O 41: Poster Tuesday: Nanostructures

Time: Tuesday 18:00–20:00 Location: Poster D

O 41.1 Tue 18:00 Poster D

Bridging states vs. simple droplets on prepatterned substrates: a free energy analysis — •Leon Topp and Andreas Heuer — Westfälische Wilhelms-Universität, Institut für Physikalische Chemie, 48149 Münster, Germany

Since the wetting properties of surfaces play a huge role in many technical applications, a lot of effort has been spent on the investigation of the behavior of droplets on homogenous as well as on heterogeneous surfaces. A simple model for a heterogeneous structure is a substrate which contains alternating lyophobic and lyophilic stripes. To better understand the behaviour of droplets on such surfaces we performed Monte Carlo simulations of systems with two lyophilic stripes, separated by a lyophobic one, and analyse the configurations with Markov State Modelling and Umbrella sampling to calculate free energy profiles. We determined different topological states where a drop is e.g. either placed on one of the lyophillic stripes or forms a bridge between these stripes. The weight of both configurations strongly depends on the stripe width and their mutual distance. With the resulting free energy profiles we gained phase diagrams and derived parameter regimes were a transition between the states is easily possible.

O 41.2 Tue 18:00 Poster D

Droplets on switchable substrates: a simulation study — •Leon Topp and Andreas Heuer — Westfälische Wilhelms-Universität, Institut für Physikalische Chemie, 48149 Münster, Germany

In this work the wetting of switchable surfaces is analyzed. These surfaces can change their hydropobicy due to an external stimulus like for example light of a defined wave length. To complement current experiments, it is desirable to study these systems also from a theoretical perpective. To evaluate the nonequilibrium effects resulting from the switching process, we performed Molecular Dynamic simulations where we modelled a droplet consisting of Lennard-Jones particles on a switchable surface. Here we present the impact of different switching frequencies on the droplet. In particular the (time-dependent) shape and the size of the resulting droplets are analyzed.

O 41.3 Tue 18:00 Poster D

Ion adsorption at solid-liquid interfaces — •Alina Sparenberg, Michael Paulus, Yury Forov, Susanne Dogan, Göran Surmeier, Jennifer Bolle, Mirko Elbers, Kristina Berger, Kevin Foryt, and Metin Tolan — Fakultät Physik/DELTA, TU Dortmund, 44221 Dortmund

The investigation of the microscopic structure of aqueous solutions is one of the important areas of modern research. In particular, the understanding of the behavior of ions at interfaces is essential for the explanation of interfacial phenomena occurring in nature and technology. A lot of pioneering work has been done to determine the interactions between ions and hydrophobic surfaces, but a complete description of the physical mechanisms for the hydrophobic interaction is still pending. Thus, we used octadecyltrichlorosilane (OTS) coated surfaces in order to study the adsorption behavior of different ions at hydrophobic solid-liquid interfaces by x-ray reflectivity. Since a first study with alkali halides indicated changes within the structure of the OTS coating that seem to scale with the ion size, this study deals with the adsorption behavior of ions with strongly varying cation sizes. For this purpose, aqueous solutions of NaBr and the ionic liquid 1-Butyl-3-methylimidazolium bromide ([BMIM][Br]) were chosen. The reflectivity experiments were performed at the beamline BL9 of the synchrotron light source DELTA in Dortmund, Germany.

O 41.4 Tue 18:00 Poster D

X-Ray Reflectivity Measurements of FeCo/TiN Magnetostructures — •Henning Vogt[1], Philipp Jordt[1], Jan-Philipp Kress[1], Niklas Wolff[2], Lorenz Kienle[2], Stefan Beierle[3], Olaf M. Magnussen[1], and Bridget M. Murphy[1] — [1]Institute of Experimental and Applied Physics, Kiel University, Leibnizstr. 19, 24098 Kiel, Germany — [2]Institute of Material Sciences, Kiel University, Kaiserstr. 2, 24143 Kiel, Germany — [3]Institute of Applied Materials – IAM-AWP, KIT Karlsruhe, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany

FeCo/TiN magnetostructures are strong canidates as robust biomagnetic sensors. FeCo has desirable magnetic properties, but loses them in thick layers. By applying alternating layers of FeCo and TiN—a material known for its hardness and corrosion resistance—the FeCo is epitaxially stabilized and keeps its magnetic properties. The samples consist of hundreds of layers of a few monolayers thickness on a silicon wafer grown by magnetron sputtering. Their atomic structure has been explored using TEM to obtain local structural information and by X-ray diffraction to investigate the whole multilayer stack.

X-ray reflectivity has revealed the structure perpendicular to the surface showing that a regular layering of FeCo/TiN forms a superlattice. Sharp peaks corresponding to the layer period are observed. Further information including thickness, roughness and the electron density of each layer is obtained by modelling the reflectivity. We show that annealing the samples leads to lowering of the electron densities of the topmost layers, suggesting oxidation or atomic diffusion.

O 41.5 Tue 18:00 Poster D

One-dimensional molecular chains of Quinacridone on Ag(100) and Cu(111): STM- and SPA-LEED-investigations — •Niklas Humberg[1], Rémi Bretel[2], Alexander Eslam[1], and Moritz Sokolowski[1] — [1]Institut für Physikalische und Theoretische Chemie der Universität Bonn, Germany — [2]University of Paris-Saclay, Institut des Sciences Moléculaires D'Orsay, France

One-dimensional molecular aggregates are of high interest because they often show specific and pronounced coupling effects for electronic excitations, e.g. in optical spectra. Here, we report a structural analysis of two such systems, quinacridone (QA) on Ag(100) and Cu(111), by STM and SPA-LEED.

On Ag(100) QA grows in parallel homochiral one-dimensional chains at room temperature (RT), forming a metastable structure. Within these chains the molecules are parallel and linked pairwise via two hydrogen bonds. The distance between neighboring chains varies with coverage. After annealing at 500 K, a two-dimensional commensurate heterochiral structure is formed. It consists of homochiral dimers forming periodically indented and closely packed chains.

On Cu(111), QA grows in similar fashion at RT. However, the structure shows more disorder than that on Ag(111). The majority of the chains are not straight and contain many kink-like defects. The high degree of disorder also becomes apparent in the SPA-LEED pattern. The observed spots smear out, yielding a highly symmetric diffraction pattern with many lines of varying intensities.

O 41.6 Tue 18:00 Poster D

Aromatic self-assembled monolayers as protective layer for silver SERS substrates — •Martha Frey[1], Christof Neumann[1], Maria Küllmer[1], Susanne Pahlow[2], Andreas Winter[1], Martin Jahn[2], Uwe Hübner[2], Dana Cialla-May[2], Karina Weber[2], Jürgen Popp[1,2], and Andrey Turchanin[1] — [1]Institute of Physical Chemistry, Friedrich Schiller University Jena, 07743 Jena, Germany — [2]Leibniz Institute of Photonic Technology, Member of the Leibniz Research Alliance Leibniz Health Technology, 07745 Jena, Germany

Surface enhanced Raman spectroscopy (SERS) is an established technique for specific detection of fingerprint spectra of molecules at lowest concentrations. In particular, the application of silver-based SERS substrates is promising due to their favorable physical properties for enhancing Raman signals. However, the silver substrates may deteriorate with time due to oxidation. Here we present a study on preventing these unwanted changes by passivating the SERS substrates with aromatic self-assembled monolayers (SAMs). We prepare the SAMs in UHV and characterize them in situ by X-ray photoelectron spectroscopy (XPS) and ex situ by SERS. After exposing these samples for several months to ambient conditions, we conducted a comparative study by both techniques. Furthermore, we characterized the samples by scanning electron microscopy (SEM). We show an enhanced stability of the passivated substrates in comparison to the bare substrates. The presence of functional groups in the SAMs leads towards specific biochemical functionalization of the SERS substrates.

O 41.7 Tue 18:00 Poster D

Wrinkle-free centimeter-scale ultrathin alumina membranes on arbitrary substrates prepared by fast surface-energy-assisted drying — •Huanming Zhang, Min Zhou, Yang Xu,

Rui Xu, Yi Wang, Zhiqiang Zeng, and Yong Lei — Institute für Physics & IMN MacroNano (ZIK), Technische Universität Ilmenau, 98693 Ilmenau

Ordered nanostructures always perform better than the disordered counterpart in many fields. Ultrathin Anodic Aluminum Oxide (AAO) membrane (UTAM) -directed fabrication is a promising technology to prepare ordered nanostructure. To transfer UTAM onto a target substrate, hydrophilic treatment or organic solvent wetting on substrate is necessary, Otherwise, a significant number of wrinkles will be generated in UTAM, and its uniformity and quality is damaged. However, widely used hydrophilic treatments, such as Oxygen plasma and Piranha solution, and organic solvent wetting are not applicable to some substrates. Moreover, the effect of the hydrophilic treatment is temporary and will be lost with time. Herein, we propose a convenient and practical technique, assisted by surface energy, to transfer UTAM onto arbitrary substrates with no observable wrinkle. Compared with surface treatments and organic solvent wetting, our method is rapid, simple, cheap, convenient and safe. In addition, the reasons behind crumpled UTAM was probed into.

O 41.8 Tue 18:00 Poster D

STM investigations on CoO_2 chains on Pt(001) — •Paula M. Weber, Chong-Heeon Park, Martin Schmitt, Matthias Vogt, and Matthias Bode — Physikalisches Institut, Lehrstuhl für Experimentelle Physik II, Universität Würzburg, Deutschland

Recently, the structural and magnetic properties of transition metal oxides (TMO) on heavy fcc(001) surfaces, such as Ir(001) or Pt(001), have attracted considerable interest [1,2]. Here, we present a spin-polarized STM investigation of CoO_2 on Pt(001). Whereas a ferromagnetic coupling along the chains was predicted for CoO_2/Ir(001) [1], it has been proposed that the CoO_2 on Pt(001)-system has an antiferromagnetic ground state [2].

Topographic STM data confirm a perfectly ordered (3×1) structural phase with a periodicity of $3a_{\mathrm{Pt}}$ between the TMO chains. Spin-resolved data were acquired by scanning with out-of-plane or in-plane polarized Cr- or Fe-coated W-tips respectively, whereby the sensitivity of each tip was characterized by test measurements on the Fe-layer on W(110). In contrast to expectations, we did not find any magnetic contrast in our SP-STM data of CoO_2/Pt(001).

We will discuss the implications of the observed structural contrasts and how the surface changes upon adsorption of residual gas from the vacuum system.

[1] P. Ferstl, *et al.*, Phys. Rev. Lett. **117**, 046101 (2016)
[2] P. Ferstl, *et al.*, Phys. Rev. B **96**, 085407 (2017)

O 41.9 Tue 18:00 Poster D

Sandwich-molecular wires: Combining cyclooctatetraene with rare- and alkaline-earth metals on Gr/Ir(111) — •Stefan Kraus[1], Ken Bischof[1], Felix Huttmann[1], Alexander Herman[2], Nico Rothenbach[2], Katharina Ollefs[2], Nicolae Atodiresei[3], Heiko Wende[2], and Thomas Michely[1] — [1]Universität zu Köln, Germany — [2]Universität Duisburg-Essen, Germany — [3]Forschungszentrum Jülich, Germany

We investigate the growth of sandwich-molecular wires, one-dimensional arrangements of alternating organic molecules and metal atoms. Here, we combine cyclooctatetraene (Cot, C_8H_8) with rare- and alkaline-earth metals in an on-surface synthesis on the inert substrate graphene/iridium(111). Recently, such wires were grown using europium (Eu), yielding crystalline islands of interlocked wires with intra-/interwire distances of 4.4Å/6.8Å. Based on the favored 2- oxidation state of Cot in this compound, we explore whether the same synthesis principle holds also for other metals releasing $2e^-$ to Cot. From the rare-earth elements we test ytterbium (Yb) and from the alkaline-earth elements barium (Ba), both favoring oxidation state 2+ in this compound. In fact, for both cases wire formation in islands is observed, with intra-/interwire distances of 4.1Å/6.4Å for Yb and 4.8Å/6.8Å for Ba which are in agreement with the slightly smaller/larger atomic radius of Yb/Ba compared to Eu. Furthermore, we accomplished to grow alloy wire islands by co-depositing Eu and Yb during synthesis.

O 41.10 Tue 18:00 Poster D

Melting behavior of FeNi nanoparticles on surfaces — •Mahboobeh Ravankhah and Mathias Getzlaff — Institute of Applied Physics, University Duesseldorf

Magnetic nanoparticles have received great attention due to their application in biomedicine and magnetic recording. The 3d bimetallic nanoparticles such as FeNi have much more complex magnetic and structural phases under different conditions. Therefore, it is important to investigate structure dependence on temperature and stoichiometry. FeNi alloy nanoparticles are prepared by a magnetron sputtering source and an Arc Cluster Ion Source (ACIS). Two different FeNi alloys are used: high purity Fe0.50Ni0.50 and Fe0.75Ni.25. All nanoparticles are prepared under UHV condition on W (110) surface, therefore contaminations are avoided. We report on the influence of different parameters like size of nanoparticles, stoichiometry and annealing temperature on the melting behavior. Particle's size, shape and structure will be investigated by Transmission Electron Microscopy (TEM), Scanning Tunneling Microscopy (STM) and Low Energy Electron Diffraction (LEED).