O 68: Nanostructured surfaces and thin films – Poster

Time: Wednesday 18:00–20:00 Location: P2

O 68.1 Wed 18:00 P2

Electrospray Ion-Beam Deposition of Organic Molecules — •Grigori Pasko, Florian Münster, Lukas Heuplick, Jan Herritsch, and J. Michael Gottfried — Fachbereich Chemie, Philipps-Universität Marburg, Germany

The preparation of molecular adsorbates on surfaces is often constrained by limitations of conventional deposition methods. While small molecules can typically be thermally evaporated from a Knudsen cell, this approach becomes unsuitable for larger or non-volatile species. Electrospray ion-beam deposition (ESIBD) provides a powerful alternative, enabling the transfer of intact, non-volatile molecules from solution into ultrahigh vacuum. Although its use is increasing, ESIBD remains an emerging technique, and the chemical state of the molecules after deposition is often insufficiently understood. Determining the oxidation state and overall chemical composition of the deposited species therefore represents a central challenge. In this study, meso-tetraphenylporphyrin (TPP) serves as a model system for evaluating the chemical integrity of ESIBD-prepared films. By combining X-ray photoelectron spectroscopy (XPS), scanning tunneling microscopy (STM), and density functional theory (DFT) calculations, we demonstrate that the porphyrins preserve the protonation state acquired during the electrospray process and remain intact upon deposition.

O 68.2 Wed 18:00 P2

Nitrogen plasma induced surface modification of nickel electrodes for enhanced electrochemical performance — •Karla Siecker[1], Christina Meinert[1], Christian Marcks[2], Timo Wagner[1], Nicolas Wöhrl[1], and Axel Lorke[1] — [1]Faculty of Physics, University Duisburg-Essen — [2]Electrochemical Reaction Engineering, RWTH Aachen University

Nickel sheets are widely used as electrode materials for electrolyzers due to their low cost and ease of handling. Here, we report on the use of a microwave-induced remote nitrogen plasma to modify the sample surface, adjusting both the electrochemical and mechanical properties of the nickel electrode. The plasma treatment leads to the formation of coral-like nanostructures on the nickel surface and promotes measurable surface nitridation. As a result, the surface roughness and wettability increase, directly affecting the electrochemical activity. For this purpose, contact angle measurements, 3D optical profilometry and electrochemical measurements were conducted to evaluate the catalytic activity of the modified electrodes.

O 68.3 Wed 18:00 P2

Nanostructured TiO_2 surfaces by low-energy ion erosion — •Berk Yildirim and Jens Bauer — Leibniz-Institut für Oberflächenmodifizierung, Permoserstraße 15, D-04318 Leipzig, Germany

Ripple nanostructures on titanium surfaces are explored as a means to enhance protein adsorption and potentially introduce directionality for implant applications. We aim to produce large areas of consistent nanostructuring on titanium surfaces. Firstly, titanium/titanium oxide thin films are deposited using argon ion beam sputtering (IBS), followed by low-energy oxygen ion etching at an angle to create the ripple structures. Four main parameters are used for control. 1) thin-film composition, adjusted by supplying a background oxygen during deposition to produce fully TiO_2 films, or by depositing without oxygen to obtain titanium films, 2) etching time, 3) etching ion beam energy, where we applied 1.4 kV and 800 V, and 4) etching ion beam incidence angle. The morphology was analysed using AFM, SEM, Thin-film Reflectometry and the composition using XPS, ToF-SIMS. At 80°, the shadowing effect dominates and produces ripples or nanoneedles aligned in the same direction as the beam, which we consistently observe across a 5 cm radius sample. Roughnesses of the unetched films were $Sq = 1\,\mathrm{nm}$ (Ti) and $Sq = 4.8\,\mathrm{nm}$ (TiOx). We obtain much rougher and larger structures on the titanium oxide thin films with $Sq \approx 15\,\mathrm{nm}$, and smoother ripple structures on the titanium thin films with $Sq \approx 3\,\mathrm{nm}$. Controlling etching time and beam voltage allows fine-tuning of roughness and topography.

O 68.4 Wed 18:00 P2

Anomalous morphologies in ion-beam induced surface nanopatterning — •Denise J. Erb and Stefan Facsko — Ion Beam Center, Helmholtz-Zentrum Dresden-Rossendorf, Germany

Irradiating solid surfaces with broad beams of low-energy ions often results in nanaoscale patterning, emerging from a combination of erosive, ballistic and diffusive processes between ions and surface atoms. Typical pattern morphologies comprise ripples, dots, or pits and mounds. The patterning outcome was typically explained as being dominated by either adjustable properties of the ion beam such as incident angle or ion energy, or by inherent properties of the solid material such as elemental composition or crystal symmetry. However, under appropriate experimental conditions, unexpected pattern morphologies can be formed and their understanding requires considering a more complex interplay between ion beam and solid surface. We present such anomalous surface patternings as well as the current state of understanding and modeling these morphologies.

[1] D.J. Erb et al., Intermediate morphology in the patterning of the crystalline Ge(001) surface induced by ion irradiation, PRB 109 (2024) 045439

[2] D.J. Erb and S. Facsko, Tuning the Morphology of Self-Assembled Nanopatterns on MgO(001) Surfaces by Sequential Broad-Beam Ion Irradiation, Phys. Status Solidi RRL (2025) 2500117

O 68.5 Wed 18:00 P2

Fabrication of Self-Assembled Carbon Nanodot Patterns on Quartz Glass Surfaces by Means of Ion Beam Processing — •Jamal Ghaith and Jens Bauer — Leibniz-Institut für Oberflächenmodifizierung, Permoserstraße 15, D-04318 Leipzig, Germany

Graphite Nanodot patterns can be used as a negative mask for subsequent etching of quartz glass surface to bring about anti-reflective properties required in high-power laser applications. This requires uniformity in size and distribution of the nanodots over large areas. Silicon wafers with a $\sim 200\,nm$ thick thermal oxide layer are used as silica test sample material. A carbon layer is initially deposited using Ion Beam Sputtering (IBS), followed by 800 eV Argon ion etching at an angle, with sample rotation. The parameters used to control the nanodot formation are incidence angle of the ion beam, etch time, and carbon layer thickness. We found that an incidence angle of 70 degrees produces the most uniform nanodot distribution. Interestingly, increasing etch time does not necessarily lead to larger (or higher amplitude) dots. Instead of an increased size coalescence of the dots is observed, at least as long as the carbon layer thickness is high enough. The morphology was analysed using AFM and SEM, and the composition using ToF-SIMS.

O 68.6 Wed 18:00 P2

Reversible and persistent changes in nanofilms of the ionic liquid BMP DCA after application of an electric current — •Mirco Wendt[1,2], Anton Schün[2], Regina Lange[2], Jens Berdermann[1], Ingo Barke[2], and Sylvia Speller[2] — [1]Deutsches Zentrum für Luft-und Raumfahrt, Institut für Solar-terrestrische Physik, Neustrlitz — [2]Universität Rostock, Institut für Physik

1-Butyl-1-methylpyrrolidinium dicyanamide (BMP DCA) layers with a thickness of 10 to 20 nm were shown to be effective as charge mitigation layer in the context of spacecraft charging [1]. While at moderate exposures to electrons in a scanning electron microscope (10^12 e/m^2), no changes were observed, intense electron exposure led to irreversible damage with reversible alterations occurring at intermediate conditions. To better understand the conductive mechanism and how these layers react to the presence of excess electrons, ionic liquid nanofilms on interdigitated electrodes were prepared and a voltage applied between them. The monitored currents indicated that charges were permanently transferred into the sample. Atomic force microscopy revealed changes to the film*s morphology as well as shifts in dynamic mode phase, indicating trapping of charges. These findings are compatible with theoretical studies, suggesting additional electrons in this particular ionic liquid do neither pair with cations nor form cation shells, but further reduce anions into a doubly negative charge state [2]. [1] Wendt et al., J. Space Weather Space Clim. 2024, 14, 18 [2] Xu et al., J. Phys. Chem. B 2015, 119, 2, 532-542