O 25: Poster Session II: Surface magnetism II

Time: Monday 13:30–15:30 Location: P

O 25.1 Mon 13:30 P

Real-time MOKE measurements of CoTMPP on magnetic Ni/Cu(110)-(2x1)O — •Gizem Mendirek[1], Aleksander Brozyniak[2], Michael Hohage[1], Andrea Navarro-Quezeda[1,3], and Peter Zeppenfeld[1] — [1]Institut für Experimentalphysik, Johannes Kepler Universität Linz, Altenberger Str. 69, 4040 Linz, Österreich — [2]CD-Labor für Nanoskalige Phasenumwandlungen, Johannes Kepler Universität Linz, Altenberger Str. 69, 4040 Linz, Österreich — [3]Institut für Halbleiter und Festkörperphysik, Johannes Kepler Universität Linz, Altenberger Str. 69, 4040 Linz, Österreich

In this work, we report real-time investigations of an organic/ferromagnetic interface by employing a sinusoidal modulation of the magnetic field with the synchronous detection of the Reflectance Difference Magneto-Optical Kerr Effect (RDMOKE) signal. Besides improving the detection limit to variations of the Kerr rotation angle below 1 μrad/mT, the present setup allows recording hysteresis loops continuously as a function of coverage, time or temperature. We illustrate the capabilities of the setup for Ni thin films grown on a Cu(110)-(2x1)O surface and the subsequent deposition of cobalt tetramethoxyphenylporphyrin (CoTMPP) thin layers. The adsorption of the molecules induces characteristic changes in the magnetic properties (magnetization amplitude, remanence and coercive field) that are monitored as a function of the coverage with sub-monolayer resolution and as a function of temperature, revealing the decrease of the Curie temperature upon CoTMPP deposition on Ni films with different thicknesses.

O 25.2 Mon 13:30 P

Domain Walls in the Row-Wise Antiferromagnet Mn/Re(0001) — •Martin Grünebohm, Jonas Spethmann, Roland Wiesendanger, Kirsten von Bergmannv, and André Kubetzka — Department of Physics, University of Hamburg, 20355 Hamburg, Germany

Typical domain walls (DWs) in antiferromgnetic (AFM) systems can be described by a coherent rotation, which allows a mapping onto ferromagnetic DWs. Experiments show, that in fcc-stacked monolayers of manganese on Re(0001), competing nearest and next-nearest neighbor Heisenberg exchange in combination with higher order interactions lead to a row-wise antiferromagnetic state (or $1Q$ state) [1]. We find that DWs, that separate the rotational domains, cannot be described by a coherent spin rotation. Instead, the low symmetry of the row-wise AFM state facilitates a new type of DW, which connects rotational domains by an opposite rotation of adjacent spin pairs across the wall. Interestingly, the non-collinear spin texture in the center of the DW has an angle of 90° between neighboring spins, characteristic of a so-called $2Q$ state. We propose an analytical description and test it using spin dynamics simulations based on DFT calculations in comparison to spin-polarized STM measurements [2].

[1] J. Spethmann *et al.*, Phys. Rev. Lett. **124,** 227203 (2020).
[2] J. Spethmann *et al.*, arXiv:2011.05678 (2020).

O 25.3 Mon 13:30 P

Magnetic force microscopy on a cobalt thin film deposited on a trampoline-type free hanging silicon nitride membrane — •Denis Goman[1], Dhavalkumar Mungpara[1], Federico Maspero[2], Simone Cuccurullo[3], Riccardo Bertacco[2,3], and Alexander Schwarz[1] — [1]Institute of Nanostructure and Solid State Physics, University of Hamburg, Jungiusstrasse 11, 20355 Hamburg, Germany — [2]CNR Istituto di Fotonica e Nanotecnologie, Piazza Leonardo da Vinci 32, 20133, Milano, Italy — [3]CNR Istituto di Fotonica e Nanotecnologie, Piazza Leonardo da Vinci 32, 20133, Milano, Italy

We apply magnetic force microscopy (MFM) in ambient conditions employing the lift mode to study the magnetic domain structure of a 130 nm thick cobalt film deposited on a 1000 nm thick silicon nitride trampoline-type membrane attached to a 0.2 mm thick silicon frame. The cobalt is deposited only onto the central rectangular part of the trampoline membrane. The four strings attached to the corners of the the 0.15 mm × 0.15 mm window are uncoated.

MFM images show that the cobalt thin film exhibit out-of-plane stripe domains predominantly aligned along the sides of the rectangular shaped film. We find a periodicity of 230 nm in the central part where the film thickness is constant. At the edges, where the film thickness decreases linearly, the domain width decreases as well. We also studied the effect of an external magnetic field on the genuine domain structure.

The authors gratefully acknowledge funding from the ERC H2020 research and innovation program grant agreement No 828784.

O 25.4 Mon 13:30 P

Chimera-type skyrmion collapse revealed by sub-nm maps of the transition rate — •Stephan von Malottki[1], Florian Muckel[2], Christian Holl[2], Benjamin Pestka[2], Marco Pratzer[2], Pavel F. Bessarab[3,4], Stefan Heinze[1], and Markus Morgenstern[2] — [1]ITAP, University of Kiel — [2]Institute of Physics B and JARA-FIT, RTWH Aachen University — [3]University of Iceland, Reykjavík — [4]ITMO University, St. Petersburg

In addition to the conventional radial symmetric collapse of magnetic skyrmions, recent studies predicted the occurrence of skyrmion annihilation processes via the chimera skyrmion state [1-3]. Here, we demonstrate the realization of both the radial symmetric and the chimera transition mechanism in the ultra-thin film system fcc-Pd/Fe/Ir(111) [4]. Scanning tunneling microscopy is used to create transition rate maps of magnetic switching events induced by single electron events. In combination with energy density maps of the transition states obtained by atomistic spin simulations parametrized from first principles, they allow for the identification of both annihilation mechanisms. It is further shown, that a transition between both mechanisms can be achieved by the application of external in- and out-of-plane magnetic fields, yielding a sound agreement between experiment and theory.

[1] Meyer et al., Nat. Commun. 10, 3823 (2019)
[2] Heil et al., Phys. Rev. B 100, 134424 (2019)
[3] Desplat et al., Phys. Rev. B 99, 174409 (2019)
[4] Muckel et al., Nat. Phys. (2021)
https://doi.org/10.1038/s41567-020-01101-2

O 25.5 Mon 13:30 P

Probing the magnetism of single atoms with orbital sensitivity — Aparajita Singha[1,2], •Daria Sostina[1,2], Christoph Wolf[1,2], Safa Ahmed[1,3], Denis Krylov[1,2], Luciano Colazzo[1,2], Pierluigi Gargiani[4], Stefano Agrestini[4], Woo-Suk Noh[5], Jae-Hoon Park[5,6], Marina Pivetta[7], Stefano Rusponi[7], Harald Brune[7], Andreas Heinrich[1,3], Alessandro Barla[8], and Fabio Donati[1,3] — [1]Center for Quantum Nanoscience, Institute for Basic Science, Seoul, Republic of Korea — [2]Ewha Womans University, Seoul, Republic of Korea — [3]Department of Physics, Ewha Womans University, Seoul, Republic of Korea — [4]ALBA Synchrotron Light Source, Cerdanyola del Vallès, Catalonia, Spain — [5]MPPC-CPM, Max Planck POSTECH/Korea Research Initiative, Pohang, Korea — [6]Department of Physics, Pohang University of Science and Technology (POSTECH), Pohang, Korea — [7]Institute of Physics, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland — [8]Istituto di Struttura della Materia (ISM), Consiglio Nazionale delle Ricerche (CNR), Trieste, Italy

Lanthanide atoms are promising candidates for atomic data storage and quantum logic due to the long magnetic lifetime.[Science 352, 318 (2016)]. Here, we use the orbital sensitivity of x-ray absorption spectroscopy to investigate the valence magnetism of rare earth atoms and clusters on MgO/Ag(100). We find both Gd and Ho atoms in a monovalent state, with one electron transferred to the underneath substrate. Combining our experiments with multiplet calculations and density functional theory we clarify the controversy on the ground state of Ho single atom magnets [Phys. Rev. Lett. 121, 027201 (2018)].

O 25.6 Mon 13:30 P

Electrical and thermal transport in antiferromagnet-superconductor junctions — •Martin Fonnum Jakobsen[1], Kristian Naess[1], Paramita Dutta[2], Arne Brataas[1], and Alireza Qaiumzadeh[1] — [1]Norwegian University of Technology — [2]Uppsala University

We demonstrate that antiferromagnet–superconductor (AF–S) junctions show qualitatively different transport properties than normal metal–superconductor (N–S) and ferromagnet–superconductor (F–S) junctions. We attribute these transport features to the presence of two new scattering processes in AF–S junctions, i.e., specular reflection of holes and retroreflection of electrons. Using the Blonder–

Tinkham–Klapwijk formalism, we find that the electrical and thermal conductance depend nontrivially on antiferromagnetic exchange strength, voltage, and temperature bias. Furthermore, we show that the interplay between the Néel vector direction and the interfacial Rashba spin-orbit coupling leads to a large anisotropic magnetoresistance. The unusual transport properties make AF–S interfaces unique among the traditional condensed-matter-system-based superconducting junctions.

O 25.7 Mon 13:30 P

Spin-spiral state of a Mn monolayer on W(110) at variable temperatures as seen by x-ray absorption spectroscopy — •Ondrej Sipr[1], Kirsten von Bergmann[2], Hubert Ebert[3], Roland Wiesendanger[2], and Jan Honolka[1] — [1]Institute of Physics, Czech Academy of Sciences, Praha — [2]University of Hamburg, Germany — [3]Ludwig-Maximilians-Universität München, Germany

The noncollinear magnetic state of epitaxial Mn monolayers on tungsten (110) crystal surfaces is investigated by means of soft x-ray absorption spectroscopy, to complement earlier spin-polarized STM experiments. X-ray absorption spectra (XAS), x-ray linear dichroism (XLD) and x-ray magnetic circular dichroism (XMCD) Mn $L_{2,3}$-edge spectra were measured in the temperature range from 8 to 300 K and compared to results of fully-relativistic *ab initio* calculations. We show that antiferromagnetic (AFM) helical and cycloidal spirals give rise to significantly different Mn $L_{2,3}$-edge XLD signals, enabling thus to distinguish between them.

It follows from our results that the magnetic ground state of a Mn monolayer on W(110) is an AFM cycloidal spin spiral. Based on temperature-dependent XAS, XLD and field-induced XMCD spectra we deduce that magnetic properties of the Mn monolayer on W(110) vary with temperature, but this variation lacks a clear indication of a phase transition in the investigated temperature range up to 300 K — even though a crossover exists around 170 K in the temperature dependence of XAS branching ratios and in XLD profiles.

O 25.8 Mon 13:30 P

Lifetimes of skyrmions and antiskyrmions in exchange frustrated systems — •Moritz A. Goerzen[1], Stephan v. Malottki[1], Sebastian Meyer[1], Pavel F. Bessarab[2,3], and Stefan Heinze[1] — [1]Institute of Theoretical Physics and Astrophysics, University of Kiel — [2]University of Iceland, Reykjavík, Iceland — [3]ITMO University, St. Petersburg, Russia

A recent study [1] on a Rh/Co bilayer on Ir(111) shows an interesting energy landscape for noncollinear magnetic states due to a high degree of exchange frustration. In particular we find, that both skyrmions and antiskyrmions co-exist in this system, which is beneficial for future spintronic technologies. Based on an atomistic spin model parameterized from density functional theory, we investigate the lifetime of co-existing states by long time scale spin dynamic simulations using the geodesic nudged elastic band method as well as transition state theory in harmonic approximation [2,3]. Due to a different number of internal degrees of freedom for skyrmions and antiskyrmions in systems without inversion symmetry, we find large differences between lifetimes of these states.

[1] Meyer, Perini *et al.*, Nature Comm. **10**, 3823 (2019)
[2] Bessarab *et al.*, Sci. Rep. **8**, 3433 (2018)
[3] von Malottki *et al.*, Phys. Rev. B **99**, 060409 (2019)