O 52: Poster: Electronic structure: Surface Magnetism and Spin Phenomena

Time: Tuesday 18:15–20:30 Location: Poster B

O 52.1 Tue 18:15 Poster B

Field and temperature dependent switching analysis of holmium single atom magnets — Fabian Donat Natterer[1], Fabio Donati[1,2,3], •Patrick Forrester[1], François Patthey[1], and Harald Brune[1] — [1]Institute of Physics, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland — [2]Center for Quantum Nanoscience, Institute for Basic Science, Seoul, Korea — [3]Department of Physics, Ewha Womans University, Seoul, Korea

As stable magnetic bits have shrunk to the fundamental limit of single atoms, questions about the thermal stability of magnetic information become pressing. Using the example of holmium single atom magnets on MgO, we investigate the magnetic bistability and switching between 4.3 K and up to 50 K. A coercive field of more than 8 T is found at 35 K. We encounter spontaneous magnetization reversal at about 45 K and 8 T in our STM study. We estimate the transverse magnetic anisotropy energy from a magnetic field and bias voltage dependent 2-state switching analysis at 4.3 K. This allows us to constrain the possible magnetic ground state to either $J_z = 8$ or $J_z = 7$, both explaining magnetic bistability at finite field strengths.

O 52.2 Tue 18:15 Poster B

Visualizing the magnetic structure of Fe bilayers on Ir(111) by atomic manipulation — Nadine Hauptmann[1], Melanie Dupé[2], •Tzu-Chao Hung[1], Alexander K. Lemmens[1], Jairo Sinova[3], Stefan Heinze[3], Daniel Wegner[1], Bertrand Dupé[2], and Alexander A. Khajetoorians[1] — [1]Institute for Molecules and Materials, Radboud University, 6525 AJ Nijmegen, Netherlands — [2]Institut für Physik, Johannes Gutenberg Universität Mainz, D-55099 Mainz, Germany — [3]Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität zu Kiel, D-24098 Kiel, Germany

Chiral magnetic structures, in which Dzyaloshinskii-Moriya interaction plays an important role on the mechanism of stabilization, have been predicted being a candidate for spintronic applications. By utilizing the combination of spin-polarized scanning tunneling microscope (SP-STM) and magnetic exchange force microscopy (MExFM), or so-called SPEX, we get both the magnetic and geometric sensitivity down to the atomic scale. We apply this method to probe the magnetic structure of the bilayer of Fe on Ir(111), which reveals chiral magnetic order. However, both SP-STM and MExFM do not reveal magnetic contrast of the total unit cell, resulting from the strongly corrugated surface. Therefore, we use the manipulation of iron adatoms, which locally exchange couple with the underlying spin spiral, providing spin information in regions of the unit cell where no magnetic contrast can be observed in SPEX images of the bare surface.

O 52.3 Tue 18:15 Poster B

Scanning tunneling microscopy and spectroscopy of endohedral fullerenes on metallic substrates — •Emmanouil Koutsouflakis, Sebastian Schimmel, Zhixiang Sun, Denis Krylov, Danny Baumann, Alexey Popov, Bernd Büchner, and Christian Hess — Leibniz-Institute for Solid State and Materials Research, IFW-Dresden, 01069 Dresden, Germany

Single Molecule Magnets (SMMs) are molecular materials whose molecules may exhibit magnetic properties such as magnetization under zero-field conditions, large relaxation times and high blocking temperatures. However towards molecular electronics and the subsequent controlled manipulation of single spins in SMMs, the obstacle of the insufficient chemical stability of many SMM architectures has to be overcome, in order to facilitate both their organization on substrates and the preservation of their properties.

We report on the investigation of resolving the limiting applicability of SMMs in molecular spintronics by the use of Endohedral Metallofullerenes (EMFs). We research on the alternative of the trimetallic nitride EMFs of the type $A_{3-n}B_nN@C_{80}$ (n=0-3; A, B rare earth metals or transition metals) where a carbon cage encapsulates a triangular cluster of three rare earth/ transition metal atoms and a nitrogen at its center. In particular, we evaporate Dy-based EMFs on metallic substrates and in order to probe the feasible monolayer coverage and to estimate the adsorption characteristics and the electronic structure of the deposited molecules we performed Scanning Tunneling Microscopy and Spectroscopy.

O 52.4 Tue 18:15 Poster B

Evolution of the Kondo effect in ConCum chains — •Neda Noei, Alexander Weismann, and Richard Berndt — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität, 24098 Kiel, Germany

Using a low temperature scanning tunneling microscope, monatomic Cu chains with lengths up to 100 nm were fabricated. By dipping the STM tip into Cu(111), different kinds of dislocations were generated. Among these dislocations, long Cu chains are an interesting system to investigate spin interaction between magnetic atoms. Two interacting magnetic atoms can be considered as a prototype system for spin exchange correlations. We attached Co adatoms to monatomic Cu chains to investigate how their adsorption sites and their distance from each other affect spin correlations between them. We observed a significant change of Kondo resonance when a Co atom was attached to the chain. This can be addressed to directional hybridization of Co atom d-orbitals to the chain. Moreover, by adding Co atom to the end of the chain, the Kondo resonance broadens appreciably. We have shown that the amplitude and width of Kondo resonance depends on the distance between Co atoms at chain.

O 52.5 Tue 18:15 Poster B

Yu-Shiba-Rusinov states of Fe adatoms on the quasi 2D superconductor $2H$-$NbSe_2$ — •Rojhat Baba[1], Eva Liebhaber[1], Sebastian Rohlf[2], Kai Rossnagel[2], Benjamin W. Heinrich[1], and Katharina J. Franke[1] — [1]Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany. — [2]Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, 24098 Kiel, Germany.

Magnetic impurities in superconducting materials induce Yu-Shiba-Rusinov (YSR) states inside the superconducting energy gap due to the exchange coupling between the impurity and the Cooper pair condensate. The superconductor $2H$-$NbSe_2$ is a transition metal dichalcogenide compound with a strong 2D character because of the weak van der Waals interaction between its layers. Furthermore, the material shows a transition to a charge density wave (CDW) state at low temperatures.

We use low temperature scanning tunneling microscopy and spectroscopy for the investigation of single Fe adatoms on $2H$-$NbSe_2$. The Fe adatoms reside in two different adsorption sites which induce significant differences in the energy of the d resonances as well as of the YSR states. A further characterization hints towards an influence of the CDW of the $2H$-$NbSe_2$ surface on the energy of the YSR states.

O 52.6 Tue 18:15 Poster B

Spin-resolved very-low-energy electron diffraction from ferromagnetic Fe films — •Christoph Angrick[1], Andre Reimann[1], Christian Thiede[1], Koji Miyamoto[2], and Markus Donath[1] — [1]Physikalisches Institut, Westfälische Wilhelms-Universität Münster, Germany — [2]HiSOR, Hiroshima University, Japan

Spin-dependent electron scattering from ferromagnetic films is interesting for two reasons: (i) A ferromagnetic film can be used as a promising scattering target in spin-polarization analyzers as single [1,2] and multichannel devices [3,4]. Ferromagnetic films offer a high Sherman function and an easy way to reverse the asymmetry. (ii) Electron scattering experiments provide information about the surface barrier, which is predicted to be spin-dependent for ferromagnets [5].

We investigate ferromagnetic Fe films with spin-resolved very-low-energy electron diffraction by varying the electron kinetic energy and the incident polar as well as azimuthal angle over a wide range. In the focus of this work are two targets: (i) p(1x1)O-Fe(001)/MgO(001) and (ii) Fe(110)/W(110).

[1] Winkelmann *et al.*, Rev. Sci. Instrum. **79**, 083303 (2008)
[2] Okuda *et al.*, Rev. Sci. Instrum. **79**, 123117 (2008)
[3] Kolbe *et al.*, Phys. Rev. Lett. **107**, 207601 (2011)
[4] Tusche *et al.*, Appl. Phys. Lett. **99**, 032505 (2011)
[5] Burgbacher *et al.*, Phys. Rev. B **87**, 195411 (2013)

O 52.7 Tue 18:15 Poster B

Magnetic anisotropy of individual Fe and Co atoms on a MgO/Ag(001) substrate — •Stanislav Stupko[1], Eva Rauls[2], Wolf Gero Schmidt[1], and Uwe Gerstmann[1] — [1]University of

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Combining high energy resolution of radio-frequency (RF) resonance methods with the spatial resolution and manipulation capabilities of scanning tunneling microscopy (STM) provide a promising avenue to study single-spin resonance at the nanoscale. Recent experiments study are promising by investigating single double-decker molecules(TbPc2) [1] and individual Fe- and Co-atoms placed on a magnesium oxide film [2]. In this work, we treat the system investigated in [2] with a full relativistic density-functional theory (DFT) approach (implemented in the Quantum ESPRESSO package), for all possible adsorption sites. Within non-collinear DFT, we compute the anisotropy of the magnetic properties, including the full EPR fingerprint. In particular, the orbital magnetization for the investigated periodic system is evaluated using a Berry-phase formula [3]. By this, we are able to clarify some open questions concerning Fe and Co adsorption, such as differences in STM/EPR signals for different Fe-atoms or their absence in case of Co-atoms.

[1] Müllegger et al., Phys.Rev.Lett. 113, 133001 (2014).
[2] Baumann et al., Science 350, 6259 (2015).
[3] Ceresoli et al., Phys.Rev. B 81, 060409(R) (2010).