O 6: Electronic structure I

Time: Monday 11:15–13:00 Location: SCH A216

O 6.1 Mon 11:15 SCH A216

Electron Dynamics of Quantum-Well States in Pb Nanocrystals — •I-Po Hong, Christophe Brun, François Patthey, and Wolf-Dieter Schneider — École Polytechnique Fédérale de Lausanne, Institut de Physique des Nanostructures, CH-1015 Lausanne, Switzerland

Electrons confined in a thin metal film occupy discrete electronic eigenstates known as quantum well states (QWS). As a function of film thickness, the electronic density of states is modulated in an oscillatory manner when a QWS passes through the Fermi level, affecting many of the physical and chemical properties of a thin film. Here we use low-temperature scanning tunneling microscopy and scanning tunneling spectroscopy to study the quasiparticle linewidth of the QWS in Pb nanocrystals on Si(111)-7×7 and on Pb-$\sqrt{3}\times\sqrt{3}$/Si(111). An analysis of the QWS linewidth within a model which accounts for the tunneling process and electron reflection at the Pb-Si and Pb-vacuum interfaces, allows us to determine quantitatively the QWS quasiparticle lifetime, including defect and interface scattering, electron-phonon interaction, and electron-electron interaction.

We acknowledge financial support of the Swiss National Science Foundation.

O 6.2 Mon 11:30 SCH A216

The Two-Dimensional Electron System Au/Ge(111) Studied by Angle-Resolved Photoemission — •Philipp Höpfner[1], Maik Hessmann[1], Jörg Schäfer[1], Carsten Enderlein[2], Thomas Braun[2], Christian Blumenstein[1], Sebastian Meyer[1], Karsten Horn[2], and Ralph Claessen[1] — [1]Physikal. Institut, Universität Würzburg, 97074 Würzburg — [2]Fritz-Haber-Institut, 14195 Berlin

Two-dimensional electron systems (2DES) at surfaces offer high potential for studying correlation effects. Adsorbed metals on (111) semiconductor substrates provide intriguing realizations of a 2DES by forming ($\sqrt{3}\times\sqrt{3}$) reconstructions with metal coverage (Sn, Pb, Au etc.) not exceeding one monolayer. Electron-electron interaction is assumed to play an important role. Examples include Sn/Ge(111) as a rather highly correlated system which even exhibits a Mott-Hubbard transition. In particular, the choice of metal species and substrate will affect orbital character and overlap. By this means, it should be possible to tailor the correlation strength, and to thus understand the mechanisms behind it. Here we explore the little studied noble metal adsorbates by addressing the Au/Ge(111)-($\sqrt{3}\times\sqrt{3}$) system. Angle-resolved photoelectron spectroscopy (ARPES) reveals a metallic character, and for the first time provides an account of the Fermi surface topology. In addition, ARPES determination of the band dispersion reveals electron- and hole-like bands. Their behavior and the effective masses are suggestive of a less correlated electron system, thereby reflecting the tunability of the electronic interactions in a monolayer 2DES.

O 6.3 Mon 11:45 SCH A216

Valence level bands and Fermi surface of decagonal Al-Cu-Co — Wolfgang Theis[1], Jan Hugo Dil[2], Ajay Shukla[3], JeongWon Kim[3], Hoon Koh[4], Eli Rotenberg[4], Peter Gille[5], and •Karsten Horn[2] — [1]Fachbereich Physik, FU Berlin, D — [2]Fritz Haber Institute of the MPG, Berlin, D — [3]UGC-DAE-CSR, Indore, India — [4]ALS, Lawrence Berkeley Lab, USA — [5]Dpt. Geosciences, LMU Munich, D

Valence electronic states in quasicrystals seem to defy the concept of Bloch states because of the absence of translational periodicity. However, this may not necessarily preclude the existence of delocalized electronic states in quasicrystals, since critical electronic states which fall off with a power law may exist, and evidence for delocalized states has been found in quasicrystals in the region of the deeper valence bands. For an analysis of the transport properties of quasicrystals an investigation of the region near the Fermi level is important, however, Here we examine the s-p-derived electronic structure of decagonal Al-Cu-Co in this region using angle-resolved photoemission. These states are accessible in Al-Cu-Co because, unlike in Al-Ni-Co, the d bands are well removed and do not interfere. We find that the electronic structure can be well represented by parabolic dispersing bands in a region of about 1 eV below the Fermi level. The data are analyzed within a model that uses a subset of specific reciprocal lattice vectors, and that provides a consistent description of the photoemission intensity distribution and the dispersion of the observed state signatures.

O 6.4 Mon 12:00 SCH A216

Interplay between electronic states and structure during Au faceting — •Frederik Schiller[1], Martina Corso[2], Javier Cordón[3], Javier García de Abajo[4], and Enrique Ortega[1,2,3] — [1]Unidad de Física de Materiales CSIC/UPV, Manuel Lardizábal 3, E-20018 San Sebastián, Spain — [2]DIPC, Manuel Lardizábal 4, E-20018 San Sebastián, Spain — [3]Dpto. Física Aplicada I, Universidad del País Vasco, Plaza Oñate 2, E-20018 San Sebastián, Spain — [4]Instituto de Óptica-CSIC, Serrano 121, E-28006 Madrid, Spain

Au(111) vicinal surfaces are characteristic examples of two-phase segregation or faceting. Between $\sim 4^\circ$ and 9.5° miscut, the surface exhibits hill-and-valley structures formed by bunches of relatively wide ($d_w \sim$ 36-41 Å) and narrow ($d_n \sim$ 14 Å) terraces. The evolution of surface electronic states in such a faceted system is followed using a curved crystal. Beyond 4° the surface state splits into distinct d_w and d_n bands. Our analysis suggests the crucial role of surface states in defining the characteristic d_w and d_n sizes during Au faceting.

O 6.5 Mon 12:15 SCH A216

The influence of reconstruction on the surface state of Au(110) — •Andreas Nuber[1], Mitsuharu Higashiguchi[2], Frank Forster[1], Peter Blaha[3], Kenya Shimada[4], and Friedrich Reinert[1,5] — [1]Experimentelle Physik II, Universität Würzburg, Am Hubland, D-97074 Würzburg, Germany — [2]Graduate School of Science, Hiroshima University, Higashi-Hiroshima 739-8526, Japan — [3]Institute of Materials Chemistry, Vienna University of Technology, Getreidemarkt 9/165, A-1060 Vienna, Austria — [4]Hiroshima Synchrotron Radiation Center, Hiroshima University, Higashi-Hiroshima 739-0046, Japan — [5]Forschungszentrum Karlsruhe, Gemeinschaftslabor für Nanoanalytik, D-76021 Karlsruhe, Germany

We present high-resolution angle-resolved photoelectron spectroscopy on Au(110). The unreconstructed surface shows a Shockley-type surface state at $E_0 = 590$ meV whereas on the (2×1) missing-row reconstructed surface no such surface state below E_F can be detected [1]. We performed relativistic LDA calculations which agree well with our experimental data. Adsorption of 1 ML Ag on the (2×1) reconstructed surface results in a destruction to a (1×1) surface structure and a Shockley state appears at $E_0 = 475$ meV. Shifting down the surface state from just above to below E_F by Na adsorption allowed to extrapolate a binding energy on the reconstructed surface of $E_0 = -120$ meV above the Fermi level.

[1] A. Nuber *et al.* Phys. Rev B **78**, 195412 (2008).

O 6.6 Mon 12:30 SCH A216

PE and IPE study of the surface electronic structure of Y(0001) — •Sebastian D. Stolwijk[1], Michael Budke[1], Kristian M. Döbrich[2], and Markus Donath[1] — [1]Physikalisches Institut, Westfälische Wilhelms-Universität Münster — [2]Fachbereich Physik, Freie Universität Berlin

Yttrium and gadolinium are isoelectronic elements with respect to their valence bands but differ in their magnetic properties due to the additional 4f electrons in Gd. Therefore, Y may be viewed as paramagnetic model for ferromagnetic Gd. A comparative study of the electronic structure of Y and Gd promises to reveal electronic properties that are directly linked to ferromagnetism.

For more than 20 years, differences in the photoemission spectra of Y(0001) obtained from single-crystalline bulk samples and thin films grown on W(110) have remained an unsolved puzzle. Our recent study on the (0001) surface of a single-crystalline yttrium bulk sample shows that most of the spectral features arise due to impurities such as carbon, chlorine, oxygen and hydrogen [1]. In order to develop a consistent picture of the surface electronic structure of Y(0001), we compare direct and inverse-photoemission results from single-crystalline yttrium bulk samples and ultrathin films, particularly with regard to the surface state close to the Fermi level. These results are discussed in view of data obtained for Gd.

[1] M. Budke, J. S. Correa, and M. Donath, Phys. Rev. B **77**, 161401(R) (2008)

O 6.7 Mon 12:45 SCH A216

Y(0001) bulk crystal - An adequate substrate for the growth of Gd(0001) films? — Michael Budke, Tobias Allmers, •Karen Zumbrägel, and Markus Donath — Physikalisches Institut, Westfälische Wilhelms-Universität Münster

With a negligible lattice mismatch and identical crystal structure, Y commends itself as the ideal substrate for Gd thin film growth. We report on the growth, magnetism and electronic structure of Gd(0001) films grown on a Y(0001) bulk crystal in comparison with films grown on W(110). By combining scanning tunneling microscopy, low-energy electron diffraction, magneto-optical Kerr-effect measurements, as well as direct and inverse photoemission in one ultra-high vacuum system, we are able to provide a detailed characterization of the obtained films. As one of the main criteria we discuss the appearance of the surface state near the Fermi energy. Our results show that although bulk Y crystals suffer from naturally occurring impurities, they are nevertheless a good alternative to W(110) substrates for the growth of Gd.