O 27 Phasenübergänge

Zeit: Samstag 15:00–16:45 Raum: TU EB107

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Surface freezing and surface phase transition studied on the liquid eutectic AuSi surface — •Reinhard Streitel, Alexei Grigoriev, Oleg G. Shpyrko, and Peter S. Pershan — Division of Applied Sciences and Department of Physics, Harvard University, Cambridge, MA 02138

We present x-ray investigations on the liquid surface of the eutectic AuSi alloy. Reflectivity and GID (grazing incidence diffraction) measurements indicate surface freezing well above the bulk melting temperature, $T_m(bulk) = 636K$. A reversible surface phase transition occurs at about $T = 645K$. Measurements performed on other metal or alloy (eutectic) surfaces did not show a similar behaviour to date. In comparison to other metals and alloys, AuSi shows a temperature dependent anomalous behaviour of the specular reflectivity in a range of $q_z = 1.0 - 2.5\AA$. Solid like surface structures on liquids were studied on different alloys before [1]. Surface free energy and entropy play a key role in surface freezing effects [2]. Our measurements were performed at the APS (Advanced Photon Source at Argonne National Lab, Chicago, USA). [1] Two-dimensional freezing in the liquid-vapor interface of dilute Pb:Ga alloy - B. Yang, S.A. Rice et al. [2] Wetting prewetting and surface freezing transitions in fluid Ga-based alloys: a surface light scattering study - W. Freyland et al.

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Reversible surface phase transitions between quasicrystalline modifications — •K. J. Franke[1,2], W. Theis[1], P. Kury[3], M. Horn-von Hoegen[3], P. Gille[4], and K. H. Rieder[1] — [1]Inst. f. Experimentalphysik, FU Berlin — [2]IPN, EPFL, Lausanne, Switzerland — [3]Inst. f. Experimentalphysik, Uni Essen — [4]Dept. f. Geo- und Umweltwiss., LMU, München

Due to the complexity of quasicrystalline structures and their derivation from periodic lattices in higher dimensional space, mechanisms such as phason flips, which are nonexistent in periodic crystals, play a key role in transitions between quasicrystalline phases. Decagonal $Al_{72.3}Ni_{9.5}Co_{18.2}$ exists in three different modifications between 30 °C and 850 °C. It therefore provides the opportunity to study the effects of phase transitions on the surface. By using low-energy electron microscopy (LEEM), rough and smooth morphologies have been observed on the nanometer scale for all three low-index surfaces at temperatures below and above 650 °C, respectively. The transition between the medium and high temperature modification at 730 °C leads to a structural change at the surfaces. Both surface phase transitions and their relation to the respective bulk transitions will be discussed.

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Metal-to-semiconductor phase transitions in VO_2 films — •Helena Prima Garcia[1], Tatjana Giessel[1], Emily Hooker[2], Martin Polcik[2], and Wolf Widdra[3] — [1]Max-Born-Institute, Berlin, Germany — [2]Fritz-Haber-Institute der Max-Planck-Gesellschaft, Berlin, Germany — [3]Martin Luther University, Halle, Germany

VO_2 films were grown by subsequent vanadium deposition and oxidation on TiO_2(110) with film thickness' ranging from less than one monolayer to approximately 100 nm and additionally thicker VO_2 films (thickness 200 nm) grown by reactive RF sputtering.

While ultrathin films up to a few monolayers grow nearly epitaxially preserving the structure of the substrate, thicker films grown by subsequent vanadium deposition and oxidation show a polycrystalline structure with a preferential azimuthal orientation of the high symmetry directions in the crystallites parallel to the high symmetry directions of the TiO_2(110) surface. All thermally grown films show only subtle changes in the V 3d region of the valence band as a function of temperature at which VO_2 undergoes a metal-to-semiconductor phase transitions (MSPT at 340 K).

In contrast the thicker VO_2 films grown by reactive RF sputtering show a substantial change in the region of the V 3d level. The spectral analysis of the change at V 3d region reveals the transition temperature around 310K and the width of the hysteresis loop of $\sim 15K$. The relatively broad transition range of $\sim 71K$ could be explained by the different size of the VO_2 particles as observed by AFM.

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Rastertunnelmikroskopische Untersuchung des Übergangs von amorphem zu kristallinem Eis auf Cu(111) — •Michael Mehlhorn[1], Karina Morgenstern[2] und Karl-Heinz Rieder[1] — [1]Institut für Experimentalphysik, Freie Universität Berlin — [2]Institut für Festkörperphysik, Universität Hannover

Bei 5 K wird mittels hochauflösender Tieftemperatur–Rastertunnelmikroskopie der Übergang von amorphem zu kristallinem Eis auf Cu(111) untersucht. Zunächst werden bis zu 2,5 Doppellagen D_2O bei 85 K aufgedampft. Wegen ähnlicher Wechselwirkungsenergien zwischen den Molekülen untereinander und zwischen Molekül und Substrat erwartet man dreidimensionales Clusterwachstum. Tatsächlich werden bis zu 6 Doppellagen hohe amorphe Cluster beobachtet. Durch Heizen auf definierte Temperaturen unterhalb der Desorptionstemperatur von 160 K kristallisieren die Cluster. Es bilden sich bis zu 2 komplette Doppellagen mit geordneten Strukturen in der dritten, unvollständigen Doppelllage. Bei 150 K entstehen auf den vollständig kristallisierten Eisclustern Bündel von bis zu 4 Doppellagen hohen Eispyramiden. Bei Erreichen der Desorptionstemperatur bilden sich daraus kompakte, über 2 nm bzw. 6 Doppellagen hohe Eistürme.

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Order-disorder transition of halogens on Pt(110) by I(T)-LEED — •Thomas Loerting, Clemens Deisl, Mariana Minca, Alexander Menzel, and Erminald Bertel — Institute of Physical Chemistry, University of Innsbruck, Austria

We have recorded low-energy electron diffractograms for halogen overlayers on Pt(110) as a function of temperature at constant coverage and electron gun voltage. A sharp decline of the fractional order spots indicates an order-disorder transition from both the (3×1) and c(2×2) phases to a disordered (1×1) phase at approximately 375 K. The peak profiles and the integrated scattered intensities of various spots on these LEED-films have been investigated according to critical scattering theory both in the [110] and [100] direction. The (3×1) as well as the c(2×2) halogen overlayer show a clear anisotropy in their phase transition behaviour, which corroborates our earlier claim of the quasi-one-dimensional nature of these systems. On the other hand, there are also pronounced differences between the phase transitions. Whereas the c(2×2) superstructure shows the expected behaviour for a continuous second-order phase-transition, e.g., the divergence of the correlation length at the critical temperature, the (3×1) superstructure shows a quite different behaviour, which also involves a change in the platinum substrate. Possible mechanisms for the (3×1)→disorder phase transition will be discussed, in particular with respect to a Peierls transition as previously proposed by us.

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The influence of adsorbates on the Si(111)-In:(4×1) surface — •Karsten Fleischer[1], Sandhya Chandola[1], Norbert Esser[2], and Wolfgang Richter[1] — [1]Technische Universität Berlin, IFP, Sekr. PN 6-1 Hardenbergstr. 36, 10623 Berlin — [2]Institute for Analytical Science, Department Berlin, Albert-Einstein Str. 9, 12489 Berlin

The one dimensional, metallic Si(111)-In:(4×1) surface undergoes a phase transition into a (8×2) symmetry at low temperatures. The nature of this phase transition is explained either as formation of a charge density wave (CDW) or as a merely structural change. With reflectance anisotropy extended into the infrared regime (0.5-6 eV) we are able to monitor the phase transition and also changes to the electronic structure introduced by additional adsorbates such as In or Cs which prevent this phase transition. The current data derived by optical measurements all favour the first model of the surface phase transition – the CDW formation.

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Submonolayer coverage of long chain alkanes at SiO2/air interfaces: Nucleation, molecular mobility, and structure formation — •Ralf Köhler and Hans Riegler — MPI für Kolloid- und Grenzflächenforschung, Abt. Grenzflächen, 14424 Potsdam

The ordering behavior of submonolayers of long chain alkanes at SiO2/air interfaces is astonishing complex. Two-dimensional nucleation and structure formation occurs below the surface melting point. The observed fractal crystallites (1,2) can be related to a process analogous

to diffusion-limited aggregation (3). One observes different growth scenarios depending on the initial thickness of the liquid alkane film, i.e., due to different supply conditions to the growth front. The system also shows a reversible (equilibrium)-coexistence of solid domains and remaining fluid film in between. On-line optical microscopy observations on recent results are presented and analyzed. (1) A.Holzwarth et al., Europhys.Lett.2000,52,653 (2) H.Schollmeyer et al., Langmuir 2003,19,5042 (3) L.Knüfing et al., Langmuir, in press