

O 27: Nanostructures: Low Dimensions

Time: Tuesday 14:00–16:15

Location: MA 005

O 27.1 Tue 14:00 MA 005

Characterizing the Ring Neighborhoods of Amorphous 2D Silica — ●KRISTEN BURSON, CHRISTIN BÜCHNER, STEFANIE STUCKENHOLZ, MARKUS HEYDE, and HANS-JOACHIM FREUND — Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin, Germany

Novel two-dimensional (2D) materials have garnered significant scientific interest due to their potential technological applications. For new 2D materials, it is important to consider not only crystalline materials, such as graphene and hexagonal BN, but also amorphous materials. For amorphous materials, a detailed understanding of the complex structure is necessary. Here we present a study of 2D amorphous bilayer silica. The atomic structure has been determined by nc-AFM and STM imaging with atomic resolution, revealing a network of different ring sizes [1]. For any given ring, the sizes of the neighboring rings can be characterized. Characteristic arrangements of rings within the amorphous structure have been identified and their relative prevalence has been quantified. Typical ring arrangements, such as the Stone-Waals defect, are compared with other atomic scale, molecular scale, and macro-scale 2D amorphous systems [2]. Notably, similar 2D ring arrangements are observed across systems with diverse length scales. Results indicate that geometric strain plays an important role in determining ring cluster configurations within 2D amorphous network structures.

[1]Lichtenstein, L.; Heyde, M.; Freund, H.-J. *Phys. Rev. Lett.* 2012, 109, 106101 [2]Büchner, C. et al. *Z. Phys. Chem.* 2014, 288(4-5), 587

O 27.2 Tue 14:15 MA 005

Structural and electronic properties of Ir nanowires on Ge(100) — ●RENÉ HEIMBUCH, IRIS SLOOTHEER, and HAROLD ZANDVLIET — Physics of Interfaces and Nanomaterials, MESA+ Institute for Nanotechnology, University of Twente

Iridium (Ir) nanowires show structural and electronic properties that are potentially of large interest for nano-electronic applications. Here we present detailed studies on the structural evolution of the surface and the growth of Ir nanowires on Ge(100). Using Scanning Tunneling Microscopy at low temperatures, we probed the wires and mapped the electronic landscape on and around the atomic chains. The wires show electronic properties that are very distinctive from the surrounding. A strong metallic character of the Ir nanowires promotes the Ir/Ge(100) system to a potential candidate for exotic low dimensional electronic effects.

O 27.3 Tue 14:30 MA 005

Reversible and self-organized formation of periodic 1D cobalt nanostructures — ●PASCAL FERSTL¹, MARINA SCHULER¹, LUTZ HAMMER¹, KLAUS HEINZ¹, M.ALEXANDER SCHNEIDER¹, FLORIAN MITTENDORFER², JOSEF REDINGER², M. ALIF ARMAN³, EDVIN LUNDGREN³, and JAN KNUDSEN^{3,4} — ¹Lst. für Festkörperphysik, FAU Erlangen-Nürnberg — ²Inst. für Angewandte Physik and Center for Computational Materials Science, TU Wien — ³Division of Synchrotron Radiation Research, Lund University — ⁴The MAX IV Laboratory

By alternate oxidation and reduction of 1/3 ML of cobalt deposited on the unreconstructed Ir(100) surface two different quasi one-dimensional nanostructures can be formed and reversibly transformed into each other: An oxygen-rich and an oxygen-free phase, which both show a well ordered single domain 3×1 periodicity.

In this study we present the atomic structure of these two phases revealed by means of quantitative LEED, STM, HRXPS and DFT calculations. The oxygen-free 3×1 phase is an ordered Ir₂Co surface alloy, where every third iridium row of the outermost layer is substituted by a cobalt row. Adsorption of oxygen transforms the latter into a metal-oxide hybrid system with CoO₂ stoichiometry. In this structure the Co rows are drastically lifted above the first Ir layer so that there are no more direct Co-Ir bonds. The clean Co-Ir alloy phase can be restored again by reducing the CoO₂ phase in hydrogen at only 80°C.

O 27.4 Tue 14:45 MA 005

Surface self-assembly of Fe₄ single molecule magnets — PHILIPP ERLER¹, NICOLE BARTH¹, PETER SCHMITT², ●LUCA GRAGNANIELLO¹, and MIKHAIL FONIN¹ — ¹Fachbereich Physik, Uni-

versität Konstanz, 78457 Konstanz, Germany — ²Fachbereich Chemie, Universität Konstanz, 78457 Konstanz, Germany

Here, we present a successful fabrication of self-organized nanoislands of Fe₄(dpm)₆L₂ (Fe₄) single molecule magnet (SMM), by using *h*-BN/Rh(111) as template. Fe₄ clusters are a promising class of molecules whose magnetic properties have recently raised great interest, due to their capability to retain their SMM behavior when chemically grafted on a gold substrate [1]. However, Fe₄ brittleness limits their thermal stability, hindering direct evaporation of the molecules in ultra-high vacuum (UHV) in most cases [2] and, consequently, a thorough investigation via scanning tunneling microscopy and spectroscopy (STM/STS). We overcome this problem by using electrospray as a gentle deposition method in UHV. The structural and electronic properties of sub-monolayers and individual molecules were studied by means of low temperature STM/STS. Despite the complexity of their structure, highly ordered arrays of Fe₄ molecules on the *h*-BN substrate can be obtained, therefore providing a promising playground to explore their electronic and magnetic properties in a well-defined configuration.

[1] M. Mannini *et al.*, *Nature Mater.* **8**, 194 (2009); M. Mannini *et al.*, *Nature* 468, 417 (2010). [2] Allowed only by a specific Fe₄ derivative (see L. Margheriti *et al.*, *Small* **5**, 1460 (2009).

O 27.5 Tue 15:00 MA 005

PtFe and IrFe atomic bilayers on Ir(111) investigated by STM — ●MAXIMILIAN MEYER, ANDRÉ KUBETZKA, KIRSTEN VON BERGMANN, and ROLAND WIESENDANGER — Department of Physics, University of Hamburg, Germany

Non-magnetic capping layers are a means to passivate chemically reactive magnetic films and they also allow to tailor specific magnetic properties by modifying the interface [1,2].

Here we use scanning tunneling microscopy (STM) to investigate the growth of Pt and Ir on an atomic layer of Fe on Ir(111) which exhibits an atomic-scale magnetic skyrmion lattice [3].

We will discuss differences and similarities of these two systems and show the influence of the substrate temperature onto the film growth.

In the low coverage regime we observe atomic layer islands of both fcc and hcp stacking and for Pt we find a tendency for 2nd atomic layer nucleation on Fe/Ir(111). For Pt/Fe/Ir(111) the smoothest films were achieved at intermediate temperatures where the atom mobility is increased and alloying has not yet set in.

- [1] N. Romming *et al.*, *Science* **341**, 636 (2013)
 [2] B. Dupé *et al.*, *Nature Comm.* **5**, 4030 (2014)
 [3] S. Heinze *et al.*, *Nature Physics* **7**, 713 (2011)

O 27.6 Tue 15:15 MA 005

1D-WO₃ nanochannel structures used for efficient H₂-sensing — ●OLE PFOCH¹, MARCO ALTOMARE¹, and PATRIK SCHMUKI^{1,2} — ¹Department of Material Science and Engineering, WW4-LKO, University of Erlangen-Nuremberg, Martensstrasse 7, D-91058 Erlangen, Germany — ²Department of Chemistry, King Abdulaziz University, Jeddah, Saudi Arabia

1D nanostructures of vertically aligned channels of amorphous WO₃ up to ca. 4 μm length were grown by means of self-organizing electrochemical anodisation. By preliminary screening experiments, the anodisation conditions were optimized so to obtain highly ordered nanochannels with pore diameter of ca. 10 nm. With a proper thermal treatment the anodic WO₃ can be converted into crystalline structures. SEM, EDX, XRD, XPS, TEM and SAED are used to further investigate the physical-chemical properties of the WO₃ layers. Since WO₃ is known to show a rapid response to reducing gases such as H₂ and nanostructures are promising candidates for fabricating gas sensors due to their high surface area, gas sensing experiments are performed. Thereby the structures are found to exhibit outstanding gas-sensing abilities such as a fast response at low temperatures (80-120°C) even down to concentrations as low as 0.5 ppm.

O 27.7 Tue 15:30 MA 005

A joint first principles and Kelvin probe force microscopy study of stepped silicon surfaces with unprecedented resolution — ●STEFAN WIPPERMANN¹, CARMEN PÉREZ LEÓN², HOLGER DREES², MICHAEL MARZ², and REGINA HOFFMANN-VOGEL² — ¹Max-Planck-Institut für Eisenforschung, D-40237 Düsseldorf, Ger-

many — ²Karlsruhe Institute of Technology, D-76131 Karlsruhe, Germany

Stepped well-ordered surfaces are important nanotemplates for the fabrication of one-dimensional nanostructures with intriguing electronic properties. The vicinal Si(7710) surface is a popular model system of this kind. It contains (7x7) reconstructed areas equivalent to the well characterized and understood Si(111)-(7x7) surface. Thereby this system essentially contains its own calibration, providing an ideal testbed for surface characterization techniques and understanding in depth the rich morphology of the structural features present in this system.

Here we present a joint experimental and theoretical investigation of the structural properties of the vicinal Si(7710) surface. We carried out Kelvin probe force microscopy (KPFM) measurements with unprecedented atomic resolution, and *first principles* calculations of the local work function as a function of the lateral position of the tip above the surface. These calculations allowed us to interpret the experimental KPFM data in terms of specific structural features and electronic properties of surface states, such as e. g. defects, dangling bond angles and occupations of dangling bonds. R. H.-V. acknowledges ERC starting grant NANOCNTACTS No. ERC 2009-Stg 239838.

O 27.8 Tue 15:45 MA 005

Computing Equilibrium Shapes of Wurtzite Crystals: The Example of GaN — •HONG LI^{1,2}, LUTZ GEELHAAR², HENNING RIECHERT², and CLAUDIA DRAXL¹ — ¹Institut für Physik and IRIS Adlershof, Humboldt-Universität zu Berlin, Zum Großen Windkanal 6, 12489 Berlin, Germany — ²Paul-Drude-Institut für Festkörperelektronik, Hausvogteiplatz 5-7, 10117 Berlin, Germany

Crystal morphologies are important for the design and functionality of devices based on low-dimensional nanomaterials. The equilibrium crystal shape (ECS) is a key quantity in this context. It is determined by surface energies, which are hard to access experimentally but can generally be well predicted by first-principles methods. Unfortunately, this is not necessarily so for polar and semipolar surfaces of wurtzite

crystals. By extending the concept of Wulff construction, we demonstrate that the ECSs can nevertheless be obtained for this class of materials. For the example of GaN, we identify different crystal shapes depending on the chemical potential. It is shown that the crystal exhibits a rod-like shape along the polar *c* axis, with top and bottom geometries depending on the chemical potential, while the side walls are formed by both types of nonpolar surfaces. Our results can well explain the experimentally observed nanowire shapes. Beyond that, it opens a perspective to gain insight into morphologies of the entire class of wurtzite materials.

O 27.9 Tue 16:00 MA 005

Near-field Optical Imaging of (6,5)SWCNT/PFO-BPy Conjugates — •XIAN SHI¹, IMGE NAMAL², TOBIAS HERTEL², and ACHIM HARTSCHUH¹ — ¹Department Chemie & CeNS, LMU München, Germany — ²Institut für Physikalische und Theoretische Chemie, JMU Würzburg, Germany

PFO-BPy wrapped single-wall carbon nanotubes (SWCNTs) are promising candidates for optoelectronic and solar cell applications [1]. We utilized tip-enhanced near-field microscopy (TENOM) [2] with nanometer resolution and signal enhancement to investigate the photoluminescence (PL) and Raman scattering of (6,5) SWCNT/PFO-BPy conjugates. PL images reveal the spatial homogeneity of both emission intensity and energy along individual nanotubes. Raman images indicate their local structural properties. This set of images provides detailed information on several key phenomena influencing the excited state properties of SWCNTs including the interaction with the environment, nanotube-nanotube coupling, exciton mobility and defect density. We compared the results obtained for PFO-BPy wrapped carbon nanotubes with other materials and different sample treatments.

Financial support from the European Project POCAONTAS (FP7-PEOPLE-2012-ITN-316633) is gratefully acknowledged.

[1] G. J. Brady et al. ACS nano 8, 11614-11621, 2014.

[2] N. Mauser and A. Hartschuh, Chem. Soc. Rev 43, 1248-1262, 2014.