DEPARTMENT OF SURFACE ENGINEERING AND OPTOELECTRONICS F-4

The research program is associated with vacuum science, technology and applications. The main activities are focused on plasma science, the modification of advanced biomedical materials and products for improved biocompatibility, the characterization of inorganic, polymer and composite materials with different thin films on the surface, the modification and characterization of fusion-relevant materials, the thermodynamics of trapped gases and methods for sustaining an ultra-high-vacuum environment, vacuum optoelectronics, and basic research in the field of surface and thin-film characterization by electron spectroscopy techniques.

Head (from 1. 12. 2009):
Asst. Prof. Miran Mozetič

Head (to 16. 7. 2009):
Prof. Anton Zalar

The Plasma Laboratory covers the field of chemically reactive non-equilibrium plasma created in high-frequency electrodeless gaseous discharges. Several different plasma reactors with a volume between 0.2 and 50 l are powered with radiofrequency and microwave generators with frequencies of 13.56, 27.12 and 2450 MHz and a nominal power up to 15 kW. The plasma is created in oxygen, hydrogen, nitrogen, ammonia, water vapor, methane, carbon dioxide and noble gases, as well as different gas mixtures. The gases are introduced into discharge chambers through gas-flow controllers or manual leak valves. The plasma reactors are pumped with one or more vacuum pumps including rotary, roots and turbomolecular pumps. The pressure is measured with baratrons, Pirani and Penning gauges. Typical working pressures in the plasma reactors are between 1 and several 100 Pa. The plasma is characterized by optical emission spectroscopy, mass spectrometry, electrical and catalytical probes. The kinetic temperature of the neutral gas is between 300 and 1000 K, the electron temperature is between 15,000 and 60,000 K, and the ion temperature is similar to the neutral gas temperature. The Debye length is of the order of 0.1 mm and the difference between the plasma and the floating potentials of the order of 10V. The density of neutral atoms is adjustable up to about 2×10^{22} m^{-3}. The basic research on plasma properties as well as the development of plasma-based technologies is carried on. The technologies include discharge cleaning, selective plasma etching, plasma functionalization, cold plasma ashing, and plasma-based techniques for the synthesis and modification of nanomaterials.

Plasma nanoscience is a new field of low-pressure plasma science and applications. We organized the first international symposium on plasma nanoscience in Fiesa, Slovenia. It attracted prominent world-leading researchers in this field. Our research group has achieved important results in understanding the mechanisms involved in the growth of nanoparticles on materials exposed to highly reactive oxygen plasma. The nanoparticles synthesized using this method includes transitional metal oxides that, depending on the plasma parameters, grow in the form of nanoneedles, nanowires, nanobelts, and more complex shapes. These nanoparticles are usually single crystalline, although vacancies in the crystalline structure may appear. The nanoparticles are growing at high rates, often several g/min, making the technique suitable for the synthesis large quantities that are applied in photovoltaics. Furthermore, the iron oxide particles are perfectly soft magnetic materials so they are suitable for application in advanced magnetic beads for the adsorption of selected proteins from body fluids. The nanoparticles are captured in liposome, so microscopic beads are formed. The technology has been protected with an appropriate patent application.

The plasma functionalization of organic materials has become a common method for the modification of the surface properties of polymer materials. Many polymers become hydrophilic after treatment with oxygen plasma, mainly due to the incorporation of polar oxygen-rich functional groups into the surface layer of the polymers. The technique is environmentally benign and ensures the improved wettability of products made from polymers and polymer-matrix composites. The surface free energy, however, is limited by the structure of the material as well as the limitations in the plasma treatment. Our group elaborated the functionalization mechanisms for a few polymer materials with different degrees of crystallinity, and found important differences in the plasma–polymer interaction. Furthermore, the treatment of many polymers results in an increase of the surface roughness, which in combination with the surface functional groups, leads to a super hydrophilic character of the materials. An application of such a treatment is for the modification of vascular grafts (artificial blood vessels). Plasma-treated grafts express an improved affinity for bonding the endothelial cells as well as the repulsion of platelets. The appropriate technology has been protected with a patent application.

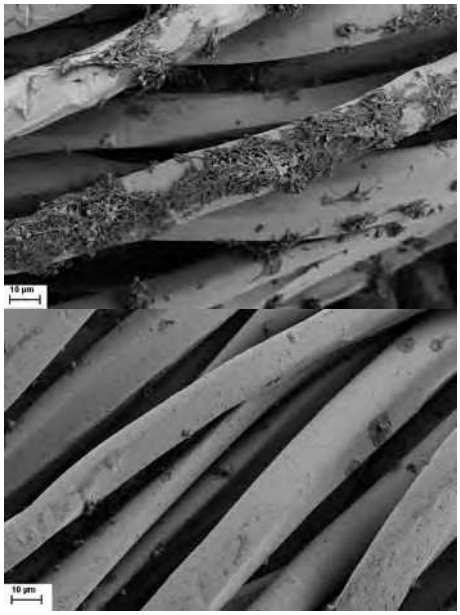

Figure 1: SEM image of a vascular graft before (a) and after (b) treatment with an oxygen plasma. Huge differences in the platelets' adsorption are observed.

Surface analytical techniques are indispensable for the characterization of the surfaces and interfaces of bulk materials, layered structures and nanomaterials. In the Laboratory for Surface and Thin Film Analyses, X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy

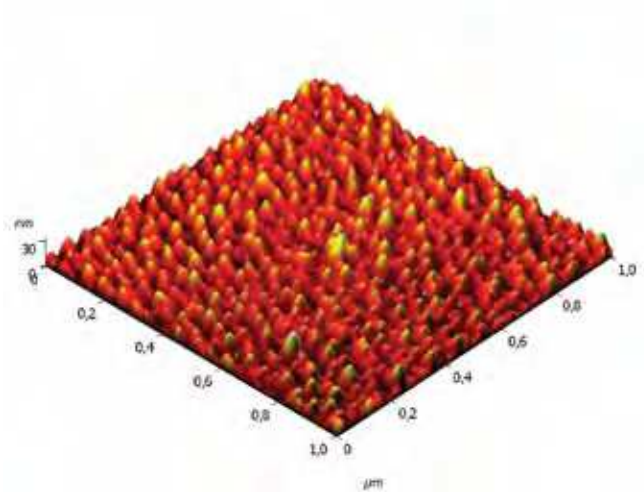

Figure 2: AFM image of oxygen plasma treated, originally flat, polyethyleneteraftelate sample shows extremely rough surface that, in combination with surface polar functional groups, ensures the super hydrophilic character of this material.

Several plasma-based technologies for bio-medical applications have been elaborated and protected with the appropriate patent applications.

Figure 3: A picture representing cotton fabrics after the deposition of a hydrophobic film by the sol-gel method appeared on the cover page of the renowned specialized journal Langmuir. The image obtained by atomic force microscopy is in the frame.

(AES) and atomic force microscopy (AFM) have been used successfully, all for basic research and for the characterization of technological samples. Our research group is recognized worldwide for the depth profiling of thin films and multilayers at a high depth resolution.

An X-ray photoelectron spectroscopy investigation was applied to study the kinetics of copper surface segregation in model polycrystalline Ag-2.2 % Cu and Ag-4.9 % Cu alloys during in-situ annealing. The results show the accelerated segregation of copper to the free surface due to the reactive interaction of copper with oxygen. This result is compatible with the proposed mechanism of frequent degradation of the archaeological copper-alloyed silver objects excavated from graves that is based on the localized corrosion of the less-noble copper-segregated regions along the grain boundaries.

In the frame of a study of ion-sputtering-related processes we measured the relative sputtering yield of carbon with respect to tantalum for 1 keV Ar^+ ion bombardment in the angular range of 70°-82° by means of Auger electron spectroscopy depth profiling of C/Ta and Ta/C bilayers. The ion bombardment-induced interface broadening was strongly different for the C/Ta and Ta/C, and whereas the C/Ta interface was found to be rather sharp, the Ta/C interface was unusually broad. Still the relative sputtering yields (Y_C/Y_{Ta}) derived for the two specimens agreed well. The relative sputtering yields obtained were different from those determined earlier on thick layers and calculated by simulation with the SRIM code.

A precise thin-film analysis by AES spectroscopy was applied to study the diffusion processes in Al/Cr, Al/Fe and Cr/Fe intermetallic films of complex metallic alloys deposited by the PVD process and annealed at various temperatures. A detailed analysis of the depth profiles was conducted using the MRI model, which takes into account interface broadening of the measured profile due to three reasons: the ion-induced atom mixing, the roughness, and the information depth of the analyzed electrons. Thus we reconstructed the true depth profile of the as-deposited samples and profiles of the annealed samples that allowed us to extract the diffusion coefficients.

The greatest achievement of the vacuum lab is the refurbishment–upgrading of the ultra-high-vacuum (UHV) system designed for quantitative analysis of the extremely low hydrogen kinetics from metal walls and a subsequent quantitative analysis of the gas compositions. The previous system could not render the sensitivity demands for hydrogen detection which is required for the study of the hydrogen–metal interactions that are occurring in fusion reactors. The new system is designed in such a way that it enables measuring of the retained and released hydrogen or deuterium (H/D) at a stable elevated temperature. Besides this, an additional UHV system is attached to the first one, which enables measurement of extremely low permeation fluxes of H/D through a metal membrane. In our new system, the mass spectrometer (MS) is mounted in a separate vessel where the pressure is ~3×10^{-11} mbar. Such a low pressure and constant pumping speed are attainable only with a magnetically levitated turbomolecular (TM) pump, which uses another standard TM pump as a fore-pump. We can determine the composition of a very small amount of the gas mixture, which resides in the gas-accumulating vessel. Special attention was devoted to the suppression of the hydrogen background from the heated sample holder. This was achieved by a careful selection of materials and pretreatment procedure, and by our original construction.

The quantitative analysis of the composition of the gas mixture by a mass spectrometer is the basic method for giving a rough insight into the reactions in gases and on surfaces which we encounter in atomic physics, nuclear fusion, accelerators, preparations of plasma, etc. The quantitative analysis is a much more demanding procedure as it dictates a consideration of the following key facts: a) the MS's sensitivity is different for each gas due to its individual crossover and ionization energy, b) the speed of flow of the

different components of the gas mixture into the MS depends on their masses, c) during the ionization and detection of the ions, reactions on the walls and in the gas flow might occur. All these facts require an initial calibration of the MS with pure gases.

An investigation of cotton by atomic force microscopy has greatly contributed to our understanding of the hydrophobisation of natural materials by the sol-gel treatment.

This new UHV system is adapted for the education process in quantitative mass spectrometry for final-grade students of physics at the Faculty of Mathematics and Physics, University of Ljubljana. The subject is coordinated and supervised by prof. dr. Peter Križan.

By means of the new UHV system we were able to perform permeation measurements through Eurofer membranes. Eurofer is a special grade of steel, carefully cast to fulfill strict requirements for low nuclear activation in the future fusion reactor DEMO. We were able to confirm published values on the hydrogen permeation fluxes obtained on this material at the stated conditions. Having these values as a good reference of the system performance, we found that TiAlN films have the highest permeation barrier reduction factor (PRF) reported so far. Films of 5 micrometers were deposited at the JSI in the department F3 by magnetron sputtering.

We continued the EU research project within the SFA (Slovenian Fusion Association) related to deuterium retention in beryllium and tungsten at prescribed low pressures and temperatures. These two metals are selected for the first wall in the future improvement in large EU reactors. The data, measured on deuterium, may be treated as complementary to those, obtained by tritium. Namely, the tritium retention is still one of the main unknowns in the prediction of the long-term operating life in fusion reactors applying a D/T mixture fuel. We obtained some new data on the kinetics of evolution and absorption as well as the amount of retained deuterium. Unfortunately, the isotope exchange with residual hydrogen in the bulk represents the reaction channel which decreases the accuracy of the measured data. In the last period of 2009 we started with an investigation of Be films on Eurofer. These films were deposited at the "National Institute for Laser, Plasma and Radiation Physics" in Bucharest in Romania. Identical films, deposition on Inconel tiles, will be applied also in the JET fusion reactor in Culham. So far, no data on the permeation of H/D exist, but also our first experience with these films is negative. A rough Be surface did not enable sealing with the Au gasket, which required polishing of the surface.

We also continued our research on nano-crystalline films on flat metal substrates, applied as thermionic cathodes that may be used in the direct conversion of heat to electricity. We designed a new measuring cell to operate in UHV from room temperature to 500°C. The main purpose was not only to measure the total current, but also to observe the spatial electron emission uniformity on the screen. The main result was that the non-uniformity originates mainly as a result of the non-uniform deposition parameters in the CVD plasma reactor. The conventional method of measuring the total emission was thus inadequate for further improving the deposition parameters. In any case, the direct conversion of heat to electricity remains a hot topic in human attempts to suppress carbon dioxide emissions.

Figure 4: The new, ultra-high-vacuum system for a quantitative analysis of gas mixtures.

Some outstanding publications in 2009

1. K. Eleršič, M. Mozetič, A. Vesel, J. Pavlič, A. Iglič, A. Žnidaršič and A. Košak, A method for synthesis of magnetic liposomes in electric field, patent application 2009/00191, filed on July 17th 2009.
2. I. Junkar, M. Mozetič, A. Vesel, U. Cvelbar, M. Krašna and D. Domanovič, A method for treatment of biomedical polymer prosthesis for improved antithrombogenic properties, patent application 2009/00109, filed on April 20th 2009.
3. U. Cvelbar, K. Ostrikov, I. Levichenko, M. Mozetič, M. K. Sunkara, Control of morphology and nucleation density of iron oxide nanostructures by electric conditions of iron surfaces exposed to reactive oxygen plasmas, Appl. Phys. Lett. 2009, vol. 92, no. 21, p. 211502-1 – 211502-3.
4. A. Vilčnik, I. Jerman, A. Šurca – Vuk, M. Koželj, B. Orel, B. Tomšič, B. Simončič, J. Kovač, Structural properties and antibacterial effects of hydrophobic and oleophobic sol-gel coatings for cotton fabrics. Langmuir, 2009, vol. 25, issue 10, str. 5869-80.

Patent granted

1. Asst. Prof. dr. Miran Mozetič, Asst. Prof. dr. Alenka Vesel, Ita Junkar, Asst. Prof. dr. Uroš Cvelbar, Asst. Prof. dr. Simona Strnad, Method and device for modification of implants and vascular grafts made from PET polymer: patent SI 22608.

Awards and appointments

1. Kristina Eleršič: Development of coated magnetic nanobeads for immuno–diagnostic tests, Piran, Slovenia, Committee president Prof. Dr. Antony Murphy (Australia). The award was granted as the best contribution in the session "Bio–nano technologies for medical applications" at the conference ICAPT 2009.
2. Ita Junkar: Plasma treatment of PET vascular grafts for improved biocompatibility, Piran, Slovenia, Committee president Prof. Dr. David Ruzic (USA). The award was granted as the best contribution in the session "Plasma technologies for treatment of advanced materials" at conference ICAPT 2009.
3. Ita Junkar: Plasma treatment of polymers, Ljubljana, Slovenia. The award was granted as the best contribution of a young researcher at the First student conference of the Jozef Stefan International postgraduate school 2009.

Organization of conferences, congress and meetings

1. 16th International Scientific Meeting on Vacuum Science and Techniques, Bohinj, Slovenia, 4. – 5. 6. 2009
2. 2nd International conference on advanced plasma technologies with 1st International plasma nanoscience symposium, Piran, Slovenija, 29. 9. – 2. 10. 2009

INTERNATIONAL PROJECTS

1. Atmospheric Plasmas for Nanoscale Industrial Surface Processing
   PlasmaNice
   7. FP
   EC; Dr. Johanna Lahti, Tampere University of Technology, Department of Energy and Process Engineering, Paper Converting and Packaging Technology, Tampere, Finland
   Asst. Prof. Janez Kovač
2. Deuterium Retention and Release from Metal Surfaces - 1.4.4. – FU
   EURATOM – MHEST
   7. FP, EURATOM, Slovenian Fusion Association – SFA
   3211-08-000102, FU07-CT-2007-00065
   EC; RS, Ministry of Higher Education and Technology, Ljubljana, Slovenia
   Dr. Vincenc Nemanič
3. Sensitive and Differential Blood and Cerebrospinal Fluid Test for Neurodegenerative Dementia Diagnosis
   NeuroScreen
   6. FP
   EC; Elodie Girardet, HLP Développement SA, Paris, France
   Asst. Prof. Miran Mozetič
4. Plasma Sterilization and Decontamination of Water
   NATO CLG. REF.983580
   Dr. Fausto Pedrazziini, NATO - North Atlantic Treaty Organisation, Brussels, Belgium
   Asst. Prof. Uroš Cvelbar
5. Development of Bioactive Packaging
   BIOPACKAGING
   EUREKA
   Univerza v Mariboru, Inštitut za inženirske materiale in oblikovanje, Maribor, Slovenia
   Asst. Prof. Miran Mozetič
6. Vascular Graft Interfaces
   VaGrint
   MNT ERA NET
   3211-07-000024
   University of Maribor, Faculty of Mechanical Engineering, Maribor, Slovenia
   Asst. Prof. Miran Mozetič
7. Hydrogen Impermeable Nano-material Coatings for Steels
   Hy-Nano-IM
   MNT ERA NET
   Dr. Vincenc Nemanič, Dr. Paul McGuiness, Dr. Miha Čekada
8. Introduction Consulting to define Targets and Specify Methods; Measurement of Three Samples at Room Temperature
   Research Agreement
   Dr. Vincenc Nemanič
9. Treatment of Fusion relevant Materials in Hydrogen Plasma at Extreme Conditions
   Traitement de matériaux pour les réacteurs de fusion sous plasma d'hydrogène en conditions extêmes
   PROTEUS 2008 – 2009
   BI-FR/08-09-PROTEUS-003
   Dr. Marianne Balat-Pichelin, PROMES-CNRS, Laboratory for Processes, Materials and Solar Energy (PROMES), French National Centre for Scientific research (CNRS), Odeillo-Font Romeu, France
   Dr. Alenka Vesel
10. Determination of the Density of Nitrogen and Hydrogen Atoms in Plasma Created in Mixture of both Gases
    Détermination des densités locales d'atoms d'azote et d'hidrogène dans deux types de décharges plasmas
    PROTEUS 2008 – 2009
    BI-FR/08-09-PROTEUS-009
    Prof. Freddy Gaborian, LAPLACE (Laboratoire Plasma et Conversion d'Energie), CNRS, Université Paul Sabatier, Toulouse, France
    Asst. Prof. Miran Mozetič
11. Modification of Cardiovascular Implants by Gaseous Plasma
    BI-HR/09-10-001
    Dr. Slobodan Milošević, Institute of Physics, Zagreb, Croatia
    Asst. Prof. Miran Mozetič
12. Quantum Dots for Solar Cells
    BI-CN/09-11-003
    Dr. Xiaoxia Zhong, Shanghai Jiao Tong University, Minhang, Shanghai, China
    Asst. Prof. Uroš Cvelbar
13. Planar Cold Cathodes Composed of Inorganic Nanowires
    BI-CN/07-09-008
    Dr. Lian-Mao Peng, Institute of Physical Electronics, Peking University, Department of Electronics, Beijing, China
    Dr. Vincenc Nemanič
14. Study of Ion Mixing caused by FIB
    BI-HU/09-10-004
    PR-02139
    Dr. Miklos Menyhard, Research Institute for Technical Physics and Materials Sciences, Budapest, Hungary
    Asst. Prof. Janez Kovač
15. Simulations and Analysis of Complex Networks in Planetary Dynamics, Algorithms and Applications
    Sinteza, modifikacija jonskim zračenjem i karakterizacija višeslojnih struktura na nanometarskoj skali
    BI-RS/08-09-031
    Prof. Momir Milosavljević, Institut za nuklearne nauke "Vinča", Belgrade, Serbia
    Asst. Prof. Janez Kovač
16. Thermoionic Energy Conversion
    BI-US/09-12-021
    Prof. Robert Nemanich, Arizona State University, (ASU), Tempe, Arizona, USA
    Dr. Vincenc Nemanič
17. Metal Oxide Nanowire/Nanotube Arrays for Electrochemical Energy Conversion Applications
    BI-US/08-10-030
    Prof. K. Mahendra Sukara, Oddelek za kemijsko inženirstvo, Univerza v Louisvillu, Louisville, KY, USA
    Asst. Prof. Uroš Cvelbar

R &D GRANTS AND CONTRACTS

1. Application of nanoparticles as additives in lubricants and friction materials
   Asst. Prof. Maja Remškar, Asst. Prof. Miran Mozetič
2. Development of diagnostics for certain edge plasma parameters in fusion devices
   Prof. Milan Čerček, Asst. Prof. Miran Mozetič

3. Electron field emission from flat nanosctructured cathodes
   Dr. Vincenc Nemanič
4. Polymer nanocomposities for chemical sensors
   Asst. Prof. Miran Mozetič
5. Development of treatments and procedures for improvement of hemocompatibility of polyethyleneterephtalate surfaces
   Asst. Prof. Miran Mozetič
6. Printed passive electronic components for smart packaging
   Asst. Prof. Alenka Vesel
7. Investigation of gas discharges for introduction of new environmentally friendly technology for semimanufacture functionalization in the production of capacitors
   Asst. Prof. Miran Mozetič
8. Synthesis and functionalization of composite nanobeads for early diagnosis of neurodegenerative diseases
   Asst. Prof. Alenka Vesel
9. Superhydrophylicity and its application to technological processes for industrial manufacture
   Asst. Prof. Uroš Cvelbar
10. Ignition and self-extinguishing of the arc in gas surge arrester at high overvoltages
    Dr. Vincenc Nemanič
11. Multifunctional nanocomposite coatings and paints
    Asst. Prof. Janez Kovač
12. Research of the integrated surge protective system
    Dr. Vincenc Nemanič
13. Oxidation of metals by reactive oxygen plasma
    Asst. Prof. Miran Mozetič
14. Plasma treatment of vascular grafts
    Asst. Prof. Miran Mozetič
15. Field emission cathode from nanomaterials for THz miniature klystron
    Dr. Bojan Zajec
16. Study of gas deuterium retention and release from metals relevant to ITER
    Dr. Bojan Zajec
17. Study of plasma parameters for conditioning of the inner surfaces of a fusion reactor
    Asst. Prof. Miran Mozetič

RESEARCH PROGRAMS

1. Vacuum technique and materials for electronics
   Dr. Vincenc Nemanič
2. Thin film structures and plasma surface engineering
   Asst. Prof. Miran Mozetič

NEW CONTRACTS

1. Co-financing L2-9657-0106-06: Oxidation of metals by reactive oxygen plasma
   Kolektor Group, d. o. o.
   Asst. Prof. Miran Mozetič
2. Co-financing L2-0330-0795-08: Development of treatments and procedures for improvement of hemocompatibility of polyethyleneterephtalate surfaces
   Bioiks, d. o. o.
   Asst. Prof. Miran Mozetič
3. Co-financing L2-0858-1538-08: Study of the plasma parameters for conditioning of the inner surfaces of a fusion reactor
   Induktio, d. o. o.
   Asst. Prof. Miran Mozetič
4. Co-financing L2-1222-0106-08: Investigation of gas discharges for introduction of a new environmentally friendly technology for semimanufactures functionalization in the production of capacitors
   Iskra Condensers, Industy of Condensers and Equipment, d. d.
   Asst. Prof. Miran Mozetič
5. Co-financing L7-2139: Plasma treatment of vascular grafts
   BIA Separations, Company for Separation Technologies, d. o. o.
   Asst. Prof. Miran Mozetič
6. Co-financing L2-2204: Superhydrophylicity and its application in technological processes for industrial manufacture
   Kolektor Group, d. o. o.
   Asst. Prof. Miran Mozetič, Asst. Prof. Uroš Cvelbar

VISITORS FROM ABROAD

1. Dr. Slobodan Milošević, Nino Čutić, Nikša Krstulović, Zlatko Kregar, Institute of physics, Zagreb, Croatia, several times
2. Primož Eiselt, Plasmabull, Lebring, Austria, several times
3. Zoran Vratnica and Danijela Vujošević, Institute of public health, Podgorica, Montenegro, several times
4. Ludvik Kumar, Kolektor Group, Idrija, several times
5. Prof. Dr. Karin Stana Kleinschek, Prof. Dr. Simona Strnad, Institute of textiles University of Maribor, several times
6. Prof. Dr. Marian Lehocky, Vladimir Pavlinek, University Tomas Bata, Zlin, Czech Republic, 6. 4. – 8. 4. 2009
7. Prof. Dr. Freddy Gaboriau, University Paul Sabatier, Toulouse, France, 11. 4. - 17. 04. 2009
8. Dr. Nevena Puač, Dr. Željka Nikitović, Institute of Physics, Belgrade, Serbia, 18. 5. – 31. 12. 2009
9. Prof. Dr. Sabu Thomas, Dr. Jesmy Jose, School of Chemical Sciences, Mahatma Gandi University Kottayam, India, 27. 5. - 29. 5. 2009
10. Dr. Boris Chernomodik, University of Louisville, Louisville, Kentucky, USA, 18. 7. – 27. 7. 2009
11. Dr. Momir Milosavljević, Dr. Velimir Milinović and Dr. Davor Peruško, Institute of nuclear sciences Vinča, Belgrade, Serbia, 6. 9. – 20. 9. 2009
12. Dr. Francisco Tabares, Dr. Jose Antonio Fereira, National institute of fusion, CIEMAT, Madrid, Spain, 4. 8. -14. 8. 2009
13. Prof. Dr. Robert J. Nemanich, North Carolina State University, Raleigh, USA, 10. 9. -14. 9. 2009
14. Dr. Jeong Hoom Kim, University of Louisville, Louisville, Kentucky, USA, 27. 9. – 5. 10. 2009
15. Prof. Dr. Xaioxia Zhong, University of Shanghai Jiao Tong, Shanghai, China, 29. 9. – 2. 10. 2009
16. Prof. Dr. Mohan Sankaran , University of Louisville and Case Western University, USA, 2. – 4. 10. 2009
17. Dr. Kinga Kutasi, University of Budapest, Budapest, Hungary, 5.-6. 10. 2009
18. Dr. Attila Sulyok, dr. Miklos Menyhard, Research Institute for Technical Physics and Materials Science, Budapest, Hungary, 30. 11. – 3. 12. 2009
19. Dr. Momir Milosavljević, Dr. Davor Peruško, Institute of nuclear sciences Vinča, Belgrade, Serbia, 6. 12 .- 11. 12. 2009
20. Dr. Corneliu Porosnicu, National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania, 7. 12. 2009

STAFF

Researchers

1. Asst. Prof. Uroš Cvelbar
2. Asst. Prof. Janez Kovač
3. **Asst. Prof. Miran Mozetič, Head**
4. Dr. Vincenc Nemanič
5. Asst. Prof. Alenka Vesel
6. Dr. Bojan Zajec
7. ***Prof. Anton Zalar, Head, died 16.07.09***

Postgraduates

8. Dr. Aleksander Drenik
9. Kristina Eleršič, B. Sc.
10. Ita Junkar, B. Sc.
11. Martina Modic, B. Sc.
12. Borut Praček, B. Sc.
13. Tjaša Vrlinič, B. Sc.
14. Marko Žumer, B. Sc.
15. Rok Zaplotnik**, B. Sc.

Technical and administrative staff

16. Ružica Bolte
17. Tatjana Filipič, B. Sc.
18. *Mihael Kocmur, retired 01.08.09*
19. Janez Trtnik

Note:
** young researcher financed by industry

BIBLIOGRAPHY

ORIGINAL ARTICLES

1. Árpád Barna, László Kotis, János L. Lábár, Zoltán Osváth, Miklós Menyhárd, Anton Zalar, Peter Panjan, "Producing metastable nanophase with sharp interface by means of focused ion beam irradiation", *J. appl. phys.*, vol. 105, no. 4, pp. 044305-1-044305-5, 2009.
2. K. Brunelli, F. Bisaglia, Janez Kovač, M. Magrini, M. Dabal à, "Effects of cathodic electrodeposition parameters of cerium oxide film on the corrosion resistance of the 2024 Al alloy", *Mater. corros. (1995)*, vol. 60, no. 7, pp. 514-520, 2009.
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5. Uroš Cvelbar, Kostya Ostrikov, Igor Levchenko, Miran Mozetič, Mahendra K. Sunkara, "Control of morphology and nucleation density of iron oxide nanostructures by electric conditions on iron surfaces exposed to reactive oxygen plasmas", *Appl. phys. lett.*, vol. 94, no. 21, pp. 211502-1-211502-3, 2009.
6. Črtomir Donik, Aleksandra Kocijan, Monika Jenko, Aleksander Drenik, Boris Pihlar, "XPS study of duplex stainless steel oxidized by oxygen atoms", *Corros. sci.*, vol. 51, no. 4, 2009.
7. Aleksander Drenik, Alenka Vesel, Miran Mozetič, "Controlled carbon deposit removal by oxygen radicals", In: *Proceedings of the 13th International Conference on Fusion Reactor Materials, ICFRM-13, 10-14 December 2007, Nice, France*, (Journal of nuclear materials, vol. 386-388, 2009), Farhad Tavassoli, ed., Thierry Hutter, ed., Amsterdam, North-Holland, 2009, vol. 386-388, pp. 893-895, 2009.
8. Nataša Drnovšek, Nina Daneu, Aleksander Rečnik, Matjaž Mazaj, Janez Kovač, Saša Novak, "Hydrothermal synthesis of a nanocrystalline anatase layer on Ti_6Al_4 implants", *Surf. coat. technol.*, vol. 203, no. 10/11, pp. 1462-1468, 2009.
9. Freddy Gaboriau, Uroš Cvelbar, Miran Mozetič, A. Erradi, B. Roufflet, "Comparison of TALIF and catalytic probes for the determination of nitrogen atom density in a nitrogen plasma afterglow", *J. phys., D, Appl. phys.*, vol. 42, no. 5, pp. 055204-1-055205-5, 2009.
10. Marija Gorjanc, Vili Bukošek, Marija Gorenšek, Alenka Vesel, "The influence of water vapor plasma treatment on specific properties of bleached and mercerized cotton fabric", *Tex. res. j.*, 11 pp., 2009.
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