Innovation and Design
   BIOGRAD
   5. FP
   G5RD-CT-2000-00354
   EC; Prof. Omer Van Der Biest, Katholieke Universiteit Leuven, Leuven, Belgium
   Dr. Saša Novak Krmpotič
4. Micrometer Scale Patterning of Protein and DNA Chips
   MICROPROTEIN
   5. FP
   G5RD-CT-2002-00744

EC; Prof. A. C. Cefalas, National Hellenic Research Foundation, Theoretical and Physical Chemistry Institute, Athens, Greece
Asst. Prof. Spomenka Kobe, Dr. Goran Dražič

5. A Novel Miniaturised High Voltage Surge Arrester
VARESTER
5. FP
G1ST-CT-2002-50263
EC; Mirjam Cergolj, Varsi, d.o.o., Ljubljana, Slovenia
Dr. Slavko Bernik
6. Microstructural Analysis of Perovskite-Based Electroceramic Materials
U3-MM/K7
Dr. Jae-Ho Jeon, Korea institute of Machinery and Materials (KIMM), Changwon, Korea
Asst. Prof. Miran Čeh
7. Energy-Filtered Transmission Electron Microscopy (EF-TEM) and High Resolution Scanning Transmission Electron Microscopy (HR-STEM) of Nanoparticles and Interfaces in Materials
SI-AT/04-05/019
Prof. Ferdinand Hofer, Graz University of Technology, Research Institute of Electron Microscopy, Graz, Austria
Asst. Prof. Miran Čeh
8. Analysing the Interactions of Rare-Earth Transition-Metal Alloys with Hydrogen and Nitrogen
BI-HR/04-05-036
Dr. Muhamed Sućeska; Brodarski Institut, Laboratorij za termičku analizu, Zagreb, Croatia
Asst. Prof. Spomenka Kobe, Dr. Paul McGuiness
9. Fabrication of Thin Films by Pulse Laser Deposition at 157 nm for Micro-Sensor Applications
BI-GR/02-05-006
Prof. A. C. Cefalas, National Hellenic Research Foundation, Theoretical and Physical Chemistry Institute, Athens, Greece
Asst. Prof. Spomenka Kobe
10. Application of Short Wavelength Light Technologies in Treating Historical Paper Manuscripts Against Foxing
BI-GR/02-05-004
Dr. Evangelia Sarantopoulou, National Hellenic Research Foundation, Theoretical and Physical Chemistry Institute, Athens, Greece
Dr. Goran Dražič
11. Controlled Processing of ZnO Based Varistor Ceramics
SLO-JPN
Dr. Toshiyuki Isshiki, Kyoto Institute of Technology, Faculty of Engineering and Design, Dept. Electronics & Information Science, Matsugasaki, Sakyo-ku, Kyoto, Japan
Dr. Nina Daneu
12. IMAGE-WARP: Processing of Atomic-Resolution HAADF-STEM Images
SLO-JPN
Dr. Hiroshi Saijo, Kyoto Institute of Technology, Faculty of Engineering and Design, Dept. Electronics & Information Science, Matsugasaki, Sakyo-ku, Kyoto, Japan
Dr. Aleksander Rečnik
13. Electron Microscopy Analysis of Nano-Structures in Perovskites
SLO-JPN
Dr. Susumu Ikeno, Faculty of Engineering, Toyama University, Venture Business Laboratory, Gofuku, Toyama-shi, Japan
Asst. Prof. Miran Čeh
14. Atomic-Resolution HRTEM and HAADF-STEM of Mixed Oxides
SLO-JPN
Dr. Kenji Matsuda, Faculty of Engineering, Toyama University, Gofuku, Toyama-shi, Japan
Dr. Sašo Šturm
15. Sub-Nano Analytical Electron Mycroscopy of Interfaces and Planar Faults in Ceramic Materials
BI-CN/03-04-017
Dr. Hui Gu, Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai, China
Asst. Prof. Miran Čeh
16. Resistive Exhaust Gas Sensors on the Basis of Temperature-Independent Semiconducting Oxides
Electron Microscopy Investigations of $SrTiO_3$-Based Perovskites
Dr. Wolfgang Menesklou, Universität Karlsruhe, Institut für Werkstoffe der Elektrotechnik (IWE), Karlsruhe, Germany
Asst. Prof. Miran Čeh
17. Nanostructural Properties of ZnO-Based Semiconducting Materials and Thin Films
BI-DE/03-04-008
Prof. Werner Mader, Universität Bonn, Institut für Anorganische Chemie, Bonn, Germany
Dr. Aleksander Rečnik
18. Electron Microscopy of Nanostructures in Ceramics
BI-DE/03-04-012
Prof. Manfred Rühle, Max-Planck-Institut für Metallforschung, Stuttgart, Germany
Asst. Prof. Miran Čeh
19. Defect Structures in Semiconducting Thin-Films for Optoelectronics
BI-DE/03-04-013
Prof. Roland Kröger, Universität Bremen, Institut für Festkörperphysik, Bremen, Germany
Dr. Nina Daneu
20. Investigations of Twinning and Epitaxial Growth in Minerals
BI-US/04-05/5
Dr. Hans-Joachim Kleebe, Colorado School of Mines, Metallurgical and Materials Engineering Dept., Colorado, USA
Dr. Aleksander Rečnik
21. Electron Probe Microanalysis of Ceramic Materials III
BI-US/04-05/30
Dr. Ryna B. Marinenko, National Institute of Standards and Technology (NIST), Chemical Science and Technology Laboratory, Surface and Microanalysis Science Division, Gaithersburg, USA
Dr. Slavko Bernik
22. Cohesive Powder Fluidization Via Magnetic Excitation
SLO-US-2001/36
Prof. James F. Klausner, University of Florida, Gainesville, Florida, USA
Asst. Prof. Spomenka Kobe
23. Novel Possibilities for the Processing of ZnO - Based Varistor Ceramics
BI-PL/04-05-009
Dr. Witold Mielcarek, Electrotechnical Institute Wroclaw Division of Electrotechnology and Materials Science, Wroclaw, Poland
Dr. Bernik Slavko
24. Orientation Imaging Microscopy and Microanalysis Applied to Advanced Materials
BI-PL/04-05-010
Dr. Marek Faryna, Polish Academy of Sciences, Institute of Metallurgy and Materials Science, Krakow, Poland
Dr. Dražič Goran
25. Improved Materials Processing Through Tailoring the Surface Characteristics of Nano- and Micro-Sized Powders
BI-PT-04-06-016
Prof. Jose Maria Fereirra, Universidade de Aveiro, Department of Ceramics and Glass Engineering, Campus Santiago, Aveiro, Portugal
Dr. Saša Novak Krmpotič
26. A Hydrogen-Storage Device for Low-Cost, Environmentally Friendly Transportation
BI-GB/04-011
Prof. Ivor R. Harris, The University of Birmingham, School of Metallurgy and Materials, Birmingham, Great Britain
Asst. Prof. Spomenka Kobe, Dr. Paul McGuiness

NEW CONTRACTS SIGNED

1. Rare-earth-transition-metal alloys for high-energy permanent magnets and metal-hydride batteries
MAGNETI, d. d., Ljubljana
Dr. Paul McGuiness
2. Application of new technologies to prevent scaling in industrial flow systems
Termoelektrarna-Toplarna, Ljubljana
Asst. Prof. Spomenka Kobe
3. Analysis of silicated deposits and new methods of conditioning
Termoelektrarna-Toplarna, Ljubljana
Asst. Prof. Spomenka Kobe

VISITORS FROM ABROAD

1. Prof. Roland Kröger, Angelika Vennemann, B. Sc., Institut für Festkörperphysik, Universität Bremen, Bremen, Germany, January 10–16, 2004
2. Prof. Omer Van der Biest, Dr. Jef Vleugels, Mr. Guy Anné, Katholieke Universiteit Leuven, Leuven, Belgium, Mr. Stephan Hecht-Mijic, Dr. Herbert Richter, CeramTec, Plochingen, Germany, Mr. Daniel Roberts, Bodycote H.I.P, Chesterfield, United Kingdom, Prof. Michael Gasik, Prof. Baosheng Zhang, Helsinki University of Technology, Espoo, Finland, Dr. Marie-Françoise Harmand, LEMI, Martillac, France, Dr. Uwe Holzwarth, Institute of Health and Consumer Protection, DG JRC, Ispra, Italy, Dr. Alessandro Facchini, Dr. Michele Pressacco, LIMA-LTO, Villanova di S. Daniele, Italy, Dr. Petr Lukáš, Nuclear Physics Institute, The Academy of Sciences of the Czech Republic, Rez, Czech Republic, January 22–23, 2004
3. Mirjam Cergolj, B. Sc., M. Sc. Alojz Tavčar, Mrs. Vanja Dimec, VARSI, Ljubljana, Dr. Michael Browne, European Commission, Brussels, Belgium, Prof. Bui Ai, Université Paul Sabatier, Laboratoire de Génie Éléctrique, Associé au CNRS, Toulouse, France, Mario Dragoni, B. Sc., Dragoni, s.r.l., Codogno, Italy, Dr. Emilio Sacchi, PEIRS, s.r.l., Venaria, Italy, Dr. Grzegorz Pasciak, Pjotr Bujlo, B. Sc., Instytut elektrotechniki - IEL, Wrocław, Poland, Jasna Pavlič, B. Sc., MECOM, Ljubljana, February 6, 2004
4. Prof. Hui Gu, Wang Xian-hao, B. Sc., Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai, China, February 22–March 5, 2004

5. Dr. George Vekinis, Advanced Ceramic Laboratory, Institute for Materials Science, National Center for Scientific Research "Demokritos" – NCSR, Athens, Greece, March 8–April 5, 2004
6. Prof. A. C. Cefalas, National Hellenic Research Foundation - NHRF, Theoretical and Physical Chemistry Institute, Athens, Greece, March 8–10, 2004
7. Dr. Marek Faryna, Institute of Metallurgy and Materials Science, Polish Academy of Science, Krakow, Poland, May 8–15, 2004
8. Prof. James Klausner, Department of Mechanical Engineering, University of Florida, Gainesville, Florida, USA, June 11–17, 2004
9. Dr. Marek Faryna, Institute of Metallurgy and Materials Science, Polish Academy of Science, Krakow, Poland, July 15–17, 2004
10. Prof. Roland Kröger, Angelika Vennemann, B. Sc., Institut für Festkörperphysik, Universität Bremen, Bremen, Germany, July 15–22, 2004
11. Dr. George Vekinis, Advanced Ceramic Laboratory, Institute for Materials Science, National Center for Scientific Research "Demokritos" – NCSR, Athens, Greece, July 28–August 2, 2004
12. Prof. Ludwig Schultz, Institut für Festkörper- und Werkstoffforschung, Dresden, Germany, August 13, 2004
13. Dr. Jae-Ho Jeon, Korea Institute of Machinery and Materials, Changwon, Korea, September 13–17, 2004; Dr. Mehmet Ali Gülgüna, Sabanci University, Istanbul, Turkey, September 16–18, 2004
14. Dr. Witold Mielcarek, Instytut elektrotechniki - IEL, Wrocław, Poland, September 28–October 2, 2004
15. Prof. Jose Maria Ferreira, University of Aveiro, Department of Ceramics and Glass Engineering, CICECO, Aveiro, Portugal, September 26–October 3, 2004
16. Prof. Ivor R. Harris, The University of Birmingham, School of Engineering Metallurgy and Materials, Birmingham, United Kingdom, September 26–30, 2004
17. Dr. Maša Rajić Linarić, Brodarski institut, Laboratorij za termičku analizu, Zagreb, Croatia, October 8, 2004
18. Elena Tchernychova, B. Sc., Max-Planck-Institut für Metallforschung, Stuttgart, Germany, October 13–23, 2004
19. M. Sc. Werner Rechberger, Technische Universität Graz, Zentrum für Elektronenmikroskopie, Graz, Austria, November 8–19, 2004
20. Elizabeth Pesch, B. Sc., Heike Burghardt, B. Sc., Institut für Anorganische Chemie der Universität Bonn, Bonn, Germany, November 20–28, 2004
21. Dr. George Vekinis, Advanced Ceramic Laboratory, Institute for Materials Science, National Center for Scientific Research "Demokritos" – NCSR, Athens, Greece, December 9– 17, 2004

ORGANIZATION OF CONFERENCES AND MEETINGS

1. 6th Regional Workshop on Electron Probe Microanalysis Practical Aspects – EMAS 2004, Bled, Slovenia, May 8–11, 2004
2. 7th Multinational Congress on Microscopy, Portorož, Slovenia, June 26– 30, 2005
3. 12th Conference on Materials and Technologies, Portorož, September 27–29, 2004 (co-organisation)
4. IX Conference & Exhibition of the European Ceramic Society - ECerS, Portorož, Slovenia, June 19–23, 2005, (co-organisation of the Analytical Methods Simposium)
5. International Workshop High Performance Magnets and Their Application – HPMA, Annecy, France, August 29–September 2, 2004 (International Advisory Committee)
6. Meeting of the 5FP EU project BIOGRAD, Ljubljana, January 22–23, 2004
7. Meeting of the 5FP EU CRAFT project VARESTER, Ljubljana, February 6, 2004

STAFF

Researchers

1. Dr. Slavko Bernik
2. Asst. Prof. Miran Čeh**
3. Dr. Goran Dražić
4. **Asst. Prof. Spomenka Kobe**, Head**
5. Dr. Matej Komelj
6. Dr. Paul John McGuiness
7. Dr. Saša Novak Krmpotič
8. Dr. Aleksander Rečnik

Postdoctoral associates

9. Dr. Nina Daneu
10. Dr. Sašo Šturm
11. Dr. Kristina Žužek Rožman

Postgraduates

12. Dr. Vesna Šrot
13. Tea Toplišek, B. Sc.

Technical officers

14. Medeja Gec, B. Sc.
15. Benjamin Podmiljšak, B. Sc.
16. Zoran Samardžija, B. Sc.

Technical and administrative staff

17. Sanja Fidler, B. Sc.

** Part-time faculty member