O 102: Epitaxy and growth: Metals and semiconductors II

Time: Friday 11:15–13:00 Location: WIL C307

O 102.1 Fri 11:15 WIL C307

Growth of Pb on Mo(110) studied by scanning tunneling microscopy. Comparison with the growth of Au, Ag and Sn on Mo(110) — •Aleksander Krupski — Institute of Experimental Physics, University of Wrocław, pl. Maxa Borna 9, 50-204 Wrocław, Poland

Scanning tunneling microscopy (STM) has been used for the first time to investigate the growth behaviour of ultra-thin Pb, Ag, Au and Sn films on the Mo(110) surface. The analysis of STM measurements indicates that for a coverage < 1 ML two-dimensional growth of the first Pb monolayer (wetting layer) took place. Above > 1 ML, the three-dimensional growth of the Pb islands with strongly preferred atomic scale *magic height* and flat top is observed. At coverages between 1 ML and 2 ML, only islands containing two atomic layers of Pb are observed. At coverages between 2 ML and 3 ML, islands containing two and four atomic layers of Pb are observed. At higher coverages above 3 ML, the island height distribution shows peaks at relative heights corresponding to N = (2, 4, 6, 7 and 9) of Pb atomic layers. In addition, closer view show coexistence of two well-ordered surface superstructures in the first lead layer. Results presented for growth of Pb will be compared with growth of Ag, Au, and Sn on Mo(110).

O 102.2 Fri 11:30 WIL C307

Stress induced by NiO monolayers on Ag (100) — •Anita Dhaka, Dirk Sander, and Jürgen Kirschner — Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, 061120 Halle (Germany)

We performed in-situ stress and medium energy electron diffraction (MEED) measurements simultaneously during the formation of NiO monolayers (ML) on Ag (100).We deposit Ni at 300 K in an O_2 partial pressure of 2×10^{-7} mbar [1]. Our stress measurement reveals a compressive stress change of -6.5 N/m after growth of 5 ML NiO.This stress measurement is ascribed to misfit stress, which is calculated as -6.3 N/m for 5 ML. From 5 to 10 ML almost constant stress is observed, and low energy electron diffractin (LEED) shows broadened spots, developing into a streaky diffraction pattern. We conclude that misfit distortions are formed, and pseudomorphic growth ends at 5 ML. MEED oscillations indicate layer-by-layer growth from 2 to 10 ML. The first ML NiO gives a (1×2) LEED pattern [2], and the stress change is +0.48 N/m. We ascribe this to an inhomogeneous surface coverage, which is composed of Ni, NiO and Ag areas, as suggested in STM work [2]. We conclude that combined stress and diffraction measurements identify different growth regimes and film stress in epitaxial oxide monolayers, quantitatively. Financial support by SFB 762 is gratefully acknowledged. [1] K.Marre and H.Neddermeyer, Suf. Sci. **287/288**, 995 (1993)

[2] Stephan Groβer, Christian Hagendorf, Henning Neddermeyer and Wolf Widdra, Surf. Interface Anal. **40**, 1741-1746 (2008)

O 102.3 Fri 11:45 WIL C307

DFT studies of small metal ad-atom clusters on fcc(111) surfaces — •Andreas Garhofer[1,2], Claudia Lenauer[2], Florian Wimmer[2], Philipp Scheiber[2], Michael Schmid[2], Peter Varga[2], and Josef Redinger[1,2] — [1]Computational Materials Science TU Wien, Vienna, Austria — [2]Institute for Applied Physics TU Wien, Vienna, Austria

Bonding of face-centered-cubic metals is usually characterized by a preference of a high coordination number for each atom. However by creating a large amount of Pt clusters with pulsed laser deposition on a Pt(111) surface, up to 1/3 of all clusters were found to be linear chains with lengths of up to 9 atoms. We studied different Pt ad-atom arrangements on Pt(111) with first principles DFT methods and found that for 3 and 4 ad-atom structures a linear chain is most stable. A three atom Pt chain is also more stable than a triangular configuration on other substrates such as fcc Rh(111), Pd(111), Ir(111), Au(111) and hcp Ru(0001), which all have similar lattice constants to Pt(111). For the homoepitaxial systems of these transition metals, only the 5d elements form stable linear ad-atom arrangements i.e. only Ir on Ir(111), Pt on Pt(111) and Au on Au(111). The main reason for the stabilization of the ad-atom chain is a strong d_{z^2} orbital interaction, which pushes the corresponding antibonding state above E_F. The formation of longer Pt chains as seen by experiment on Pt(111) is due to steering by lower diffusion barriers towards the end of the chain.

O 102.4 Fri 12:00 WIL C307

SPA-LEED investigation of a thin hexagonal iron-oxide-layer on Ag(001) — •Irena Kiesel[1], Daniel Bruns[2], and Joachim Wollschläger[2] — [1]Fakultät Physik/DELTA, Technische Universität Dortmund, 44221 Dortmund, Germany — [2]Fachbereich Physik, Universität Osnabrück, 49069 Osnabrück, Germany

We present a SPA-LEED (spot-profile-analysis low-energy-electron-diffraction) investigation of a thin iron-oxide-layer on Ag(001). The layer was produced by reactive vapour-deposition of iron in a thin oxygen atmosphere at different substrate temperatures.

The SPA-LEED anaysis of the films produced at 300°C and 400°C has shown a hexagonal structure of the iron-oxide-layer in addition to the cubic structure of the silver-substrate. Accessorily the reflexes of the hexagonal structure split in one direction. The splitting could be explained by an height-modulation of a FeO(111)-film on Ag(001). This height-modulation acts as a phase-grating for the diffracted electrons.

O 102.5 Fri 12:15 WIL C307

Phase diagrams of two dimensional Pd_xAg_{1-x}/Pd(111) and Pt_xAg_{1-x}/Pt(111) surface alloys — •Albert K. Engstfeld[1], Ralf T. Rötter[1], Andreas Bergbreiter[1], Harry E. Hoster[1,2], and R. Jürgen Behm[1] — [1]Institute of Surface Chemistry and Catalysis, Ulm University, D-89069 Ulm, Germany — [2]Current address: Technische Universität München, Centre for Electromobility, 50 Nanyang Drive, Singapore 637553

The distribution of Ag and Pd or Pt in Ag_xPd_{1-x}/Pd(111) and Ag_xPt_{1-x}/Pt(111) surface alloys was studied by high resolution UHV-STM. The alloys were prepared by evaporating Ag on the respective substrate and subsequent annealing to 800 K. From quantitative 2D atom distributions we can show that AgPt tends towards two dimensional clustering and AgPd towards a 'quasi' random distribution, with small deviations for low and high coverages. From effective pair interactions, we are able to calculate the surface mixing energy and determine 2D phase diagrams. Furthermore we will elucidate whether the size mismatch or the differences in the intermetallic bonding are the dominant factor for the respective distribution in the surface alloy.

O 102.6 Fri 12:30 WIL C307

Properties of Cu on Ru(10-10) revealed by AES, LEED and DEPES — •Michal Jurczyszyn, Jacek Brona, Ireneusz Morawski, and Marek Nowicki — Institute of Experimental Physics, University of Wroclaw, Pl. Maxa Borna 9, 50-204 Wroclaw, Poland

The growth of Cu and the crystalline structure of the Cu/Ru(10-10) system was investigated by means of Auger electron spectroscopy (AES), low energy electron diffraction (LEED) and directional elastic peak electron spectroscopy (DEPES). All experiments were performed by using an RFA analyzer. The Auger signal from the substrate and adsorbate recorded during continuous Cu deposition shows the formation of two monolayers of Cu at early stages of growth. Further evaporation leads to 3D growth of Cu. In DEPES the intensity of elastically backscattered electrons was measured as a function of the incidence angle of the primary electron beam at energies: 0.6keV, 0.9keV, 1.2keV, 1.5keV, and 1.8keV. Due to the forward scattering of primaries the enhancement of the recorded signal was obtained at incidence angles parallel to the close packed rows of atoms in clean and covered substrate. The distribution of intensity maxima reflects very well the twofold symmetry of the Ru(10-10) sample. The stereographic distributions obtained for 6ML of Cu reflect threefold symmetry pattern, characteristic for a (111) surface of the fcc structure. The latter was confirmed by LEED pattern observations. The experimental DEPES results were compared to theoretical distributions obtained by using the multiple scattering (MS) theory.

O 102.7 Fri 12:45 WIL C307

Comparing Zn on Pd(110) with Zn on Pd(111) with LEED, LEIS and TDS — •Werner Stadlmayr, Christoph Rameshan, Simon Penner, Bernhard Klötzer, and Norbert Memmel — Physikalische Chemie, Universität Innsbruck, Austria

Methanol-steam-reforming (MSR) is an important catalytic reaction with regards to hydrogen usage and storage. PdZn-systems were found

to show promising properties regarding MSR-capability. In several recent works, Zn on the densely-packed Pd(111)-surface was studied as possible model system and compared with catalytic studies on a polycrystalline Pd-foil. In the present work we present thermodesorption (TDS), low-energy electron diffraction (LEED) and angle-resolved low-energy ion scattering (LEIS) data for the growth and alloying of Zn on the more open Pd(110)-surface. We compare these results with Zn on Pd(111) and discuss differences and similarities.