# DS 29: Nanoengineered Thin Films II

Time: Thursday 11:15–12:45 Location: GER 37

DS 29.1 Thu 11:15 GER 37

**Geometric properties and thermal stability of size selected Ag clusters on $C_{60}$ films** — •Stefanie Duffe[1], Lukas Patryarcha[1], Ben Wortmann[1], Bernd von Issendorff[2], Michael Moseler[2,3,4], and Heinz Hövel[1] — [1]TU Dortmund, Experimentelle Physik I, 44221 Dortmund, Germany — [2]Universität Freiburg, Fakultät für Physik, 79104 Freiburg, Germany — [3]Fraunhofer Institut für Werkstoffmechanik, 79108 Freiburg, Germany — [4]Freiburger Materialforschungszentrum, 79104 Freiburg, Germany

Mass selected clusters from $Ag_{55}^+$ to $Ag_{923\pm9}^+$ were soft landed at 165 K on $C_{60}$/HOPG and $C_{60}$/Au(111) and imaged with STM at 77 and 5 K. We observed extremely narrow cluster height distributions. The cluster heights are in agreement with calculated heights for spherical clusters. We studied the thermally activated decay of the deposited clusters. Using $C_{60}$/HOPG or 2 ML $C_{60}$/Au(111) the cluster heights are stable for more than 12 h at RT. For 1 ML $C_{60}$/Au(111) the clusters decay atom by atom, which is revealed by atomistic calculations [1, 2]. For $Ag_{309\pm3}$ and $Ag_{923\pm9}$, we used scanning tunnelling spectroscopy at 5 K and measured identical spectral features for individual clusters with the same selected size. The spectra can be classified in different groups showing energetic shifts of the peaks due to different shapes of the STM tip. For this reason, we measured spectra of $C_{60}$ molecules as reference. Besides, we observed for 2 ML $C_{60}$/HOPG three different orientations of the $C_{60}$ molecules in STM images measured at 5 K. In contrast, the first ML $C_{60}$ molecules/HOPG show only one orientation.

[1] S. Duffe et al., EPJD 45, 3 (2007), [2] S. Duffe et al., submitted

DS 29.2 Thu 11:30 GER 37

**Nanostructured carbide surfaces prepared by surfactant sputtering** — Hans Hofsäss, •Kun Zhang, and Hayo Zutz — II. Physikalisches Institut, Universität Göttingen Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

Nanostructured surface layers of titanium carbide and tungsten carbide were prepared on tetrahedral amorphous carbon (ta-C) films using the surfactant sputtering technique. Surfactant sputtering is a novel ion beam erosion technique, which utilizes the steady state coverage of a substrate surface with foreign atoms simultaneously during sputter erosion by combined ion irradiation and atom deposition. These foreign atoms act as surfactants, which strongly modify the substrate sputtering yield on atomic to macroscopic length scales. The novel technique allows smoothing of surfaces, the generation of novel surface patterns and nanostructures, controlled shaping of surfaces on the nanometer scale and the formation of ultra-thin compound surface layers. We have sputter eroded ta-C films using 5 keV Xe ions under continuous deposition of either tungsten or titanium surfactants. This leads to the steady state formation of a $W_xC$ or a TiC/a-C nanocomposite surface layer of few nm thickness. Depending on the ion angle of incidence the layer is either smooth or nanostructured with a ripple- or dot-like surface topography. We have analyzed the surface topography, the composition and microstructure of the metal-carbon nanocomposites, and compare coverage dependent sputtering yields with SRIM and TRIDYN simulations.

DS 29.3 Thu 11:45 GER 37

**Self-organization in metal containing amorphous carbon nanocomposites** — •Hayo Zutz[1], Dominika Lyzwa[1], Carsten Ronning[2], Michael Seibt[3], and Hans Hofsäss[1] — [1]II.Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1,37077 Göttingen — [2]Institut für Festkörperphysik, Universität Jena, Max-Wien-Platz 1, 07743 Jena — [3]IV.Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1,37077 Göttingen

Carbon based nanocomposites gained much interest in the last years. The low energy ion deposition using a mass selected ion beam with carbon and metal quasi-simultaneously allows the formation of various compounds. Gerhards et.al. found a self-organization process resulting in alternating metal-rich and metal deficient layers with layer periods in the nm range for a-C:Au and a-C:Fe[1]. The self-organization process occurs in a certain parameter regime for ion energies and $C^+$/metal$^+$ fluence ratios. By proper selection of the fluence ratio it is possible to deposit metal-carbon nanocomposite films with homogenously distributed metal clusters in an a-C matrix or a multilayer structure. In this presentation we will discuss results for the a-C:Cu and a-C:Ni system. The films are analyzed by Rutherford backscattering spectroscopy, energy dispersive X-ray spectroscopy and cross-section transmission electron microscopy. For both systems the results are in agreement with predictions and the model developed in [1] based on an interplay of sputtering, surface segregation and ion induced diffusion. Extensions to the simple model based on the new results will be discussed. [1] I Gerhards et.al., PRB70(2004)245418.

DS 29.4 Thu 12:00 GER 37

**Effect of structure formation on electrical conductivity in thin ITO-films composed of nanoparticles** — •Mahdi Mahajeri and Wolfgang Peukert — LFG, Friedrich- Alexander- Universität Erlangen- Nürnberg, Cauerstrasse 4, 91058 Erlangen

Due to high transparency in the visible wavelength region and excellent electrical conductivity, $In_2O_3 : Sn$ (ITO) is a promising candidate for application in printable electronics. Transparent conductive films of ITO are usually made by vapor deposition which results in high production costs. The use of ITO-nanoparticles in combination with wet deposition methods such as dip-coating offers a high potential for cost reduction. However, these techniques currently lead to an electrical conductivity, which order of magnitude is smaller than that of the layers produced by vapor deposition. The reasons for the low conductivity is the disperse nature and (surface / bulk) defects of the deposited ITO-thin films. The aim of our studies is to understand the correlation between structure formation and electrical conductivity. Therefore, we used ITO-suspensions with varying stabilities to fabricate the ITO-films. The morphology of the layer and structure formation was investigated with AFM, SEM, spectrophotometry and light microscopy. The conductivity was characterized by impedance spectrometry (IS), van der Pauw-method (vdP) and a four-probe setup. It was found that the charge transfer is directly correlated to the structure formation which is a function of the stabilization of the ITO-nanoparticles. The mechanism of charge transfer in the ITO-films is identified and found to be strongly dependent on the structure formation.

DS 29.5 Thu 12:15 GER 37

**Investigation of Silver Release from 2d and 3d Metal/Polymer Nanocomposites** — Vladimir Zaporojtchenko, •Thomas Strunskus, Venkata Girish Kotnur, Venkata Sai Kiran Chakravadhanula, Jan-Hendrik Pöhls, and Franz Faupel — Lehrstuhl für Materialverbunde, Technische Fakultät der CAU Kiel, Kiel

Metal-polymer nanocomposites have a host of functional applications ranging from optical and magnetic to antibacterial materials. While in the latter case metal ion release is essential for the antibacterial function, it is often detrimental and affects the stability and functionality of the nanocomposites during long-term aging. The mechanism and the kinetics of metal ion release from metallic nanoparticles on and in a polymer or ceramic matrix as function of the arrangement, composition, and filling factor of the nanoparticles and the properties of the polymer or ceramic matrix have been investigated following changes in particle plasmon resonance and x-ray photoelectron spectroscopy. Emphasis has been placed on pure Ag and combined Ag/Au nanoparticles.

DS 29.6 Thu 12:30 GER 37

**Metal Nanostructures bound to Dielectric Substrates for Plasmonic Applications** — •Marisa Mäder, Susanne Perlt, Markus Lippmann, Jürgen Gerlach, Thomas Höche, and Bernd Rauschenbach — Leibniz-Institut für Oberflächenmodifizierung e.V., Permoserstraße 15, 04109 Leipzig, Germany

Metal nanospheres, especially when arranged in a predefined way, facilitate surface plasmon related applications [1]. In this paper, a method called Diffraction Mask Projection Laser Ablation (DiMPLA) [2] is used to create such nanostructres. The straightforward method uses an Excimer laser pulse (KrF, 248 nm, 25 ns) whose intensity is laterally modified by a phase mask and subsequently demagnified (15x, 36x, 50x) by a reflective objective. Exposure of a thin metal film on a dielectric substrate leads to the formation of metal nanostructures. Dependent on the phase mask that is applied in the setup, the arrangement of nanospheres on the sample can be controlled as desired. It is

even possible to create non-regular pattern arrangements. Dependencies of the nanospheres on different parameters and some first steps into plasmonic applications are presented in this paper.

[1] W. M. Saj, Optics Express 13, 2005, 4818
[2] M. Maeder et al., Phys. Stat. Sol. (RRL) 2, 2008, 34