DS 27: Polymer and Composite Films

Time: Friday 9:30–11:15 Location: H32

DS 27.1 Fri 9:30 H32

Structure and Dynamics of laser deposited poly(alkylmethacrylate)s — •Andreas Meschede[1], Thorsten Scharf[1], Hans-Ulrich Krebs[1], and Konrad Samwer[2] — [1]Institiut für Materialphysik, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen — [2]I. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Thin polymer films were grown by pulsed laser deposition (PLD) at 248 nm in ultra high vacuum and by Matrix Assisted Pulsed Laser Evaporation (MAPLE). The observed films show strongly different chemical, structural and mechanical properties depending on the deposition parameters, especially the laser fluence, which will be discussed with respect to the ablation mechanism. In this study, two poly(alkyl methacrylate)s are studied: poly(methyl methacrylate) (PMMA) and poly(ethyl methacrylate) (PEMA). Having the same backbone, these polymers differ by the size of their sidegroups and consequently their dynamics, which easily can be seen by a decrease in glass transition temperature with increasing side group length. Additional to chemical and morphological characterization, results obtained by mechanical spectroscopy using the Double Paddle Oscillator (DPO) and the Plasma Plume eXcited Reed (PPXR) technique will be presented to clarify the relaxation behaviour and the underlying dynamics.

DS 27.2 Fri 9:45 H32

Pulsed laser deposition of PMMA thin films — •Britta Lösekrug, Thorsten Scharf, and Hans-Ulrich Krebs — Institut für Materialphysik, University of Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Thin films of Poly(methyl methacrylate) (PMMA) are of special interest for instance as photoresist or coating material. Here pulsed laser deposition (PLD) has proven to be an effective and flexible method. The influence of the laser fluence during deposition on the film structure, morphology and roughness was studied by FTIR, REM, AFM and XRR. It is shown that close to the deposition threshold (between 50 and 125 mJ/cm^2) completely smooth (roughness at 600 nm thickness: 0.7 nm) and droplet-free films can be prepared. In contrast, at higher laser fluences two components are formed, a smooth cross-linked film and droplets (with a diameter of up to 10 μm) consisting of polymer with reduced chain length [1]. The origin of the droplet formation and the ablation mechanisms are discussed.

[1] E. Süske, T. Scharf, T. Junkers, M. Buback, H.U. Krebs, J. Appl. Phys. **100** (2006) 014906.

DS 27.3 Fri 10:00 H32

Antimicrobial properties of co-sputtered Ag,Au/PTFE nanocomposite films — •Vladimir Zaporojtchenko[1], Rainer Podschun[2], Amit Kulkarni[1], Venkata Sai Kiran Chakravadhanula[1], and Franz Faupel[1] — [1]Chair for Multicomponent Materials, Technical Faculty of CAU Kiel, Kaiserstrasse2, 24143 Kiel, Germany — [2]Institute of Infection Medicine, CAU Kiel

In this work, we used co-sputtering of noble metals together with polytetraflourethylene(PTFE) as a method to produce antibacterial polymer/metal nanocomposite coatings, where the precious metals are only incorporated in a thin surface layer. Moreover, they are finely dispersed as nanoparticles, thus saving additional material and providing a very large effective surface for metal ion release. The nanocomposite films with the thickness between 100 and 300 nm were prepared in a large range of metal filling between 10 and 40 %. The antimicrobial effect of the nanocomposite coatings was evaluated by means of two different assays. Bactericidal activity due to silver release from the surface was determined by a modification of conventional disc diffusion methods. Inhibition of bacterial growth on the coated surface was investigated by a modified proliferation assay. Staphylococcus aureus was used mostly as test bacterium as this species commonly causes infections associated with medical polymer devices. The antibacterial efficiency of the coatings against different bacteria was demonstrated at extremely small noble metal consumption. The maximum ability of antibacterial effect was shown by the polymer/Ag-Au nanocomposite, followed by polymer/Ag nanocomposite.

DS 27.4 Fri 10:15 H32

2-dimensional metal/polymer nanocomposites near the percolation threshold as sensors for organic vapor — •Christian Hanisch, Amit Kulkarni, Vladimir Zaporojtchenko, and Franz Faupel — Lehrstuhl für Materialverbunde, Technischeu Kiel, Kaiserstraße 2, 24143 Kiel Fakultät der Christian Albrechts Universität zu Kiel, Kaiserstraße 2, 24143 Kiel

Low cost reversible sensors for organic vapor detection are of increasing interest for various applications. We have produced quasi two dimensional systems of Au clusters embedded in different polymer films (PMMA, PS). The polymer films were prepared via spin-coating in various thickens from 100 to 500 nm on different substrates. The clusters were prepared by the deposition of metal in high vacuum on the ion-beam pretreated polymer surface near the percolation threshold. The threshold was determined by in-situ measurements of the electrical resistance as well as TEM measurements. The shape and size of the clusters were specified by TEM measurements. After embedding of the clusters, vapor concentrations down to a few ppm could be detected and the signal change was reversible. The time dependent resistance measurements showed that the sensitivity of the sensor depends on the film thickness of the polymer as well as on the type of vapor used. By comparison of the two polymer substrates we could show that each polymer exhibits a different sensitivity to the used gases, which leads to the possibility of creating an electronic nose by combining different polymer substrates in an sensor array.

DS 27.5 Fri 10:30 H32

Hydrophilic finishing of LDPE films using plasma treatment — •Dieter Ihrig[1], Jens Eggemann[1], Michael Licht[1], Ulrich Brunert[1], Hubert Paulus[2], and Karl-Heinz Müller[2] — [1]FH Suedwestfalen, Interdis. Zentr. f. Lebenswissenschaften, Frauenstuhlweg 31, 58644 Iserlohn — [2]TWS an der FH Suedwestfalen, Lübecker Ring 2, 59494 Soest

Conventional plasma based procedures are able to generate polar groups on the surface of polymers. But they are not stable, because they link to other polymer chains inside the polymer. We have searched for a procedure to inhibit this cross-linking. For this we used an Oxygen or rather Carbon-dioxide Plasma, that are able to generate -COOH, -OH, -C=O groups. To stabilise this groups we coated the films with another layer. By this we are able to generate a lower contact angle on the film than on a film which was only plasmatreated. Also the coated groups are even more long-term stable.This technique is interesting for films which are prepared to be printed with water based lacquer; they can be stored longer before printing. If several areas of the polymer film are covered from the plasma, it is possible to structure the film with hydrophilic and hydrophobic areas. It will be given an introduction in winning water using radiation exchange. First results of field-tests will be presented. The changing contact-angle over the time on plasmatreated and films with stabilisation layer, and the results of XPS measurements will be shown. First results of a structure with hydrophobic and hydrophilic areas present the capability of the used Stenocara surface. The project is funded by the German Federal Ministry of Education and Research (FKZ 02WD0458)

DS 27.6 Fri 10:45 H32

Smoothing of thin film surfaces and interfaces — •Johanna Röder, Tobias Liese, Britta Lösekrug, and Hans-Ulrich Krebs — Institut für Materialphysik, Universität Göttingen, Friedrich-Hund-Platz 1, D-37077 Göttingen

The control of surface and interface roughness is of great interest in technology especially for all kind of optical applications, e.g. x-ray mirrors. To obtain smooth surfaces with only sub-nanometer roughnesses, sputtering with energetic particles, etching, polishing or annealing are usually applied. In this contribution, different methods are discussed to smooth systems with island growth or artificial roughnesses of some nanometers produced before. Here namely Ag islands on PMMA or Si are smoothened by pre-deposition of nucleation sites and/or island zipping. Furthermore, it is shown that such surface roughnesses can significantly be reduced by covering the surface with metal oxide or polymer layers of different thicknesses. This smoothening technique can also be applied for surfaces with statistic roughness or periodic ripple formation created by sputter erosion or nano-structuring. The development of the microstructure and reduction of roughness was investigated via atomic force microscopy (AFM), transmission electron

microscopy (TEM) and x-ray reflectivity (XRR). The smoothing mechanisms as well as the limits of smoothing will be discussed with respect to their dependencies on frequency and film thickness.

DS 27.7 Fri 11:00 H32

Deposition of silicon oxide thin films on polymer films using magnetron based PECVD and high frequency PECVD — •John Fahlteich[1], Ralph Schmittgens[2], Matthias Fahland[1], Björn Meyer[1], and Waldemar Schönberger[1] — [1]Fraunhofer Institut für Elektronenstrahl- und Plasmatechnik, Dresden, Germany — [2]Technische Universität Dresden, Institut für Festkörperelektronik, Dresden, Germany

In this study we investigated the deposition of silicon-oxide (SiOx) thin films on flexible polymer substrates using magnetron-based plasma enhanced chemical vapor deposition (Mag-CVD) and very high frequency (VHF 60 MHz) PECVD. Hexamethyldisiloxane (HMDSO) and oxygen were used as precursor materials. The Mag-CVD process was performed using a dual magnetron sputter system with a 40 MHz mid-frequency power supply.

Both the process-gas excitation and the fragmentation of the monomer were analyzed using optical emission spectroscopy. Additionally similar deposition rates could by achieved for both processes. However, the Mag-CVD process runs at a significantly lower process pressure. Chemical bonds within the different SiOx layers could be compared by analyzing the FT-IR spectra. The film composition was characterized in dependence on both the monomer and the reactive gas flow using X-Ray photoelectron spectroscopy. The thin film properties could be varied from siloxane plasma polymers to inorganic silicon oxide without changing the gas composition.