O 22: Surface or Interface Magnetism

Time: Tuesday 11:15–12:15 Location: H36

O 22.1 Tue 11:15 H36

Image potential states: a sensor for magnetization? — Martin Pickel[1], •Markus Donath[1], Anke Schmidt[2], Ilja Panzer[2], Fabian Giesen[2], and Martin Weinelt[2,3] — [1]Physikalisches Institut, Universität Münster, 48149 Münster — [2]Max-Born-Institut, 12489 Berlin — [3]Freie Universität Berlin, Fachbereich Physik, 14195 Berlin

Image-potential surface states (IPS) at ferromagnetic surfaces exhibit exchange splittings which are explained by the exchange-split boundaries of the projected bulk band gap [1]. So far, no experimental study is available that deals with the response of this splitting to changes of the magnetization as a consequence of, e.g., temperature variation. Spin-resolved two-photon photoemission spectroscopy on the first IPS on 7 ML Fe/Cu(100) has been employed to study the influence of temperature, especially close to T_C, on the spin dependence of its binding energy, spin polarization and linewidth. The evolution of the linewidths as a function of the temperature contradicts the temperature behavior of the exchange splitting and the spin polarization, both suggesting a much lower T_C. This is manifested by measurements with different light polarization, which can be used to deduce the exchange splitting from spin-integrated measurements. The discrepancy is explained by domain formation below T_C leading to an apparent loss of spin polarization and exchange splitting significantly below T_C in the spin-resolved measurements. This experiment demonstrates the strength of using specific electronic states as sensors for magnetization, however, it shows also the danger of misinterpretation.

[1] F. Passek and M. Donath, Phys. Rev. Lett. **69**, 1101 (1992)

O 22.2 Tue 11:30 H36

Electronic structure and magnetic properties of two-dimensional metal-organic coordination structures at a metal surface — •Sebastian Stepanow[1,2], Alexandre Dmitriev[2], Subhra Sen Gupta[3], Jan Honolka[2], Sylvain Clair[4], Stephane Pons[4], Magali Lingenfelder[2], Peter Bencock[5], Dipankar Das Sarma[3], Nian Lin[2], Harald Brune[4], Johannes Valentin Barth[6], Klaus Kern[2,4], and Pietro Gambardella[1,7] — [1]ICN, Barcelona — [2]MPI-FKF, Stuttgart — [3]IIoS, Bangalore — [4]EPFL, Lausanne — [5]ESRF, Grenoble — [6]UBC, Vancouver — [7]ICREA, Barcelona

Recently various 2D metal-coordination structures at a Cu(100) surface have been synthesized. The arrays contain mono- and dinuclear Fe ions embedded in defined ligand-field environments tunable by the employed organic ligand molecules and further manipulated by adsorbed gas molecules. Polarized x-ray absorption spectroscopy was used to investigate the electronic structure and magnetic properties of the metal ions. The results demonstrate that the properties of the Fe centers are mainly determined by the strong coordination bonds to the ligands which drive the effective dehybridization of the Fe atoms from the surface. In-plane and out-of-plane magnetic anisotropy orientations as well as isotropic compounds can be obtained. The temperature dependence of the magnetic anisotropy and related orbital magnetization indicate the thermally excited molecular states present different magnetic properties compared to the ground state. XMCD spectra are discussed in the framework of a simple atomic multiplet theory considering the influence of the crystal-field and spin-orbit coupling on the Fe ^{5}D term.

O 22.3 Tue 11:45 H36

Magnon-enhanced intraband scattering on a d-band ferromagnet — •Anke Schmidt[1,2], Fabian Giesen[1], Martin Weinelt[1,2], Martin Pickel[1,3], and Markus Donath[3] — [1]Max-Born-Institut, Max-Born-Straße 2A, 12489 Berlin, Germany — [2]Freie Universität Berlin, Fachbereich Physik, Arnimallee 14, 14195 Berlin, Germany — [3]Physikalisches Institut, Universität Münster, Wilhelm-Klemm-Straße 10, 48149 Münster, Germany

Experimental access to the spin-dependent decay processes of low-energy electrons in d-band ferromagnets remains a challenge despite advanced techniques such as spin-polarised electron energy loss spectroscopy [1] or spin-resolved two-photon photoemission of image-potential states (IPS). In a spin- and time-dependent photoemission study of thin iron and cobalt films, we have combined the advantages of both methods. The dispersing IPS electron is employed as observer or primary electron, thus effectively separating low-energy losses from direct decay into d-holes. We found that intraband decay on iron is not only much stronger than on cobalt, but also highly spin-dependent. We interpret this in terms of magnon-enhanced exchange scattering between opposite spin-bands, consistent with theoretical predictions [2] that spin-flip processes contribute significantly to the decay of minority electrons in iron.

[1] J. Kirschner, Phys. Rev. Lett. **55**, 973 (1985)
[2] M. Plihal and D.L. Mills, Phys. Rev. B **58**, 14407 (1998), V.P. Zhukov, E.V. Chulkov, and P.M. Echenique, Phys. Rev. Lett. **93**, 096401 (2004).

O 22.4 Tue 12:00 H36

Magnetic linear dichroism in time-resolved two-photon photoemission — Martin Pickel[1], Anke Schmidt[2], Andreas Goris[2], •Fabian Giesen[2], Martin Weinelt[2,3], and Markus Donath[1] — [1]Physikalisches Institut, Universität Münster, Wilhelm-Klemm-Str. 10, 48149 Münster — [2]Max-Born-Institut, Max-Born-Str. 2A, 12489 Berlin — [3]Freie Universität Berlin, Fachbereich Physik, Arnimallee 14, 14195 Berlin

Magnetic linear dichroism in photoemission spectroscopy, i.e. a magnetization-direction dependence of the intensity, has so far only been observed in direct excitation processes [1].

We will present a two-photon photoemission (2PPE) study on ultrathin cobalt films on Cu(100), where the image-potential states (IPS) show a strong dichroism. Varying the photon energy, however, reveals that its origin is caused by initial-states of the 2PPE process. What is more, a spin-dependent lifetime of the IPS in combination with a magnetization direction dependent spin polarization leads to a "dichroic"lifetime in time-resolved 2PPE. This enables a determination of the initial state quantum number without any spin-resolution. The corresponding direct spin-resolved measurements substantiate this possibility and demonstrate that spin-resolved 2PPE can be used as a probe for the electronic structure of occupied states close to the Fermi-level with respect to the spin polarization and the symmetry quantum number.

[1] W. Kuch and C. M. Schneider, Rep. Prog. Phys. **64**, 147 (2001)