O 55: Surface magnetism II (jointly with MA)

Time: Wednesday 15:00–16:45 Location: CHE 184

O 55.1 Wed 15:00 CHE 184

Hyrogen-induced Kondo effect for Co/Pt(111) — •Quentin Dubout, Fabian Calleja Mitja, Markus Etzkorn, Anne Lehnert, Laurent Claude, Pietro Gambardella, and Harald Brune — Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland

We present 0.4 K Scanning Tunneling Spectroscopy (STS) results on hydrogenated Co adatoms on Pt(111). Molecular H dosage creates two Co-H adsorption complexes with comparable abundance. Type I displays very large (~40 %) inelastic conductance steps that originate from vibrations, as evidenced by their shift when substituting H by D. Type II displays smaller (~5 %) conductance steps at higher energies, again due to H vibrations, together with a large conductance peak at the Fermi level. This feature is attributed to the Kondo effect. Its splitting in magnetic fields up to 8 Tesla identifies the Co-H complex as a S = 1/2 system, whereas clean Co/Pt(111) has a spin of 1 and shows no Kondo effect. H-adsorption has been reported to quench the Kondo effect, here we show that it can produce it.

O 55.2 Wed 15:15 CHE 184

Magnetic and structural investigations of thin ferromagnetic CrSb layers on GaAs(110)/GaAs(001) — •Carsten Godde and Ulrich Köhler — Institut für Experimentalphysik IV / AG Oberflächen, Ruhr-Universität Bochum, Germany

In this contribution we present structural and magnetic measurements of thin CrSb layers on GaAs(110) and GaAs(001) surfaces. These systems are of great interest because of their possible use as spin aligner for spin injection in semiconductors. Thin CrSb layers up to 4 ML thickness grow in the metastable zinc blende structure on GaAs and keep ferromagnetic properties and structural stability up to high annealing temperatures which is interesting for enabling better crystalline quality. We investigate the growth of CrSb on the GaAs surfaces at different coverages and annealing temperatures by STM, LEED and SQUID magnetometry. The CrSb films are co-deposited on the GaAs substrate by MBE at a deposition temperature of 250°C with a co-deposition ratio of Cr and Sb: 1:6. On the GaAs(110) surface STM shows for a 3ML CrSb deposition a closed film of rectangular and rooflike islands elongated in [1$\bar{1}$0]-direction of substrate with increasing tendency towards a flat continuous morphology with height variations in the monolayer range after thermal processing at 300°C for 45min. These flat areas are characterized by a atomic fishbone row structure in [1$\bar{1}$0]-direction. SQUID magnetometry measurements show ferromagnetic characteristics of the thin CrSb layers with a magnetic moment per atom of $\approx 3\ \mu_B$.

O 55.3 Wed 15:30 CHE 184

Fe/GaAs(001) and MgO/Fe/GaAs(001) epitaxial systems: A spin- and angle-resolved photoemission study — •Daniel Gottlob[1,2], Lukasz Plucinski[1], Carsten Westphal[2], and Claus M. Schneider[1] — [1]Forschungszentrum Jülich GmbH — [2]Technische Universität Dortmund

Spintronics is an inportant field of current Solid State Research and memory units based on Magnetic Tunnel Junctions (MTJs) are now within reach. In MTJ's the nature of the electronic structure at the interface determines the spin-selectivity of the tunneling process, and thereby the magnetorestive potential of the MTJ.

Electronic interface states can influence the tunneling process in epitaxial MTJs especially for thinner tunnel barriers. The research that has been done at Beamline 5, DELTA, Dortmund in the context of a Diploma thesis focussed on the electronic structure of Fe/GaAs(001) and MgO/Fe/GaAs(001) and a surface/interface state of these systems. The samples have been prepared *in situ* by molecular beam epitaxy and characterized by LEED and Auger spectroscopy.

The electronic structure was probed in two different regions of the Brillouin zone, which have been chosen for reference (normal emission, Γ point) and the expectation of the surface state (21° off normal) that has been seen on Fe/W(001) in a previous study [1]. Measurements on the MgO capped iron sample have been conducted to confirm whether the surface state does transform into an interface state.

[1] L. Plucinski, Y. Zhao, C.M. Schneider, B. Sinkovic, and E. Vescovo; Phys. Rev. B 80, 184430 (2009)

O 55.4 Wed 15:45 CHE 184

Itinerant Nature of Atom-Magnetization Excitation by Inelastic Scanning Tunneling Spectroscopy — Alexander Khajetoorians[1], Samir Lounis[2], Bruno Chilian[1], Antonio Costa[3], Lihui Zhou[1], Douglas Mills[2], Sergej Schuwalow[4], Frank Lechermann[4], •Jens Wiebe[1], and Roland Wiesendanger[1] — [1]Institute of Applied Physics, Hamburg University, Germany — [2]Department of Physics and Astronomy, University of California Irvine, USA — [3]Instituto de Física, Universidade Fedeal Fluminense, Niterói, Brazil — [4]I. Institute for Theoretical Physics, Hamburg University, Germany

We have performed single-atom magnetization curve (SAMC) measurements [1] and inelastic scanning tunneling spectroscopy (ISTS) on Fe atoms adsorbed on a semiconducting [2] and a metallic substrate [3]. ISTS reveals magnetization excitations whose lifetime strongly depends on the type of substrate. In the semiconducter case the lifetime is relatively long. In the metallic case the lifetime decreases upon application of a magnetic field and the SAMCs show a broad distribution of magnetic moments. The experimental observations are quantitatively explained by the decay of the magnetization excitation into Stoner modes of the itinerant electron system as shown by newly developed theoretical modeling [3].

[1] F. Meier *et al.*, Science **320**, 82 (2008).
[2] A. A. Khajetoorians *et al.*, Nature **467**, 1084 (2010).
[3] A. A. Khajetoorians *et al.*, arXiv:1010.1284v2.

O 55.5 Wed 16:00 CHE 184

Magnetism of ultrathin Fe layers on $BaTiO_3$(001) — •Remya Kunjuveettil Govind[1], Vasili Hari Babu[2], Federica Bondino[3], Marco Malvestuto[3], Martin Trautmann[1], Karl-Michael Schindler[1], and Reinhard Denecke[2] — [1]Institut fur Physik, Martin-Luther-Universität Halle-Wittenberg — [2]Wilhelm-Ostwald-Institut fur Physikalische und Theoretische Chemie, Universität Leipzig — [3]IOM CNR, Laboratorio Nazionale TASC, Area Science Park, Basovizza, Italy

Multiferroic systems are promising candidates for switching magnetization using voltages. Layered systems from ultrathin magnetic films on ferroelectric substrates are model systems. In this study ultrathin layers of Fe are deposited on a $BaTiO_3$(001) substrate and characterized by XPS, AES, NEAXFS and LEED. X-ray circular dichroism (XMCD) measurements in remanent magnetization show no magnetization for thicknesses up to 6 Å, in contrast to theoretical predictions [1]. From 8 to 28 Å, the XMCD spectra clearly show in-plane magnetization and the XMCD spectra look like bulk Fe. However, the dichroism is smaller and values for orbital and spin magnetic moments derived from a sum rule analysis are significantly smaller than bulk values. Possible reasons for this behavior, like partial oxidation of the Fe layer or non-uniform layer growth will be discussed.

[1] M. Fechner et al., Phys. Rev. B 78 (2008) 212406; M. Fechner et al., Phys. Stat. Sol. B 1 (2010) 8.

O 55.6 Wed 16:15 CHE 184

Quantum-well-states in a copper/cobalt/copper hetero-structure — •Philipp Kloth[1], Martin Wenderoth[1], Henning Prüser[1], Alexander Weismann[2], and Rainer G. Ulbrich[1] — [1]IV. physikalisches Institut, Georg-August Universität Göttingen, 37077 Göttingen — [2]IEAP, Christian-Albrechts-Universität zu Kiel, 24098 Kiel

The morphological and electronic properties of a copper/cobalt/copper hetero-structure have been investigated by LEED, AES and STM/STS. We focus on the structural dependent electronic features, that could be observed for different preparation methods.

The samples are prepared and analyzed under UHV-conditions. Cobalt and copper films are deposited onto a (100)-copper single crystal by electron beam evaporation. The growth of both materials at room and LN2 temperature with a subsequent annealing step reveals different surface morphology. Furthermore a considerable diffusion between the interfaces takes place during the deposition process - even at low temperatures.

Due to the finite thickness of just a few monolayers the copper film on top of the sample exhibits the formation of quantum-well-states which can be identified by STS. The crossover to smoother hetero-structures by growing at low temperatures leads to a change in the energetic behaviour of those states. This is explained by the anisotropic electron propagation of copper [1]. This work is supported by the SFB 602 TP A3.

[1] A. Weismann et al., Science 323, 1190 (2009)

O 55.7 Wed 16:30 CHE 184

Observing the Spin of an Individual Mn_{12} Molecule — •Steffen Kahle[1], Zhitao Deng[1], Charlène Tonnoir[1], Nicha Thontasen[1], Gordon Rinke[1], Nikola Malinowski[1], Alicia Forment Aliaga[1], Stephan Rauschenbach[1], Markus Ternes[1], and Klaus Kern[1,2] — [1]MPI for Solid State Research, Stuttgart — [2]EPFL, Lausanne, Switzerland

The Mn_{12}-acetate$_{16}$ molecule (Mn_{12}) is considered a prototypical single molecular magnet (SMM) because its high spin measured in bulk is commonly attributed as spin of the individual molecules [1]. To confirm this we want to measure the spin of an individual Mn_{12} molecule.

We are able to gently deposit Mn_{12} molecules on different metal substrates by electrospray ion beam deposition [2]. STM images show intact and individual addressable molecules, which can be resolved with submolecular resolution.

Low temperature (1K) scanning tunneling spectroscopy on top of the molecule adsorbed on bare metal is featureless near E_F. This changes when we decouple the molecule from the metal adding a BN layer on the substrate before deposition. We now observe symmetric inelastic tunneling features around E_F in the range of a few mV, which is ascribed to spin flip excitations. The excitation is delocalized evenly over the whole molecule supporting the giant-spin model.

This proofs the existence of a molecular spin, thus confirming the SMM nature of individual Mn_{12} molecules on the surface.

[1] R. Sessoli *et. al.*, **Nature** 365, 141, (1993).

[2] N. Thontasen *et. al.*, **J. Phys. Chem. C** 114, 17768, (2010).