21. MEĐUNARODNI ZNANSTVENI SASTANAK VAKUUMSKA ZNANOST I TEHNIKA

21st INTERNATIONAL SCIENTIFIC MEETING ON VACUUM SCIENCE AND TECHNIQUES

PROGRAM I KNJIGA SAŽETAKA

PROGRAMME AND BOOK OF ABSTRACTS

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Nikša Krstulović, Slobodan Milošević, Zlatko Kregar

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Sadržaj / Content

TIME TABLE

Thursday, 8th of May	
12:00 – 13:00	Registration
13:00 – 14:30	Lunch
14:30 – 14:40	Opening
14:40 – 16:00	INVITED TALKS
16:00 – 16:30	Coffee break
16:30 – 17:50	INVITED TALKS
18:00 – 20:00	Poster session
20:00 – 22:00	Dinner

Friday, 9th of May	
10:00 – 11:00	INVITED TALKS
11:00 – 11:30	Coffee break
11:30 – 12:10	INVITED TALKS
12:10 – 12:20	Closing
13:00	Lunch

PROGRAMME

Thursday, 8th of May

12:00 – 13:00	Registration
13:00 – 14:30	Lunch

Session 1 (chairman: S. Milošević, J. Kovač)

14:30 – 14:40	Opening
14:40 – 15:00	**Barbara Šetina Batič** (invited talk) *Nanostructuring thin films by dewetting*
15:00 – 15:20	**Galja Pletikapić** (invited talk) Vesna Svetličić, Tea Mišić Radić, Miklos Kellermayer, Jasna Brujić *Self-assembly of marine biopolymers and interactions with nanoparticles*
15:20 – 15:40	**M. Spreitzer** (invited talk) Z. Jovanović, D. Klement, J. Kovač, D. Suvorov *Interfacing oxides with Si substrates*
15:40 – 16:00	**Marijan Bišćan** (invited talk) *Laser produced plasmas for analytical and depositional applications*
16:00 – 16:30	Coffee break

Session 2 (chairman: A. Vesel, I. Capan)

16:30 – 16:50	**Martina Modic** (invited talk) Metod Kolar, Ita Junkar, Miran Mozetič *Plasma technologies as s biotechnology tool*
16:50 – 17:10	**Iva Šrut Rakić** (invited talk) Vesna Mikšić Trontl, Petar Pervan, Fabian Craes, Wouter Jolie , Carsten Busse, Marko Kralj *Effects of nanoscale structural modulation on graphene's electronic structure*
17:10 – 17:30	**Besnik Poniku** (invited talk) Igor Belič, Monika Jenko *Using correlation for better identification of low intensity peaks in Auger Electron Spectroscopy*
17:30 – 17:50	**Zlatko Kregar** (invited talk) *Optical and catalytic probe investigation of inductively coupled plasma*

18:00 – 20:00	Poster session
20:00 – 22:00	Dinner

Friday, 9th of May

Session 3 (chairman: O. Milat, M. Mozetič)

10:00 – 10:20	**Matej Hočevar** (invited talk) Monika Jenko, Matjaž Godec, Damjana Drobne

	The influence of surface properties on the adhesion of bacteria Escherichia coli to stainless steel, silver, and titanium oxide thin films
10:20 – 10:40	**Veljko Grilj** (invited talk) *An ultra-thin diamond membrane as a single ion transmission detector and vacuum/air interface for external microbeams*
10:40 – 11:00	**Zdenka Peršin** (invited talk) Karin Stana Kleinschek, Miran Mozetič *Non-equilibrium plasma - as potential surface engineering tool suitable for applications in medical and health care*
11:00 – 11:30	Coffee break

Session 4 (chairman: M. Čekada, M. Buljan)

11:30 – 11:50	**Davor Ristić** (invited talk) Alphonse Rasoloniaina, Andrea Chiappini, Patrice Féron, Stefano Pelli, Gualtiero Nunzi Conti, Mile Ivanda, Giancarlo C. Righini, Gilles Cibiel, Maurizio Ferrari *Coated microresonators for photonics applications*
11:50 – 12:10	**Peter Gselman** (invited talk) Tonica Bončina, Franc Zupanič, Darja Kek Merl, Miha Čekada, Matjaž Panjan, Peter Panjan *Defekti v PVD-prevlekah in njihov vpliv na fizikalno-kemijske lastnosti sistema prevleka/podlaga*
12:10 – 12:20	Closing
13:00	Lunch

POSTER SESSION (to be added)

Number	Authors, Title
P1	Aleksander Drenik, Angelos Mourkas, Rok Zaplotnik, Gregor Primc, Miran Mozetic, Peter Panjan, Daniel Castro, Francisco L. Tabares *Erosion of amorphous hydrogenated carbon thin films in the afterglow of NH3 plasma*
P2	I. Capan, J. Martín-Sánchez, A. Chahboun, S.R.C. Pinto, E.M.F. Vieira, A.G. Rolo, M.J.M. Gomes *Morphological, Structural and Charge Trapping Properties of Ge Nanoparticles Produced by Pulsed Laser Deposition*
P3	Alenka Vesel, Rok Zaplotnik, Miran Mozetič *Characterization of SO2 plasma by optical emission spectroscopy*
P4	Janez Kovač, Gregor Jakša, Tatjana Filipič, Bogdan Štefane *Comparison of aliphatic and aromatic aminosilane thin films deposited on silicon wafer*
P5	Darja Jenko, Rebeka Rudolf, Jelena Bogovic, Peter Majerič, Srečko Stopić, Ivan Anžel, Monika Jenko, Bernd Friedrich *Characterization of Au Nanoparticles Synthesized by Ultrasonic Spray Pyrolysis by Means of Transmission Electron Microscopy*
P6	Krešimir Salamon, Ognjen Milat, Nikola Radić, Miroslav Očko, Sigrid Bernstorff *X-RAY STUDY OF DEFFECTS AND NANOMORPHOLOGY IN TANTALUM NITRIDE THIN FILMS*
P7	M. Buljan, N. Radić, T. Car, I. Bogdanović-Radović, M. Jerčinović, S. Bernstorff *Tuning the structural properties of Ge nanowire networks in glass Al2O3 matrix*
P8	Marin Petrović, Jerzy T. Sadowski, Marko Kralj *Characterizing wrinkles of graphene on Ir(111)*

P9	Mario Rakić, Goran Pichler *Optical frequency comb on potassium D1 resonance line*
P10	Miha Čekada, Georg Geiger *Evaluation of selected nanolayered and nanostructured coatings for cutting applications*
P11	Miran Mozetič *CHARACTERIZATION OF EXTREMELY WEAKLY IONIZED HYDROGEN PLASMA WITH A DOUBLE LANGMUIR PROBE*
P12	Nina Recek, Alenka Vesel, Miran Mozetič, Metod Kolar *Protein Adsorption on Various Plasma-Treated Polyethylene Terephthalate Substrates*
P13	Ognjen Milat, Nikola Radić, Krešimir Salamon, Nazif Demoli *Interferometry of thin film buckling patterns*
P14	Rok Zaplotnik, Aleksander Drenik, Miran Mozetic *LOW PRESSURE PLASMA REACTORS AS A SOURCE OF NEUTRAL OXYGEN ATOMS FOR CARBON DEPOSITS REMOVAL*
P15	Sanja Ercegović Ražić, Jelena Peran *Changes of Physical-Mechanical Properties of Natural and Man-made Plasma-Treated Cellulosic Fabrics*
P16	Gregor Primc, Miran Mozetic *Influencing the density of neutral oxygen atoms in an afterglow chamber by a movable recombinator*
P17	Domagoj Kos, Marijan Bišćan, Krešimir Salamon, Nikša Krstulović Thin films of GaAs produced by colliding laser produced plasma

Pozvana predavanja
Invited talks

Abstract title : Nanostructuring thin films by dewetting

Authors : Barbara Šetina Batič

Institutions : Inštitut za kovinske materiale in tehnologije

Abstract : Thin films, with their thickness in the few ten nanometers range, become unstable upon melting and self-organize into characteristic nanoscale patterns in the form of percolated networks and spherical droplets. Focused ion beam irradiation of a thin film leads to a similar pattern development, even though the melting mechanism is different and there are also sputtering effects to be taken into consideration. The presented work focuses on gold thin film nanostructuring by dewetting, induced by focused beam irradiation as well as thermal annealing.

Focused ion beam induced dewetting follows a series of characteristic steps, starting with roughening of the substrate, development of percolated networks and the final steps consist of a completely dewetted film, until all of the film is sputtered away by Ga+ ions. The patterns exhibits a characteristic length, which can be determined from the ring-shaped 2D FFT image, and it depends on the initial film thickness.

We also performed annealing of thin Au films in vacuum environment. In this case, the film breaks down into spherical droplets, and their sizes and spatial distributions can be correlated to the initial film thickness. The resulting structures were observed by scanning electron microscopy to determine the shapes, spacings, spatial distribution and morphological features.

Abstract title : Using correlation for better identification of low intensity peaks in Auger Electron Spectroscopy

Authors : Besnik Poniku (presenting), Igor Belič, Monika Jenko

Institutions : IMT - Ljubljana

Abstract : The presence of noise in AE spectra represents a challenge, especially in cases when peaks of low intensity are present. In these cases the recognition of the peak is either made difficult or impossible.

This work describes the use of correlation as a tool for improving the recognition of the peaks in cases when the intensity of the peak is comparable to the level of noise. For the purpose of this work the noise signal was generated at certain known levels, and then the extracted copper peak normalized according to its maximum value was added. Six cases of signals with different peak – to – noise ratios (P:N) were generated, namely of P:N of 1:1, 1:1.2, 1:1.4, 1:1.6, 1:1.8, and 1:2. In the cases of higher peak to noise ratios the peak in the direct form is only slightly distinguishable, with this distinguishability tending to barely noticeable as the P:N approaches 1:2.

The correlation experiments followed after the generation of the signal with the addition of the normalized copper peaks. The correlation experiments were performed by shifting the extracted and normalized copper peaks along the generated noisy signal containing the added peaks. Prior to this the autocorrelation of the two normalized copper peaks without the presence of noise was performed in order to observe the emergence of the new characteristic shape and thus to know what to look for when the normalized copper peaks are shifted along the noisy signal. It turns out that the new shape resulting from correlation is much more recognizable for the signal with the same P:N compared to the recognizability of the peaks added to the generated noise as such. Averaging further on up to 10 generated signals of the same noise level improves even more the recognizability of this shape which emerges from correlation, even for the most severe cases tested in this work in which the peak i

n the direct form could not be distinguished at all, validating this way the use of correlation as a method to be used in the post processing stage for better peak identification.

Abstract title: Coated microresonators for photonics applications

Authors : Davor Ristić[1], Alphonse Rasoloniaina[2], Andrea Chiappini[3], Patrice Féron[2], Stefano Pelli[4], Gualtiero Nunzi Conti[4], Mile Ivanda[1], Giancarlo C. Righini[5], Gilles Cibiel[6], and Maurizio Ferrari[3]

Institutions:

[1]Institut RuđerBošković, Bijeničkacesta 54, 10000 Zagreb, Croatia

[2]FOTON-Systèmes Photoniques (CNRS-UMR 6082), ENSSAT, 6 rue de Kerampont, CS 80518, 22305 Lannioncedex, France.

[3]IFN – CNR CSMFO Lab., Via alla Cascata 56/C Povo, 38123 Trento, Italy

[4]IFAC - CNR, MiPLab., 50019 Sesto Fiorentino, Italy

[5]Enrico Fermi Centre, Piazza del Viminale 1, 00184 Roma, Italy

[6]Centre National d'EtudesSpatiales (CNES), 31401 Toulouse Cedex 9, France

Abstract : Whispering gallery mode resonators are very high Q factor, low mode volume optical resonators and as such can fund applications in numerous fields of photonics such as microlasers, optical amplifiers, frequency comb generation, quantum electrodinamics, sensing and so on. By coating the microresonator with a suitable high refractive index coating the spheres different optical and spectroscopical properties can be improved. We will present some results about the coating of the microresonators with optically active layers, in particular for lasing applications. Additionally we will discuss some other effects of the coating on the resonator such as modal dispersion tailoring and sensing sensitivity improvement.

Abstract title : Marine gel phase: network formation and interaction with nanoparticles

Self-assembly of marine biopolymers and interactions with nanoparticles

Galja Pletikapić,[1,*] Vesna Svetličić,[1] Tea Mišić Radić[1], Miklos Kellermayer,[2] Jasna Brujić[3]

[1] *Division for Marine and Environmental Research, Ruđer Bošković Institute, Zagreb, Croatia*
[2] *Department of Biophysics and Radiation Biology, Semmelweis University, Budapest, Hungary*
[3] *Center for Soft Matter, New York University, New York, USA*

*gpletik@irb.hr

The gel formation in aqueous solutions such as seawater is a complex process that depends on biopolymer chemical structure, nature of co- and counter ions, polymer concentration and temperature. Microscopic (TEM, AFM) and NMR studies revealed that fibrillar acyl heteropolysaccharides are major constituents of naturally occurring marine high molecular weight dissolved organic matter [1,2]. These polysaccharides stand out by their supramolecular organization and gelling capacity due to hydrogen bonding and electrostatic interactions [2] and are directly related to their function in marine ecosystem [3]. Here, we used force spectroscopy to quantify the intra- and intermolecular forces within the marine gel network. Even though marine biopolymers are complex naturally occurring materials, careful experimentation using high-resolution AFM imaging and force spectroscopy revealed reproducible and distinct mechanical responses. These mechanical signatures depend on the level of association between the fibrils and the topology of the gel network itself.

To reveal the interaction of nanoparticles (NPs) in complex matrices like marine gel phase is a challenging task [4]. By high-resolution AFM imaging, the incorporation of NPs into the marine gel matrix was identified [5]. This nanospecific interaction could have significant environmental implications.

References

[1] L. I. Aluwihare, and D. J. Repeta, Mar. Ecol. Prog. Ser. **186** (1999) 105-117.
[2] T. Mišić Radić, V. Svetličić, V. Žutić and B. Boulgaropoulos, J. Mol. Recognit. **24** (2011) 397–405.
[3] P. Verdugo, Ann. Rev. Mar. Sci. **4** (2012) 375–400.
[4] A. Quigg, W. C. Chin, C.S. Chen, S. Zhang, Y. Jiang, A.J. Miao, K.A. Schwehr, X. Chen, and P.H. Santschi, ACS Sustainable Chem. Eng. **1** (2013) 686–702.
[5] G. Pletikapić, I. Vinković Vrček, V. Žutić, and V. Svetličić, J. Mol. Recognit. **25** (2012), 309–317.

Abstract title : Effects of nanoscale structural modulation on graphene's electronic structure

Authors : Iva Šrut Rakić1(presenting), Vesna Mikšić Trontl1, Petar Pervan1, Fabian Craes2, Wouter Jolie 2, Carsten Busse2, and Marko Kralj1

Institutions : 1 Institut za fiziku, Zagreb, Croatia
2 II. Physikalisches Institut, Universität zu Köln, Germany

Abstract : The first truly two dimensional material – graphene has a wide spectrum of possible applications most prominent of which are applications in electronics and optoelectronics. But to accommodate specific requirements in such crucial applications it is necessary to engineer the graphene's electronic structure which presents a vital course in graphene research. In this work we utilize the fact that structural modifications of graphene, in particular the ones involving strain, lead to changes of its electronic structure. Our approach, linked to strain engineering, is based on growing graphene on a stepped surface Ir(332) in UHV conditions. Graphene on Ir(332) causes severe surface restructuring resulting in new mesoscopic features consisting of wide (111) terraces bounded by step bunches dominantly of (133) orientation. We have studied this system by means of scanning tunneling microscopy (STM) and spectroscopy (STS) as well as angular resolved photoemission spectro

scopy (ARPES). ARPES averaged on a scale of micrometer, shows an anisotropy of the Fermi velocity as well as a slight n-doping. In addition, STS spectra and maps visualize electronic states localized on flat terraces, step bunches or step edges, showing distinction depending on a direction of graphene bending. More detailed examination of step bunches reveals an additional electronic substructure likely mediated by local changes in van der Waals interaction with the substrate. Our findings demonstrate a viable route to alter epitaxial graphene's electronic structure by means of strain and van der Waals interaction.

Abstract title : Laser produced plasmas for analytical and depositional applications

Authors : Marijan Bišćan

Institutions : Institut za fiziku, Zagreb

Abstract : Nowadays, plasmas generally play an important role from both scientific and technological point of view. For example, they are being used for sterilization, material surface processing, welding, highlighting, etc. One, more common, way of producing plasma is by using high-power lasers for ablation of material under investigation. The advantage of this approach is that the material itself can be in any state of matter. In our present work we are mainly focused on researching depositional capabilities (thin films) of laser produced plasmas and partially on their analytical usage. Here we present an overview of results which include comparison of deposition using single-pulse, double-pulse and colliding plasma configurations, description of plasma plume expansion under vacuum and various gas pressures and element analysis under atmospheric pressure.

Abstract title : PLASMA TECHNOLOGIES AS A BIOTECHNOLOGY TOOL

Authors : Martina Modic1, Metod Kolar2, Ita Junkar1, Miran Mozetič1

Institutions : 1Inštitut »Jožef Stefan«, Jamova cesta 39, 1000 Ljubljana
2Ekliptik d.o.o., Teslova 30, 1000 Ljubljana

Abstract : Plasma technologies are based on a simple physical principle of matter changes, when enough energy is supplied to a gas. Gas becomes ionized and goes into the energy-rich plasma state or so called the fourth state of matter. Gaseous plasmas has been used in different branches of industry for several decades, with progress in science they are getting more and more attention also in the field of biology and biotechnology.

Providing efficient health care at tolerable cost is still one of the greatest challenges facing the world in this century. Cardiovascular diseases are one of the leading causes of death in developed countries. Among CVD´s atherosclerosis is one of the most common ones. Atherosclerosis is a condition where the arteries becomes narrowed and hardened due to an excessive build up of plaques around the artery wall. This can potentially leads to a failure of vascular graft. Treatment of atherosclerosis is a complex and long lasting process and in several cases ends up with surgical procedures and in the last stage with blood vessel replacement with artificial vascular implant. Biomaterials used for fabrication of artificial vascular implants are still not optimal in spite of several improving methods. After the surgical procedure, more than 10 % of patients still face the post-surgical complications. Hydrophobicity of the implant surface limits the surface endothelization, and on the other side presents the ideal surface for protein and platelets adhesion and consequently the formation of thrombi.

Plasma treatment offers a perspective alternative to conventional methods for improvement of artificial grafts. With the use of plasma technologies we managed to achieve significant modification of surface properties in the sense of changes in surface wettability, surface roughness and surface chemistry. All these changes lead to improved surface endothelization and reduced adhesion and platelet activation on the surface of artificial vascular grafts.

Abstract title : The influence of surface properties on the adhesion of bacteria Escherichia coli to stainless steel, silver, and titanium oxide thin films

Authors : Matej Hočevar1 (presenting), Monika Jenko1, Matjaž Godec1, Damjana Drobne2

Institutions : 1Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia
2Department of Biology, Biotechnical Faculty, University of Ljubljana, Večna pot 111, SI-1000 Ljubljana, Slovenia

Abstract : We have investigated the influence of surface properties of austenitic stainless steel (AISI 316L), silver (Ag), and titanium oxide (TiOx) thin films on the adhesion of bacteria Escherichia coli. Six stainless steel (SS) surface finishes were prepared and compared with the Ag and TiOx thin films modified surfaces using atomic force microscopy, X-ray photoelectron spectroscopy and scanning electron microscopy. SS samples with different surface finishes correspond to different topographies and roughness values Ra ranging from 0.4 μm to 0.002 μm. Ag and TiOx thin films on the SS samples modify the chemistry of the surface, thus causing significant differences in hydrophobicity and surface energy values of investigated samples.

Bacterial adhesion experiments revealed that roughness and topography are important parameters influencing bacterial adhesion to surfaces. On SS samples minimal adhesion was observed on A800 surface finish (Ra 0.08 μm), whereas on Ag and TiOx samples minimum adhesion was observed on A1200 surface finish (Ra 0.04–0.05 μm). Adhesion to rougher or smoother SS, Ag and TiOx surface finishes was higher. The surface topography influenced the adhesion pattern of bacteria. E. coli cells tend to concentrate inside and often along surface morphological features, whereas more even distribution of cells with aggregates was observed on polished surfaces without surface features.

The adhesion of bacteria was significantly lower on the Ag samples compared to SS and TiOx, thus demonstrating the antibacterial properties of Ag thin films. TiOx on the other hand exhibited no antibacterial effect and the level of adhesion observed was comparable to SS samples. Additionally no clear correlation was observed between hydrophobicity, surface energy and adhesion of bacteria on all three different surface chemistries. Results revealed that the influence of roughness and topography on bacterial adhesion was greater compared to that of surface chemistry.

Abstract title : Interfacing oxides with Si substrates

Authors : M. Spreitzer1, Z. Jovanović1,2, D. Klement1, J. Kovač3 and D. Suvorov1

Institutions : 1 Advanced Materials Department, Jožef Stefan Institute, Ljubljana, Slovenia
2 Laboratory of Physics, Vinča Institute of Nuclear Sciences, Belgrade, Serbia
3 Department of Surface Engineering and Optoelectronics, Jožef Stefan Institute, Ljubljana, Slovenia

Abstract : Interfacing an oxide with silicon is a great challenge that has attracted a lot of interest so far. Solving the problem would enable the further scaling of microelectronic devices to smaller dimensions and the growth of epitaxial thin films with different functionalities. Using molecular beam epitaxy (MBE) high-quality SrTiO3 has already been prepared on silicon using a silicide intermediate layer. However, since the process is slow and expensive it is less attractive for industrial applications. In our work, pulsed laser deposition has been used to grow SrTiO3 on (100) silicon. In contrast to MBE procedures, which use a combination of high temperature and ultra-high vacuum to remove the native oxide from the surface of the silicon substrate, a HF treatment was also applied in our work.
The results show that the optimal conditions for the direct growth of SrTiO3 on silicon involve a two-step procedure, in which the initial vacuum and the lower deposition temperature have an important role. The obtained films are textured with (100) orientation. Improved growth characteristics were observed in the case when SrO was used as a buffer layer. In this case the SrTiO3 film is epitaxial with STO(110)//Si(100) and STO[100]//Si[110]. In addition, X-ray photoemission spectroscopy of the film shows that the SrO and Sr2SiO4 layers are formed at the interface, which influence the growth direction of the SrTiO3 layer considerably.

Abstract title : DEFEKTI V PVD-PREVLEKAH IN NJIHOV VPLIV NA FIZIKALNO-KEMIJSKE LASTNOSTI SISTEMA PREVLEKA/PODLAGA

Authors : Peter Gselman1,2, Tonica Bončina2, Franc Zupanič2, Darja Kek Merl1, Miha Čekada1, Matjaž Panjan1, Peter Panjan1

Institutions : 1 Institut "Jožef Stefan", Jamova cesta 39, SI-1000 Ljubljana, Slovenija, peter.gselman@ijs.si

2Univerza v Mariboru, Fakulteta za strojništvo, Smetanova 17, SI-2000 Maribor, Slovenija

Abstract : Čeprav so se trde PVD-prevleke izkazale za enega izmed najučinkovitejših načinov povečanja produktivnosti odrezovalnih postopkov, njihov potencial ni v celoti izkoriščen. Negativen vpliv na njihove tribološke lastnosti imajo zlasti defekti, ki nastanejo med nanašanjem prevlek. V splošnem je v prevlekah veliko nodularnih defektov, kraterjev in drobnih luknjic (por). Takšni defekti poslabšajo oprijemljivost prevlek na podlago, povečajo hrapavost in lokalne notranje napetosti ter povzročijo jamičasto korozijo. Z vidika uporabe so nezaželeni, zato poskušamo njihovo koncentracijo čimbolj zmanjšati. V tem delu smo podrobneje preučili izvor defektov PVD-prevlek ter določili njihov vpliv na fizikalno-kemijske lastnosti sistema prevleka/podlaga.

Nanoplastno TiAlN/CrN-prevleko smo nanesli na štiri različna jekla (D2, M2, M3:2+Co, 316L). Za nanos prevleke smo uporabili naprševalnik s štirimi neuravnoteženimi magnetronskimi izviri. Površino vsakega vzorca smo analizirali po poliranju, po jedkanju in po nanosu prevleke. Za ta namen smo uporabili vrstični elektronski mikroskop (SEM), s katerim smo izvedli eksterno karakterizacijo defektov, SEM mikroskop v kombinaciji s fokusiranim ionskim curkom (FIB), s pomočjo katerega smo naredili serijo rezov izbranih defektov za njihovo interno karakterizacijo ter presevno elektronsko mikroskopijo (TEM) za študij rasti defektov na atomski skali. Vpliv defektov na tribološke lastnosti sistema prevleka/podlaga pa smo ovrednotili s tribometrom in merilnikom adhezije.

Ugotovili smo, da nodularni defekti in kraterji nastanejo na mikroskopsko majhnih topografskih nepravilnostih (raze, vršički) na površini podlag, na tujih delcih, ki so po čiščenju ostali na površini podlag in na tistih delcih, ki so prispeli na podlage med ionskim jedkanjem oz. med nanosom prevleke. Vse te nepravilnosti in tuji delci so kali za nastanek nodularnih defektov. Njihov nastanek je posledica geometrijskega senčenja. Do nepravilne rasti prevleke pride tudi na mestih, kjer se v podlagi iz orodnega jekla nahajajo nekovinski vključki. Rast prevleke je najbolj motena na mestih MnS vključkov. Tribo-meritve so pokazale, da defekti vplivajo na koeficient trenja in obrabno obstojnost prevlek, test razenja pa, da nodularni defekti zmanjšujejo žilavost sistema prevleka/podlaga.

Abstract title : An ultra-thin diamond membrane as a single ion transmission detector and vacuum/air interface for external microbeams

Authors : Veljko Grilj
Institutions : Ruder Boskovic Institute

Abstract : Several applications of single ion microprobe techniques require trigger signal as information about the ion passage. Among others, these include single event upsets, timing applications and investigation of radiation effects on living cells which demand a very accurate and controlled dose delivery. Therefore, the charged particle detection system with 100% detection efficiency is of outmost importance in all such experiments. Here we present a novel detector setup that consists of an ultra-thin diamond membrane used as a transmission single ion detector. Negligible intrinsic noise specific for wide band gap materials like diamond provides a very good signal to noise ratio which highly surpasses those of silicon transmission detectors of similar thickness. Moreover, because of an outstanding diamond mechanical stiffness this membrane can also simultaneously serve as a vacuum window allowing the extraction of ion microbeam into the atmosphere. Approximately 6μm thi ck membrane made of low cost optical quality scCVD diamond material was produced at CEA-Saclay and fully characterized at the Zagreb microprobe facility. In particular, the hit detection efficiency and the beam spreading caused by the membrane thickness were measured for different ion energies. High vacuum withstanding capability was also tested. Additionally, radiation hardness of this device was investigated by irradiating it with 2MeV protons and measuring the charge collection efficiency degradation by ion beam induced charge technique. Results will be discussed.

Abstract title : Non-equilibrium plasma - as potential surface engineering tool suitable for applications in medical and health care

Authors : Zdenka Peršin1 (presenting), Karin Stana Kleinschek1, Miran Mozetič2

Institutions : 1University of Maribor, Faculty of Mechanical Engineering, Laboratory for Characterisation and Processing of Polymers, Smetanova 17, SI-2000 Maribor,
2Jožef Stefan Institute, Department of Surface Engineering and Optoelectronics, Plasma Laboratory, Jamova 39, 1000 Ljubljana, Slovenia

Abstract : Medical and health care products demonstrate a remarkable range of applications, from simple bandages to intelligent textiles. One of the key factors contributing to this market growth is the increase in the aging population suffering from serious chronic wounds complications.

Several products of wound dressing are available in the market designed to facilitate and accelerate the healing process. Significant improvements in wound dressing products have been recorded, but are still far from challenging the characteristics that chronic wounds exhibit. The non-equilibrium plasma may be the surface engineering tool of choice offering tailor-made surface material suitable for wound dressings.

Viscose in the form of non-woven was used, as mostly suitable absorbent material in wound dressings. Its wettability is better compared to similar materials, but still not optimal. Extreme non-equilibrium oxygen plasma was used resulting in the effective diffusion of O-atoms into inter-fibril space and thus the activation of fibrils throughout the non-woven materials. The results of improved hydrophilicity were compared to effects gained by ammonia plasma. NH3 plasma was created by electrode-less RF discharge at the power of 100 W. Optical emission spectroscopy, double electrical probes as well as mass spectrometry were applied for plasma characterization. The density of charged particles was about 5x1015 m-3, the electron temperature about 3 eV, and dissociation fraction of NH3 molecules above 4%.

Plasma – induced properties often gradually change with time thereby limiting the durability of surfaces for industrial applications. The plasma treated samples were stored under two different gasses (i.e. air and argon) for maintaining the plasma-gained hydrophilicity. The hydrophilicity studies were performed by capillary –rise technique using wound relevant fluids (i.e. saline solution and exudate). The ammonia plasma resulted also as on-step process compared to existing procedures combining different functionalization steps one after another in order to simultaneously obtain hydrophilicity and biostatic activity, as desired effect by wound dressings. The biostatic activity was tested against two G+ and two G- bacteria; whist fungistatic activity was monitored against Candida albicans.

Abstract title : Optical and catalytic probe investigation of inductively coupled plasma

Authors : Zlatko Kregar

Institutions : Institut za fiziku

Abstract : Monitoring of plasma processing during treatment of materials is of great importance in low pressure plasma systems. Analysis of treated samples has to be complemented by plasma diagnostics because interactions between reactive plasma and material that is being modified are often very intensive and occur in a short period of time. Standard diagnostic techniques include various probes that are immersed into the plasma. Even though these techniques offer interesting and accurate results, they are often not fast enough to monitor changes in plasma. Therefore, optical emission spectroscopy that monitors real-time changes is introduced. Low pressure inductively coupled plasmas were investigated with a combination of two diagnostic techniques: catalytic probes and optical emission spectroscopy. Concentrations of oxygen and hydrogen were measured in different positions throughout the system in various operating conditions. These spatially resolved concentrations are very

important in plasma processing of materials, because radical concentrations over the sample determine plasma-material interactions. This work demonstrates that a relatively simple detection system can be practical and sufficiently successful in many plasma applications.

Poster sekcija
Poster session

Abstract title : Erosion of amorphous hydrogenated carbon thin films in the afterglow of NH3 plasma

Authors : 1Aleksander Drenik, 1Angelos Mourkas, 1Rok Zaplotnik, 1Gregor Primc, 1Miran Mozetic, 1Peter Panjan, 2Daniel Castro, 2Francisco L. Tabares

Institutions : 1. Jozef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia

2. CIEMAT, Avenida Complutense 40, E-28040 Madrid, Spain

Abstract :

In fusion devices with carbon-based plasma facing components, the formation of amorphous hydrogenated carbon (a-C:H) deposits presents a serious operational issue as the buildup of a-C:H can lead to uncontrolled fuel release and thus cause density control problems. To insure an uninterrupted and efficient operation of the reactor, the a-C:H deposits must be regularly removed. While oxidation by neutral oxygen atoms has proven efficient in a-C:H removal, the concern of damaging the plasma facing and structural components of the reactor prohibits its use in fusion devices. As an alternative, removal by neutral NHx radicals is proposed.

In this contribution, we present the study of removal of a-C:H by neutral species from NH3 plasma. Samples of a-C:H were prepared by thermionic arc sputtering of a graphite target in a mixed Ar-C2H2 atmosphere. The NH3 plasma used in erosion experiment was ignited at the pressure of 50 Pa with an inductively coupled RF generator. The plasma system was characterized by optical emission and mass spectroscopy. At the set pressure, the system was found to operate in two modes, low and high dissociation mode, where the degree of NH3 dissociation was 30 % and near 100 % respectively. In-situ monitoring of the erosion was performed with a laser interferometric system. The erosion rates exhibited an exponential dependency on the surface temperature, and on the degree of dissociation. The measured erosion rates were an order of magnitude higher in the high-dissociation regime and reached up to 8 nm/s.

Abstract title : Characterization of SO2 plasma by optical emission spectroscopy

Authors : Alenka Vesel, Rok Zaplotnik, Miran Mozetič
Institutions : Jozef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia

Abstract : Characterization of SO2 plasma and its mixture with O2, H2, Ar and CO2 was performed using optical emission spectroscopy (OES). The intensity of oxygen line O (777 nm), sulphur line S (921 nm) and SOx continuum was measured at different total pressures 30, 60 and 100 Pa. In the case of gas mixtures 20% of O2, H2, Ar or CO2 was added to SO2 keeping the total pressure constant. Plasma was excited by means of a radiofrequency (RF) generator. RF power was also varied and it was in the range between 50 and 1000 W. At powers between 50 and 400 W plasma in so called E-mode appeared, while at higher powers (600 W) H-mode appeared. In the middle range between 400 and 600 W plasma was unstable (constantly jumping between E- and H-mode). OES results showed that in the E-mode the intensity of SOx continuum prevailed over the intensity of S and O lines which indicates than in the E-mode the reaction SO2 -> SO + O prevailed. In the H-mode the situation was just the opposite i.e.

the intensity of O and S lines was higher than the intensity of SOx continuum, leading to conclusion that in H-mode full SO2 dissociation prevailed SO2 -> S + O + O. Another important difference between E and H modes was observed: while in the E-mode the intensity of all measured lines was increasing with the increasing power, this was no longer the case for H-mode, where the intensity was constant regardless of the power used. The situation was the same also in the case of gaseous mixtures. When comparing the intensity of S line in different gas mixtures it was found that its intensity is the highest in the case of a mixture with Ar and the lowest in the case of a mixture with O2. In the case of changing the gas pressure it was found that in the E-mode the intensity of S line was the highest at the lowest pressure (30 Pa), while in the H-mode it was just the opposite.

Abstract title : Characterization of Au Nanoparticles Synthesized by Ultrasonic Spray Pyrolysis by Means of Transmission Electron Microscopy

Authors : Darja Jenko1, Rebeka Rudolf2,3, Jelena Bogovic4, Peter Majerič2, Srečko Stopić4, Ivan Anžel2, Monika Jenko1, Bernd Friedrich4

Institutions : 1 Institute of Metals and Technology, Laboratory for Surface and Structure Characterization of Materials, Lepi pot 11, SI-1000 Ljubljana, Slovenia,

2 Faculty of Mechanical Engineering, University of Maribor, Smetanova ulica 17, SI-2000 Maribor, Slovenia,

3 Zlatarna Celje d.d., Kersnikova 19, SI-3000 Celje, Slovenia

4 IME Process Metallurgy and Metal Recycling, RWTH Aachen University, Intzestrasse 3, 52072 Aachen, Germany

Abstract : Metal nanoparticles (NPs) of typical dimensions ranging from 1 nm to 100 nm are similar to cellular objects and because of their high stability, biological compatibility, controllable morphology and size dispersion, and easy surface functionalization, they are of high interest. Ultrasonic Spray Pyrolysis (USP), which is a simple aerosol synthetic technique, enables synthesis of metal NPs of various sizes and shapes, including nanoparticles contaminated with metals from alloys.

The study focused on the Transmission Electron Microscopy (TEM) analysis of Au NPs synthesized from pure Au by means of USP: their size, shape, and morphology, which are associated with the key parameters of growth. Conventional TEM (CTEM), Energy Dispersive X-Ray Spectrometry (EDS), Selected Area Electron Diffraction (SAED) and Scanning TEM (STEM) were used for TEM characterization. The average size of Au NPs ranged from 7 nm to 50 nm, and some were bigger than 200 nm. The Au NPs were either spherical (especially smaller particles of up to 20 nm in diameter), hexagonal or in polygonal irregular form. TEM characterization of cross-section of NPs was also used to interpret the results and USP synthesis of NPs regarding to the parameters of the synthesis.

Title: Thin films of GaAs produced by colliding laser produced plasma

Authors : Domagoj Kos, Marijan Bišćan, Krešimir Salamon, Nikša Krstulović
Institutions : Institute of physics Zagreb

Abstract: Pulsed laser deposition is a standard technique to produce thin films of various materials. To get the best quality of the film, plasma must be spatially homogeneous in density and temperature. Colliding plasmas are formed when two closely produced seed plasmas collide. In collisional front between such two plasmas a stagnation layer may be formed which lasts longer and is of better from seed plasmas. Stagnation layer is thus interesting media for deposition of thin films.

In this work we present the results of thin film of GaAs deposition in vacuum (p=8*10^-4 mbar) by colliding plasmas produced on a planar target. Seed plasmas were separated by 1.7 mm and distance between target and substrate was 4 cm. Preliminary results of a difference between standard pulsed laser deposition and deposition by stagnation layer, or colliding plasma deposition, are shown. Results were obtained by XRD analysis of thin films, in terms of film thickness and roughness, and by OES and film transmittance.

Abstract title : Influencing the density of neutral oxygen atoms in an afterglow chamber by a movable recombinator

Authors : Gregor Primc (presenting), Miran Mozetic
Institutions : Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia

Abstract : Variation of the neutral oxygen atom density in an afterglow chamber was monitored with a nickel catalytic probe. The source of neutral oxygen atoms was an inductively coupled electrodeless radiofrequency discharge created in pure oxygen. Oxygen molecules were partially dissociated in the discharged and the resultant atoms entered the afterglow chamber where a standard nickel catalytic probe was mounted. A movable recombination was mounted along the afterglow chamber. Neutral oxygen atoms recombined on the recombination surface so the atom density as detected by the catalytic probe depended on the position of the recombinator. The device allowed for pretty good control of the O atom density independent from the discharge parameters.

Abstract title : Morphological, Structural and Charge Trapping Properties of Ge Nanoparticles Produced by Pulsed Laser Deposition

Authors : I. Capan1, J. Martín-Sánchez2, A. Chahboun3,4, S.R.C. Pinto3, E.M.F. Vieira3, A.G. Rolo3, M.J.M. Gomes3

Institutions : 1Rudjer Boskovic Institute, Bijenička 54, 10 000 Zagreb, Croatia
2 Johannes Kepler University, Linz, Austria
3University of Minho, Centre of Physics and Physics Department, Braga 4710-057, Portugal
4 FST Tanger, Physics Department, BP 416 Tanger, Morocco

Abstract : In this work, a novel customized shadowed off-axis pulsed lased deposition set-up is used for production of Ge nanoparticles in an inert Ar gas atmosphere at room temperature. Influence of deposition parameters such as Ar gas pressure and target-substrate distance on the crystalline quality of as-deposited Ge nanoparticles has been studied systematically by micro-Raman spectroscopy and an enhancement of their crystallinity has been demonstrated as the Ar background pressure is raised. The nanoparticles functionality for charge trapping applications has been successfully demonstrated by temperature dependent capacitance–voltage (C–V) electrical measurements. The flat-band voltage shift (directly related to nanoparticles as a charge trapping centers) increases with the nanoparticles density from $\Delta VFB = 0.62$ V to $\Delta VFB = 1.05$ V, while a flat-band voltage decrease was measured by increasing the tunnel oxide layer thickness from 5 to 10 nm. Moreover, a lower ΔVFB value is found (i.e. lower charge trapping) as the temperature is decreased and the tunnel layer thickness is increased.

Abstract title : Comparison of aliphatic and aromatic aminosilane thin films deposited on silicon wafer

Authors : Janez Kovač(presenting)(1), Gregor Jakša(1), Tatjana Filipič(1), Bogdan Štefane(2)

Institutions : (1) Jozef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia
(2) Faculty of Chemistry and Chemical Technology, Aškerčeva 5, SI-1000 Ljubljana, Slovenia

Abstract : Aminosilanes are used for surface modification and adhesion promotion. They have the ability to form a durable bond between organic and inorganic materials. A surface modified with aminosilanes has many applications: it can be used in chromatography, as a biosensor (immobilization of DNA, proteins, etc.), in medicine, for attaching metal nanoparticles, and for the detection of specific gases and explosives, etc. Organosilane are self-assembled monolayers (SAM).

In our work we will present preparation and characterization of different selfassembled aminopropylsilane thin films (APS) on Si substrate. Single crystal silicon wafers (111) were modified with (3-aminopropyl)-trimethoxysilane (APTMS) and p-aminophenyltrimethoxysilane (APhS). We deposited the self-assembled layers from a solution of aminosilanes in different solvents under various reaction conditions. The surfaces were characterized using X-ray photoelectron spectroscopy (XPS), atomic force microscopy (AFM) and Time-of-Flight secondary ion mass spectrometry (TOF-SIMS). The surface composition and the chemical bonding were determined by XPS, the surface morphology and roughness by using AFM and the chemical structure with TOF-SIMS. Our results show that increased mobility of molecules at higher temperatures of reaction mixture leads to greater surface coverage. At longer deposition times and at higher concentrations of aminosilanes in solvent, polymerization of molecules occ

urs and the formation of thick layer is observed. Differences between formation of aliphatic and aromatic aminosilane thin films will be discussed. In general lower degree of polymerization of APhS molecules was found compared to APTMS attributed to rigidity of the aromatic part of the APhS molecule.

Abstract title : X-RAY STUDY OF DEFFECTS AND NANOMORPHOLOGY IN TANTALUM NITRIDE THIN FILMS

Authors : Krešimir Salamon (presenting), Ognjen Milat, Nikola Radić, Miroslav Oško, Sigrid Bernstorff

Institutions : Institute of Physics, Bijenička 46, 10000 Zagreb, Croatia
Rudjer Bošković Institute, Bijenička 54, 10000 Zagreb, Croatia
Elettra-Sincrotrone, SS 14, km 163.5, 34149 Basovizza, Italy

Abstract : Tantalum nitride (Ta-N) thin films were prepared by reactive magnetron sputtering at room temperature and at various partial pressures of the reactive gas N2. The films were subsequently annealed in the temperature range up to 950Â°C. The crystal structure and the nanomorphology of films were investigated with grazing incidence X-ray techniques: specular reflectivity (XRR), diffraction (GIXRD) and small angle scattering (GISAXS). At relatively low Nitrogen partial pressures (20%<pN2<30%) the films are compact and crystallized into fcc-TaN phase which is stable up to 950Â°C. In these films, the density of stacking fault deformations was found to decrease upon annealing at higher temperatures. At higher Nitrogen partial pressures (65%<pN2<75%) the films reveal loose homogenous structure which turns into particulate nanostructure upon annealing; the average grain size increases from 3nm (aged @550Â°C) to 15 nm (aged @950Â°C). The grains are found to crystallize @750Â °C into fcc-TaN phase.

Abstract title : Tuning the structural properties of Ge nanowire networks in glass Al2O3 matrix

Authors : M. Buljan (presenting), N. Radić, T. Car, I. Bogdanović-Radović, M. Jerčinović, S. Bernstorff

Institutions :

-Ruđer Bošković Institute, Bijenička cesta 54, 10000 Zagreb

-Elettra Sincrotrone Trieste, 34149 Basovizza, Trieste, Italy

Abstract : Semiconductor nanowires that are regularly arranged in glass matrices show very interesting properties and have many relevant applications. Consequently, the simple methods for preparation of such structures are of great significance.

Here we present conditions for the growth of network of self-assembled Ge nanowires in amorphous alumina matrix. The wires are produced by a simple single-step magnetron-deposition process. A dense array of nanowires, regularly distributed in the glass is formed by self-assembled growth. The separation between neighboring nodes of the nanowire network is shown to decrease with the increase of Ge content in the matrix. The regularity in the nanowire ordering is found to increase with lowering of Ar pressure and it is found dependent on the deposition temperature. The prepared materials show strongly structure-dependent electrical properties.

Abstract title : Characterizing wrinkles of graphene on Ir(111)

Authors : Marin Petrović(1), Jerzy T. Sadowski(2), Marko Kralj(1)

Institutions : (1)Institut za fiziku, Bijenička 46, 10000 Zagreb, Croatia
(2)Center for Functional Nanomaterials, Brookhaven National Lab, Upton, New York 11973, USA

Abstract : Wrinkles are an intrinsic feature of many epitaxial graphene systems as well as transferred graphene in devices. For graphene on iridium (111) surface, wrinkles have been studied several times up to now, but a more comprehensive study on their long-range ordering as well as description of their internal structure are still missing.
In this work, scanning tunneling microscopy was used to reveal the structure of individual wrinkles of graphene on Ir(111) which extends beyond simple semi-circular model. Once graphene is delaminated from iridium, complex folded structures are formed, presumably due to the van der Waals interaction. By the use of low energy electron microscopy, we were able to characterize the long-range order of graphene's interconnecting wrinkles network. For the aligned R0 graphene, we found a clear relation between the direction of extension of wrinkles and high symmetry directions of the iridium substrate. We also show that such network can be approximated by a Voronoi diagram which facilitates its characterization. In contrast, such ordering was not observed on R30 rotational domains of graphene on Ir(111), indicating reduced binding to the substrate. Real-time imaging of the wrinkle formation enabled us to visualize local stress relaxation in graphene and partial wrinkle anchoring t
o the substrate. Our findings are relevant for the control and technological implementation of wrinkled graphene.

Abstract title : Optical frequency comb on potassium D1 resonance line

Authors : Mario Rakić, Goran Pichler
Institutions : Institute of Physics, Zagreb, Croatia
Physics Department, Kuwait University, Kuwait

Abstract : We present direct observation of the velocity-selective optical pumping of the potassium (39K) ground state hyperfine levels induced by femtosecond pulse-train excitation centered on D1 transition (770 nm). Experiment has been performed with a modified direct frequency comb spectroscopy. Spectra physics Tsunami mode locked Ti:sapphire laser with duration of the pulse of about 100 fs and a repetition rate of about 80 MHz has been used as a pump laser and it was centered on D1 transition. Weak Toptica ECDL had been used as a probe laser. It was also centered on the same transition and had a linewidth less than 1 MHz. We observed how the optical frequency comb was inprinted on the Doppler profile of the resonance line. Theoretical calculation has also been performed and it is in very good agreement with experiment. In addition we show the interaction of the frequency comb and potassium atoms in external magnetic field from 0 to 75 Gauss. In that range we found osci
llations in the intensity of modulations (amplitude of the comb fringes).

Abstract title : Evaluation of selected nanolayered and nanostructured coatings for cutting applications

Authors : Miha Čekada(presenting), Georg Geiger

Institutions : Jožef Stefan Institute, Ljubljana, Slovenia; Vienna University of Technology, Vienna, Austria

Abstract : PVD hard coatings are nowadays commonly used in protection of cutting tools such as milling tools, cutting inserts, etc. In the development of the coatings, most attention is paid to their structural and mechanical properties. When implemented into selected industrial applications, different objectives become relevant, i.e. the ones related to economical issues. These include increase of tool lifetime, enhanced productivity, workpiece quality, etc.

There are several other issues with a significant influence, yet a relatively small emphasis has been given insofar. In this work we concentrated on two such aspects: (i) evaluation of surface quality of the base material before coating deposition, (ii) testing of the cutting performance on a milling system with in-situ diagnostics of the cutting process.

Cemented carbide mills were used for tests having a diameter of either 6 mm or 10 mm. Two coatings were selected for evaluation: the nanolayer TiAlN/TiN coating and the (Ti,Al,Si)N coating, which consists of a TiAlN base layer, a nanocomposite TiSiN middle layer and a nanolayer/nanocomposite TiAlSiN toplayer. A standard TiAlN coating was used for selected reference tests. They were all deposited by magnetron sputtering in a commercial deposition system CemeCon CC800/9 with a thickness of around 3 μm.

The surface quality was systematically evaluated using a confocal optical microscope. Identical motives were taken on bare tool, after coating deposition, and after cutting tests. We analysed, how do individual failures (both on the bare tool surface and on the coating alone) influence the cutting performance. Special attention was given to the cutting edge rounding/chipping.

The machining tests were performed on an OPS600 3-axis milling machine equipped with a high-speed spindle. To describe the shifting of the tool behavior during the lifetime several parameters have been measured during every cut of the tests such as cutting forces, tool temperature and tool wear. Afterwards surface quality, chip formation and tool wear analysis have been done. The two coatings have been tested by cutting three different materials: C45E (1.1191), X40CrMoV5-1 (1.2344) and X153CrMoV12 (1.2379) running dry and with minimal quantity lubrication. The tests show that the TiAlN/TiN coating performs best related to the tool wear independent of test material and cooling using the same cutting parameters.

Abstract title : CHARACTERIZATION OF EXTREMELY WEAKLY IONIZED HYDROGEN PLASMA WITH A DOUBLE LANGMUIR PROBE

Authors : Miran Mozetič

Institutions : Jozef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia

Abstract : Basic parameters of hydrogen plasma created in a large discharge chamber were determined using a double Langmuir probe.Plasma was created in a pyrex cylinder with the diameter of 25 cm and the height of 80 cm by an antenna connected to a RF
generator operating at the frequency of 27.12 MHz and the power of about 200 W. The antenna was a copper coil of 4 turns. The discharge chamber was pumped with an oil diffusion pump with the nominal pumping speed of 600 L/s backed by a two stage
rotary pump with the pumping speed of 4.4 × 10–3 m3 s–1. The ultimate pressure of about 2 × 10–3 Pa was obtained in the vacuum system after pumping for few hours. A double Langmuir probe was galvanic separated from the mains and placed into the centre of the discharge chamber. The probe was made from 2 tungsten rods with a diameter of 1.2 mm and separated for 2 cm. The length of non-insulated part of the rods was 17.5 mm. Plasma parameters were measured at different pressures between 0.4 and 7.2 Pa. The electron temperature reached the maximum of about kTe = 3.5 eV at the pressure of 1 Pa. The plasma density was slowly decreasing with increasing pressure and was of the order of 1015 m–3, and the Debye length was rather constant at about 2 × 10–4 m. The results were explained by characteristics of an electrode less RF discharge in the E mode.

Abstract title : Protein Adsorption on Various Plasma-Treated Polyethylene Terephthalate Substrates

Authors : Nina Recek, Alenka Vesel, Miran Mozetič, Metod Kolar

Institutions : Jozef Stefan Institute, Plasma laboratory, Jamova 39, 1000 Ljubljana, Slovenia
Jozef Stefan International Postgradute School, Jamova 39, Ljubljana, Slovenia

Abstract : The aim of this study was to find out how different surface modification of PET polymer by means of low-pressure plasma treatment influences the adsorption of albumin and other proteins from the cell culture medium. Polymer polyethylene terephthalate (PET) was treated either in oxygen plasma to make the surface hydrophilic or in CF4 plasma to make the surface hydrophobic. The source of plasma was radiofrequency (RF) discharge. Adsorption of albumin and other proteins from cell-culture medium onto these surfaces was studied using Quartz crystal microbalance (QCM). It is one of the best methods for studying the adsorption kinetics of proteins, which measures the mass per unit area by measuring the change in frequency of a quartz crystal resonator. It is also one of few techniques that can be used to give a direct observation of the adsorption process because it enables real-time measuring.

The results show that the adsorption of proteins is very fast at the beginning and later it slows down slowly reaching equilibrium where the surface saturation is reached. The adsorption is the fastest in the case of PET sample treated in oxygen plasma while in the case of control sample and the sample treated in fluorine plasma there are no important differences. This is true for all three different protein solutions that were used. Also the amount of the adsorbed proteins was higher for oxygen-plasma treated surface and the adsorbed layer was more viscoelastic.

After rinsing the samples with PBS solution a change in a resonant frequency is observed, meaning, that some desorption of loosely bound proteins occurred. Desorption is the most pronounced for the case of the control sample, where the major part of proteins was desorbed. In the case of plasma treated samples, we can also observe high desorption, but due to the higher mass of pre-adsorbed proteins, there still remain quite a lot of proteins on the surface in comparison to the control sample. These results therefore show that more proteins were adsorbed on the hydrophilic surface than on the hydrophobic one.

Abstract title : Interferometry of thin film buckling patterns

Authors : Ognjen Milat1*, Nikola Radić2, Kresimir Salamon, Nazif Demoli1
Institutions : 1. Institute of Physics, Bijenička 46, Zagreb, Croatia
2. Rudjer Boskovic Institute, Bijenička 52, Zagreb, Croatia

Abstract : Morphology and topography of buckling patterns in residually compressed thin film, observed during or after its delamination from the substrate, were studied by holographic interferometry using a home made Digital Optical Holographic Microscope.
Various types of buckling patterns such as disordered surface wrinkles, regular herringbone, straight-sided or telephone cord buckles and circular blisters has been studied are analysed. Delamination usually starts as straight-sided linear wrinkle, but then deviate to the telephone cord (TC) periodic wavy geometry due to the fact that the compressive residual stress in the film is biaxial. In general, buckling profiles can be characterized, by scanning electron microscopy, mechanical or laser-scanning profilometry, optical interferometry, or depending on scale - by using an atomic force microscope.
Our home-adapted Digital Optical Holographic Microscope is a commercial metallurgical instrument with sophisticated extensions. The extended set-up consists of two lines for traditional imaging and digital hologram recording, plus a line for “real time” hologram reconstruction. It provides simultaneous or alternative white-light or monochromatic illumination of the very same area of a specimen. By traditional imaging and optical processing in holographic mode, one can display interferometric fringes patterns that reveal lateral and vertical buckling features. Correlation of traditional microscopy and holographic interferometry provides better understanding and modeling of TC buckling morphology.

Abstract title : LOW PRESSURE PLASMA REACTORS AS A SOURCE OF NEUTRAL OXYGEN ATOMS FOR CARBON DEPOSITS REMOVAL

Authors : Rok Zaplotnik, Aleksander Drenik, Miran Mozetic

Institutions : Jozef Stefan Institute

Abstract : There is a lot of demand for cleaning of carbon deposits without any chemicals. One of the examples in basic science is cleaning of amorphous hydrogenated carbon (a-C:H) deposits in fusion devices. Even though most of the fusion community is now focused towards the research of tungsten for a divertor material, some of the old tokamaks are still loaded with carbon walls. The walls are etched and the products are deposited inside the reactor vessel in a form of a-C:H. In order to prevent the fuel retention and to make a fusion plasma more reproducible, the a-C:H deposits will have to be regularly cleaned. While a-C:H that form on the plasma wetted surfaces are efficiently removed by the fusion plasma itself, the a-C:H formed in shaded areas will require more efforts in removal.

Among the proposed chemical cleaning methods, oxidation by atomic oxygen seems especially suitable for removing a-C:H deposits from surfaces with complex geometries. In this work, we present three different approaches to production of atomic oxygen. We have used an inductively coupled 1.2 kW radiofrequency generator, a 300 W microwave power supply and a 5 kW radiofrequency generator. The first two plasma systems are dedicated to the research of interaction of a-C:H with atomic oxygen. Beside the finely tunable power supplies, they also feature a temperature controlled sample holder which allows for setting the sample surface temperature from room temperature up to 400 °C. The 5 kW plasma system is used to demonstrate the feasibility of using a remote source of atomic oxygen and to ensure that suitable fluxes of atomic oxygen are delivered to the contaminated surfaces even through non-optimal transport paths. All plasma systems were characterised by means of Fiber Optic Catalytic Probes and optical emission spectroscopy.

Abstract title : Changes of Physical-Mechanical Properties of Natural and Man-made Plasma-Treated Cellulosic Fabrics

Authors : Sanja Ercegović Ražić & Jelena Peran
Institutions : Faculty of Textile Technology, University of Zagreb
Department of Materials, Fibres and Textile Testing
Prilaz baruna Filipovića 28 a
10 000 Zagreb, Croatia

Abstract : The research presented describes the impact of the plasma treatments on physical and mechanical properties of natural and man-made cellulosic fabrics defined structural characteristics. Oxygen (O2) and Argon (Ar) as non-polymerizing working gases were used in the experiments. Plasma treatments were carried out using a low-frequency plasma system of 40 kHz under process conditions: gas flowrate of 40 cm3/min, pressure of 0.3 mbar, power of 300 W, and treatment time of 5 and 10 min. Two fabrics of cotton, lyocell and modal fibers of approximately equally structural characteristics but diferent of linear density were used in experiments. Through the preliminary researches process parameters of plasma treatments were optimized in order to achieve the fiber with more reactive sites on the surface and more appropriate for physical - chemical treatments to obtaining new functional properties. Such process are complex, and the final effects depend on many factors; type of used material, plasma type, plasma parameters and treatment conditions.

For better analysing of the physical properties changes of the thickness, mass per unit area, number of threads per cm (linear density) and porosity were obtained.

Mechanical properties - breaking force and breaking elongation were tested, according to HRN EN ISO 13934-1:2013, while the bending rigidity was tested using standardized method according to HRN EN ISO 9073-7:2003.

The results of physical properties tested of all fabrics suggest that the oxygen and argon plasma treatment leads to a certain thickening of macrostructure, which is particularly reflected in the decrease in porosity of the treated samples. The results provide data which indicate on increased of breaking force after plasma treatments of natural (cotton) fabrics, in relation to the man-made cellulosic fabrics (lyocell and modal) where the lower reduction of breaking force is evident. Bending rigidity of tested fabric samples indicate on the similar effect, but results are non-uniform.

Lista sudionika
List of participants

No.	Ime i prezime	Abstract
Poster predavanja / Poster presentations		
1	Aleksander Drenik	y
2	Alenka Vesel	y
3	Darja Jenko	y
4	Ivana Capan	y
5	Janez Kovač	y
6	Krešimir Salamon	y
7	Maja Buljan	y
8	Marin Petrović	y
9	Mario Rakić	y
10	Marko Kralj	n
11	Miha Čekada	y
12	Miran Mozetič	y
13	Nikola Radić	n
14	Nina Recek	y
15	Ognjen Milat	y
16	Rok Zaplotnik	y
17	Slobodan Milošević	n
18	Sanja Ercegović Ražić	y
19	Jelena Peran	n
20	Nikša Krstulović	n
21	Domagoj Kos	y
22	Gregor Primc	y
Pozvana predavanja / Invited talks		
23	Barbara Šetina Batič	Y
24	Besnik Poniku	Y

25	Davor Ristić	Y
26	Galja Pletikapić	Y
27	Iva Šrut Rakić	Y
28	Marijan Bišćan	Y
29	Martina Modic	Y
30	Matej Hočevar	Y
31	Matjaž Spreitzer	Y
32	Peter Gselman	Y
33	Veljko Grilj	Y
34	Zdenka Peršin	Y
35	Zlatko Kregar	Y

INDEX

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