O 78: Nanostructures at Surfaces IV: Various Aspects

Time: Thursday 10:30–13:00 Location: S052

O 78.1 Thu 10:30 S052

Charge dynamics at semiconductor surfaces investigated with time-resolved Scanning Tunneling Microscopy — •Philipp Kloth, Katharina Kaiser, Terence Thias, and Martin Wenderoth — IV. physikalisches Institut, Georg-August-Universität Göttingen, 37077 Göttingen, Germany

An overview on the combination of optical excitation and Scanning Tunneling Microscopy (STM) for studying the carrier dynamics at the GaAs(110) surface is given. In this system the tip-induced electric potential is very sensitive to the charge configuration composed of locally fixed dopants and ambipolar optical excited free carriers present at the surface. A detailed spectroscopic analysis [1] has shown that photo-excited charge carriers, trapped in a very local region beneath the STM tip, contribute to the tunneling current. By adjusting the current in a controlled manner we are able to actively access different screening conditions of the electric potential at the surface. Depending on the dominant tunneling channel, pump-probe excitation can resolve different recombination processes of charge in the nanoscaled Space Charge Region. By using the lateral resolution of the STM, the influence of single dopants on the relaxation dynamics of the system is investigated. We discuss the impact of these charged and surface-sided defects in terms of their varying binding energy [2] in comparison to conventional bulk-positioned donors.

[1] Kloth et al., Nat. Comm. (2015) [2] Teichmann et al., PRL (2009)

O 78.2 Thu 10:45 S052

Scanning tunneling potentiometry of resistivity dipoles in thin Bismuth films — •Felix Lüpke, Stefan Korte, Vasily Cherepanov, and Bert Voigtländer — Peter Grünberg Institut (PGI-3), Forschungszentrum Jülich, 52425 Jülich, Germany, and JARA-Fundamentals of Future Information Technology

We present scanning tunneling potentiometry measurements of thin Bismuth films using a multi-tip scanning tunneling microscope. Defects in the Bismuth films prepared on Si(111) result in localized electric dipoles when a lateral current is injected into the film. We map the potential landscape around such defects and analyze them with respect to classical diffusive transport effects and the Landauer dipole.

O 78.3 Thu 11:00 S052

Circular dichroism and spin polarization from artificial nanostructures — •Daniel Nürenberg[1], Andrew Mark[2], Matthias Kettner[1], Peer Fischer[2], and Helmut Zacharias[1] — [1]Westfälische Wilhelms-Universität, Münster — [2]Max Plank Institut für intelligente Systeme, Stuttgart

Metal nanohelices are receiving growing interest because of their giant plasmon-enhanced optical circular dichroism. We address circular dichroism in multi-photon photoemission from metal nanohelix arrays triggered by polarized ultra-short laser pulses from an optical parametric chirped-pulse amplifier. We use time-of-flight spectroscopy and Mott polarimetry to measure the energy distribution and spin polarization of the emitted electrons. Helices made of non-magnetic Ag:Ti and Ag:Cu alloys on a silicon wafer emit photoelectrons with a polarization dependence in yield and longitudinal spin polarization. The results are compared with single-photon photoemission measurements.

O 78.4 Thu 11:15 S052

Modeling AFM Adhesion Measurements on Rough Substrates — •Till Junge, Michael Schäfer, Christian Greiner, and Lars Pastewka — IAM-CMS, KIT, Karlsruhe, Germany

Understanding adhesion forces in dry contact is of particular importance for the study of both technical and biological micro- and nanoelectromechanical systems. Even in their simplest manifestation – the pull-off force necessary to break the contact between a nano-scale indenter and a rough surface – they are poorly understood. We here use a boundary element method in combination with an empirical interaction potential the contact of a stiff spherical indenter of varying size acting on an elastic rough substrate. The model is compared to a series of atomic-force microscopy (AFM) pull-off measurements performed with silicon tips with tip radii varying between 14 nm and 100 nm on an ultrananocrystalline diamond (UNCD) substrates. Without any fitting parameters, we find good agreement between the experiment and our simulations. We use our simulations to analyze the link between distribution of pull-off forces and statistics of surface roughness of the substrate. This enables in particular extraction of small scale features of the rough topography not accessible by standard AFM measurements, such as the root mean square slope of surface roughness.

O 78.5 Thu 11:30 S052

Morphological study of formation of nanopatterned Si substrate produced by Fe assisted low energy ion beam erosion — •Sarathlal Koyiloth Vayalil[1], Ajay Gupta[2], and Stephan Roth[1] — [1]Photon Science, DESY, Notkestr. 85, D-22607 Hamburg, Germany — [2]Amity Center for Spintronic Materials, Amity University, Sector 125, NOIDA 201313, India

In this work, formation of self-organized Si nanostructures induced by pure Fe incorporation during normal incidence low energy (1keV) Ar+ ion bombardment is presented. It has been observed that the incorporation of Fe affects the evolution of the surface topography. The addition of Fe generates pronounced nano patterns, such as dots, ripples and combinations of dots and ripples. The orientation of the ripple wave vector of the patterns formed is found to be in a direction normal to the Fe flow. The nanoripples with wavelength of the order of 39 nm produced is expected to be the lowest wavelength of the patterns reported on ion beam eroded structures under the incorporation of metallic impurities as per our knowledge. From the AFM and GISAXS analysis, it has been confirmed that the ripples formed are asymmetric in nature. The effect of the concentration of the Fe on morphological transition of the patterns has been studied using Rutherford back scattering measurements.

O 78.6 Thu 11:45 S052

Investigation of thin Ni films on Pd with Positron annihilation induced Auger electron spectroscopy, XPS and STM — •Samantha Zimnik, Christian Piochacz, Sebastian Vohburger, and Christoph Hugenschmidt — Heinz Maier-Leibnitz Zentrum (MLZ) and Physik Department E21, Technische Universität München, Lichtenbergstraße 1, 85748 Garching, Germany

Positron annihilation induced Auger Electron Spectroscopy (PAES) is a powerful technique to gather information about the elemental composition of only the topmost atomic layer of a specimen. The positron beam facility NEPOMUC at the research reactor Heinz Maier-Leibnitz in Garching delivers the world's most intense positron beam and enables measurement times of only a few minutes per PAES spectrum. Thus, time-dependent PAES becomes possible and enables the in-situ observation of the surface segregation process. The surface spectrometer at NEPOMUC uses the complementary techniques PAES, X-ray photoelectron spectroscopy (XPS) and Scanning Tunneling Microscopy (STM) to characterize both, the elemental composition of the surface and its topology. Recent studies on sub-monolayers of Ni on Pd using time- and temperature dependent PAES will be presented. Financial support by the BMBF within the project no. 05K13WO1 is gratefully acknowledged.

O 78.7 Thu 12:00 S052

Nanopore-Electrodes With High Aspect-Ratio For High Performance Electrochemical Devices Replicated From AAO-Templates — •Stefan Bösemann, Liaoyong Wen, Huaping Zhao, and Yong Lei — Technische Universität Ilmenau, Germany

Usually nanowires or nanotube arrays are used for high surface area nanostructures. The length of these nanostructures is limited due to agglomeration and collapsing of the NWs or NTs if they reach a specific length. This restricts the reachable aspect-ratio as well as the maximization of the surface area and the device performance. We enhanced a new approach to go beyond this limit with a more stable nanostructure architecture.

Very high aspect-ratios (>100) have been realized with nanopore arrays which show a highly regular structure and made of metal or metal oxides e.g. Ni and NiO2. The fabricated nanopore electrodes can be made of active material or can be utilize as scaffolding for functional core-shell structures for electrochemical devices such as supercapacitors or batteries. The realized devices have the ability to show outstanding performances due to the very high surface area, the highly ordered structure which allows very good ion transport and the

conductive metal core which enables a very good electron transfer

O 78.8 Thu 12:15 S052

Chemical characterization and structural evolution of diamond-like carbon films with increasing deposition on polyethylene terephthalate — •Alberto Catena[1], Michael Kunze[2], Simone Agnello[3], Stefan Wehner[1], and Christian B. Fischer[1] — [1]Department of Physics, University Koblenz-Landau, 56070 Koblenz, Germany — [2]Department of Chemistry, University Koblenz-Landau, 56070 Koblenz, Germany — [3]Department of Physics and Chemistry, University of Palermo, 90100 Palermo, Italy

The interest in diamond-like carbon (DLC) films on polyethylene terephthalate (PET) steadily increases due to their potential applications as food/beverage packaging and medical devices. Although much is known about the macroscopic features of such composites, the physical and chemical properties of the DLC/PET interface and the film evolution during the deposition are still not fully understood. The films were gradually deposited on PET by radio frequency plasma enhanced chemical vapor deposition with acetylene plasma, and analyzed by Diffusive Reflectance Infrared Fourier Transform and Raman spectroscopy. Chemical changes of the growing films are discussed in terms of subplantation processes and interface effects. After an initial intermixing between DLC and PET forming an interlayer, the epitaxial growth of a polymer-like DLC structure is observed. For higher depositions a structural modification between the polymer-like to a more diamond-like DLC configuration is revealed. This transition is related to the folding of dehydrogenated sp2 segmented chains with subsequent rearrangement of the DLC network in higher depositions.

O 78.9 Thu 12:30 S052

Bioinspired dry adhesives from carbon nanotubes — •Christian Lutz[1], Julia Syurik[1], Sharali Malik[2], Sergei Lebedkin[2], and Hendrik Hölscher[1] — [1]Institute of Microstructure Technology (IMT), Karlsruhe Institute of Technology (KIT), 76344 Karlsruhe, Germany — [2]Institute of Nanotechnology (INT), Karlsruhe Institute of Technology (KIT), 76021 Karlsruhe, Germany

Geckos show amazing adhesive properties and are able to walk on walls and hanging on ceilings. Their adhesion force originates from nanostructures on their feet. Millions of hierarchical hairs contact the surface to generate van der Waals forces.

Mimicking the gecko structures can lead to artificial dry adhesives with a great range of applications (e.g. in robotics, medicine and space technology). While most dry adhesives are polymer-based and have benefits of easy fabrication routs and low cost production, they are not applicable at high temperatures and pressures. Carbon nanotubes (CNTs) are stable at high temperatures and, therefore, very promising as artificial adhesives for specific applications. Several scientific groups have already demonstrated dry adhesives from carbon nanotubes (CNTs). Which is due to their high aspect ratio the effective elastic modulus of the tips of CNTs is dropping below 100 kPa according to the contact splitting theory. Thus, for a free standing array of CNTs the resulting adhesive force depends on aspect ratio of CNTs and array density. In this work we analyse the relation between geometry of CNT arrays (i.e. diameter of CNTs, their height and density) and resulting pull-off force measured by AFM (force-distance curves).

O 78.10 Thu 12:45 S052

Adsorption of diclofenac on single-walled carbon nanotubes — •Mariana Kozlowska[1], Pawel Rodziewicz[1], Marta Ziegler-Borowska[2], and Anna Kaczmarek-Kedziera[2] — [1]University of Bialystok, Ciolkowskiego Str. 1K, 15-245 Bialystok, Poland — [2]Nicholas Copernicus University, Faculty of Chemistry, Gagarina 7, 87-100 Torun, Poland

Diclofenac belongs to the nonsteroidal anti-inflammatory drugs that can interact efficiently with biopolymers and carbon materials on the way of physisorption or/and chemisorption. This allows to apply carbon-based materials for the removal of diclofenac and its metabolites from water because of their hazardous impact on the environment. In order to model the efficient sorption material the systematic theoretical description of the interactions between diclofenac and carbon-based material is needed.

Therefore, we investigate the noncovalent adsorption of diclofenac on single-walled carbon nanotube (SWCNT)(10,0) using density functional theory (DFT) calculations and Car-Parrinello molecular dynamics simulations (CP-MD). We analyze the adsorption energies and the most stable adsorption patterns. Additionally, CP-MD simulations are used to mimic the properties of the dicofenac molecule adsorbed and estimate its adsorption affinity at finite temperature.

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