O 66: Nanostructures at Surfaces VI (Surface Reconstructions)

Time: Friday 10:15–12:00 Location: H36

O 66.1 Fri 10:15 H36

Morphology and growth of hafnium silicide on Si(111) — •Eva Henschel[1], Mark Schürmann[1], Christian Flüchter[1,2], Daniel Weier[1,2], Axel Beimborn[1], and Carsten Westphal[1,2] — [1]Experimentelle Physik 1 - Universität Dortmund, Otto-Hahn-Str.4, D 44221 Dortmund, Germany — [2]DELTA -Universität Dortmund, Maria-Goeppert-Mayer-Str. 2, D 44221 Dortmund, Germany

The structure and growth of hafnium on Si(111) were studied by scanning tunneling microscopy (STM). Hafnium was deposited by electron beam evaporation onto a clean Si(111) surface under UHV-conditions. The sample was heated in several steps to 900°C. A growth of elongated nanosized structures was observed. Since it is known that hafnium on silicon forms silicide compounds [1], the islands are assumed to consist of $HfSi_2$. The islands were found to grow in three main directions, related to the symmetry of the (111) surface.

The morphology of these silicide islands is affected by the annealing temperature. The first structures were observed after annealing at 450°C and the first free standing islands were found at 650°C. The islands grow in all three dimensions simultaneously, although the growth of length, width and height starts at different temperatures.

With increasing island volume the island number decreases. An analysis of the mean coverage was performed which indicated a possible decrease of the hafnium amount on the surface. Furthermore, the influence of step edges on the island distribution was studied.

[1] A. de Siervo et al., Phys. Rev. B **74** (7), (2006) 075319

O 66.2 Fri 10:30 H36

AFM studies of the systems Hf/Si(100) and HfO_2/Si(100) — •Axel Beimborn[1], Mark Schürmann[1], Christian Flüchter[1,2], Daniel Weier[1,2], Eva Henschel[1], and Carsten Westphal[1,2] — [1]Experimentelle Physik 1 - Universität Dortmund, Otto-Hahn-Str.4, D 44221 Dortmund, Germany — [2]DELTA -Universität Dortmund, Maria-Goeppert-Mayer-Str. 2, D 44227 Dortmund, Germany

The ongoing down-scaling of silicon based structures in the semiconductor industry leads to the demand of new gate dielectrics with high-k values in order to replace the currenty used SiO_2. One of the most promising candidates is HfO_2. In this work the thermal stability of thin films of Hf on Si(100) was studied with *in situ* (conductive)-AFM and LEED investigations. At temperatures above 700°C a (2x1) LEED pattern indicates large parts of the uncovered Si substrate surface. Further HfO_2 was evaporated onto Si(100) substrates. The oxide films were stepwise heated from 400°C up to 900°C. After each annealing process the surface morphology and the growth of the $HfSi_2$ islands was investigated by AFM and LEED.

O 66.3 Fri 10:45 H36

Static Speckle Experiments with White Synchrotron Radiation — •Tushar Sant[1], Tobias Panzner[1], Wolfram Leitenberger[2], Gudrun Gleber[1], and Ullrich Pietsch[1] — [1]Solid State Physics, University of Siegen, 57068 Siegen, Germany — [2]Institute of Physics, University of Potsdam, 14415 Potsdam, Germany

Static speckle experiments were performed using white synchrotron radiation at EDR beamline at BESSY-II. It has been shown that for coherent scattering experiments in reflection geometry the knowledge of the illumination function incident on the sample is important[1]. In order to prove the inter play between the illumination function and a real sample the coherent reflectivity has been recorded from the surface of technologically smooth GaAs wafer. Besides periodic oscillations which are caused by the scattering from incident pinhole other features appear which are associated with the sample surface profile. The illumination function calculated by means of Lommel formalism matches well with the measured function and will be used for further surface reconstruction from speckle maps. For further examination speckle map of reflection from a laterally periodic structure like GaAs grating is studied [2]. Under coherent illumination the grating peaks split into speckles which correspond to fluctuations on the sample surface. The surface morphology of the grating is reconstructed from this coherent scattering so as to determine local height fluctuations. 1.Pietsch U, et al. Physica B- Condensed Matter, 357 (2005) 45. 2.Pietsch U, et al. Physica B- Condensed Matter, (2007) in press.

O 66.4 Fri 11:00 H36

A Simplified Model for FIB Structuring I — •Andreas Stadler — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Jungiusstr. 11, 20355 Hamburg

Within the wide field of Nano-Technology, methods - as Focused Ion Beam (FIB) - which allow a well defined structuring of any material, have an outstanding position. Therefore the primary aim must be to minimize the producible structure-diameters. While a lot of effort has been undertaken to focus the ion beam, we have focused on the investigation of the influence of substrate parameters on structure diameters.

A 'non-numerical' model has been developed to comprehensibly interpret the measured structures. So called internal and external redepositions have been taken into account for dots, lines and two-dimensional structures.

Besides the parameters current and diameter of a Gaussian beam profile the influence of substrate parameters as density, molar mass and aspect ratio (structure depth versus beam diameter) on structure topography are shown. The effect of typical parameters for FIB processes as dose, step width and write cycle repetition on the morphology have been investigated.

O 66.5 Fri 11:15 H36

Nanostructuring of metallic thin films — •Stefan Griesing, Andreas Englisch, Joachim Sukmanowski, and Uwe Hartmann — Institute of Experimental Physics, Saarland University, P.O. Box 15 11 50, D-66041 Saarbruecken

Several methods are established for micro- and nanostructuring of metallic and dielectric films: Focused ion beam milling, ultraviolet and electron beam lithography and nanoimprint techniques. In this context, we introduce a new method of structuring metallic thin films: A focused electron beam is used for directly melting metallic films. Charge carrier densities in the range of 10^6...10^8 muC/cm^2 in conjunction with beam currents of 0.1...1.5 nA are applied. The applicability on different substrate-metal systems is demonstrated. Structures of different geometry in the sub-100-nanometer range can be achieved by this method. Scanning electron microscopy and atomic force microscopy were used for topographical characterization. The excitation and propagation of surface plasmons in structures of different sizes and geometries was checked by scanning optical near-field microscopy.

O 66.6 Fri 11:30 H36

Low pressure Hydrogen Loading of Pd nanoparticles and films using a Hydrogen plasma — •Hans-Gerd Boyen[1], Paul Ziemann[1], Anitha Ethirajan[1], Luyang Han[1], Ulf Wiedwald[1], Andriy Romanyuk[2], and Peter Oelhafen[2] — [1]Institut für Festkörperphysik, Universität Ulm, D-89069 Ulm} — [2]Institut für Physik, Universität Basel, CH-4056 Basel

The loading of metals with atomic Hydrogen is usually performed in (molecular) Hydrogen atmospheres at elevated pressures (several bars) in order to overcome the problem of small dissociation rates at the surface of the corresponding metal. Here, we present an experimental study for the in-situ loading with atomic Hydrogen of Pd nanoparticles of different size (10nm,3nm, prepared by a micellar method) as well as of a Pd bulk reference sample using a Hydrogen plasma (0.1mbar). The chemical state of the different samples is studied by means of X-ray photoelectron spectroscopy (XPS) allowing to identify the interdiffusion of Hydrogen atoms into the metal by means of an hydride-induced chemical shift of the Pd-3d core levels. First results for the loading/unloading behaviour of the different samples (bulk, nanoparticles) will be presented.

O 66.7 Fri 11:45 H36

DFT Studies on Ir(210)-Surface Faceting Induced by Oxygen Adsorption — •Payam Kaghazchi, Timo Jacob, and Matthias Scheffler — Fritz-Haber-Institut der MPG, D-14195 Berlin, Germany

Some atomically rough surfaces show facet formation in presence of strongly interacting adsorbates. STM and LEED studies demonstrated that the initially planar Ir(210) surface becomes faceted when exposed to oxygen and annealed to temperatures above 600K. The facets that form have been identified to have a pyramidal shape showing (311) and (110) faces. While the (311) faces are smooth and unreconstructed the

(110) faces are rough and consist of both 1×1 terraces and a stepped double-missing-row superstructure [1]. Using density functional theory calculations together with the *ab initio* atomistic thermodynamics we studied the adsorption of oxygen on those surfaces, being involved in the facet-formation. In agreement with the experiment our calculated (p, T)-surface phase diagram shows that while at the experimental oxygen partial pressure and temperatures above ≈900K the planar O/Ir(210) surface is stable, at lower temperatures the facets are thermodynamically more stable. Those combine two O/Ir(311) faces and one face of either O/Ir(110)-regular or O/Ir(110)-superstructure. Due to the relatively small difference in stability our calculations support the picture of a coexistance of the regular and the superstructured Ir(110). We are now in the process of investigating contributions from step-edges, kinks and phonons. [1] I. Ermanoski, C. Kim, S. P. Kelty, T. E. Madey, *Surf. Sci.*, **596**, 89 (2005).