O 21 Phase transitions

Time: Tuesday 11:15–13:00 Room: WIL C207

O 21.1 Tue 11:15 WIL C207

Inplane order observed at the liquid surface of eutectic AuSi above bulk melting temperature — •Reinhard Streitel[1], Venkat Balagurusamy[1], Peter Pershan[1], Oleg Shpyrko[2], and Alexei Grigoriev[3] — [1]Harvard University, Cambridge, MA — [2]Center for Nanoscale Materials, Argonne National Lab, IL — [3]University of Wisconsin-Madison, WI

The liquid surface of eutectic AuSi shows inplane order above bulk melting temperature (T=361° Celsius). Similar behaviour was not observed in any other binary alloy to date. In comparison to other Au based alloys AuSi shows anomalous, enhanced specular X-ray reflectivity ($q_z = 1.0 - 2.5\mathring{A}$) indicating a pronounced surface layering. GID measurements at different temperatures show reversible structural changes at the surface about 12° Celsius above bulk melting temperature. For low temperatures (above T_{melt} and below $T_{melt} + 12°$ Celsius) GID measurements indicate a powder like 2D inplane structure of the eutectic surface. At higher temperatures (380° Celsius) GID measurements indicate a structural change. At T=430° Celsius no stable phase is present. The inplane correlation length estimated from the FWHM for the low temperature phase is about $200nm$.

O 21.2 Tue 11:30 WIL C207

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

The ordering behavior of submonolayers of long chain alkanes at SiO2/air interfaces is a surprisingly complex phenomenon. Below the surface melting point two-dimensional nucleation and structure formation occurs. The observed fractal crystallites (1,2) can be related to a process analogous to diffusion-limited aggregation (3). One can distinguish three 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. The melting temperature of the two-dimensional domains depends on the total amount of alkane at the surface and follows the liquid-drop model for melting of low-dimensional systems (4) if one introduces a critical length, i.e., a critical film thickness, into this model. On-line optical microscopy observations are presented and analyzed. 1) A.Holzwarth et al., Europhys.Lett. 52, 653 (2000) 2) H.Schollmeyer et al., Langmuir 19, 5042 (2003) 3) L.Knüfing et al., Langmuir 21, 992 (2005) 4) K.K.Nanda et al., PRA 66, 013208 (2002)

O 21.3 Tue 11:45 WIL C207

Thermal switching due to a surface phase transition. — •Justin Wells, Jesper Kallehauge, and Philip Hofmann — Institute for Storage Ring Facilities and iNano center, University of Aarhus, Denmark.

Temperature induced surface phase transitions such as charge density waves (CDWs) have recently been studied extensively because of the interesting basic physics of these quasi two dimensional systems. Although changes in surface electronic structure due to such phase transitions have been well studied, a direct influence on the physical properties appears not to have been measured.

We report on the surface conductivity of Si(111)+Ag($\sqrt{3} \times \sqrt{3}$) as it undergoes a surface phase transition. A temperature dependent switching of the surface conductivity between $\approx 10^{-6}\ \Omega^{-1}$ and $10^{-3}\ \Omega^{-1}$ can be seen. The transition temperature is around 200 K, but small changes in the surface preparation can shift the transition temperature by at least 20 K

Such a strong conductivity change due to a surface phase transition has applications as an ultimately small thermal switch, with a switching temperature that can be controlled by the surface preparation.

The measurements of surface conductivity have been made under UHV conditions in our newly developed micro 4 point probe. As a demonstration of the instrument, Si(111) 7×7 has also been studied, and the surface and bulk conductivities are clearly distinguishable. This is confirmed by observing the effect of changing the bulk properties (by changing the doping) and changing the surface properties (by the adsorption of silver).

O 21.4 Tue 12:00 WIL C207

Unusual reversible disorder-order transition in Br/Pt(110) below 100 K — •Enrico Donà and Erminald Bertel — Institut für Physikalische Chemie, Innrain 52a, Innsbruck Austria

The temperature dependence of Bromine overstructures on Pt(110) has been investigated by variable-temperature scanning tunneling microscopy (VT-STM). Surprisingly, for the c(2x2)structure formed at a coverage of 0.5 monolayers (ML) at room temperature it was found that the long-range order disappears upon lowering the temperature. Strongly anisotropic domains elongated along the [1-10]directions are formed, which exhibit local (2x1) or c(2x2) symmetry. In addition, areas with a local (3x1) geometry are also observed. While it is known from DFT calculations that the (2x1) phase is energetically slightly favoured with respect to the c(2x2) phase, the (3x1) phase is believed to be distinctly higher in energy [1]. The present data seem to indicate that the three phases are almost degenerate at T $\sim$ 50 K, whereas at room temperature the c(2x2) phase is stabilised. Possible mechanisms for this phenomenon are entropic stabilisation or an incipient Peierls transition into an incommensurate phase.

[1] J. Redinger, R. Zucca, private communication

O 21.5 Tue 12:15 WIL C207

A Low-Energy Electron Diffraction Study of Phase Transitions in Br/Pt(110) — •Simon Penner, Thomas Lörting, and Erminald Bertel — Institut für Physikalische Chemie, Innrain 52a, A-6020 Innsbruck, Austria

Peak shape analysis of low-energy electron diffraction spots recorded as a function of temperature are used to analyse phase transitions in c(2x2) and (3x1) Bromine overstructures on Pt(110). A well-defined one-dimensional order-disorder transition at 370 K in the c(2x2) structure indicates the existence of long-range interactions within the adsorbate layer consistent with a quasi-1D electronic structure. Lowering the temperature to $\sim$ 100 K leads to an unexpected decrease in the long-range order consistent with observations by variable-temperature STM. It is shown that the decay of the long-range order cannot be attributed to contamination but seems to be related to fluctuations which involve the substrate atoms as well. Similar experiments carried out for various Br coverages 0.5 monolayers (ML) $< \Theta <$ 0.67 ML also point to the possibility that the substrate plays an essential role in driving the phase transitions. A possible explanation in terms of a Peierls mechanism is discussed.

O 21.6 Tue 12:30 WIL C207

Dynamics of electrons in a Mott insulator — •luca perfetti — Freie Universität Berlin, Arnimallee 14, D-14195 Berlin

We monitor the photoelectrons emitted by a Mott insulator after the absorption of an intense laser pulse. This experiment allows to visualize directly the ultrafast melting of the insulating phase and the coherent excitation of a coupled phonon mode. The Mott phase is fully restored after 1 ps but a coherently excited phonon induces electronic oscillations lasting longer than 20 ps. As a consequence, the effects of electron-electron and electron-phonon interactions can be clearly disentangled.

O 21.7 Tue 12:45 WIL C207

Interface melting of ice at deeply buried ice-silicondioxide interfaces investigated with high energy x-ray reflectivity — •Sebastian Schoeder[1,2], Simon Engemann[1], Harald Reichert[1], Helmut Dosch[1], Jörg Bilgram[3], and Veijo Honkimäki[2] — [1]Max-Planck-Institut für Metallforschung, Heisenbergstraße 3, D-70569 Stuttgart — [2]ESRF, 6 rue Jules Horowitz, F-38000 Grenoble — [3]ETH Zürich, Schafmattstr. 16, CH-8093 Zürich

Ice interfaces play a key role in many technological and environmental phenomena. Yet the properties of the ice interface are poorly understood, especially at conditions close to the melting point. It is well established that surface melting occurs at the free ice surface. However only very few and contradictory measurements exist for the melting of ice at buried interfaces. We have investigated the temperature dependence of the structure of ice in contact with silicondioxide by x-ray reflectivity measurements exploiting a high energy x-ray beam from a 3rd generation synchrotron source. The high penetration length of this radiation allows us to investigate interface phenomena through macroscopic amounts of

material. We show that interface melting can be observed at the ice - silicondioxide interface for both crystalline and amorphous substrates and give values for the thickness of the quasi-liquid layer.