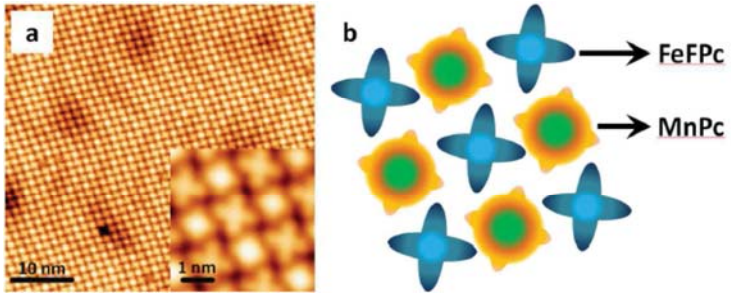


SLS Symposium on

Magnetism

Tuesday, October 6th, 2015

10:00 to 11:45, WBGB/019

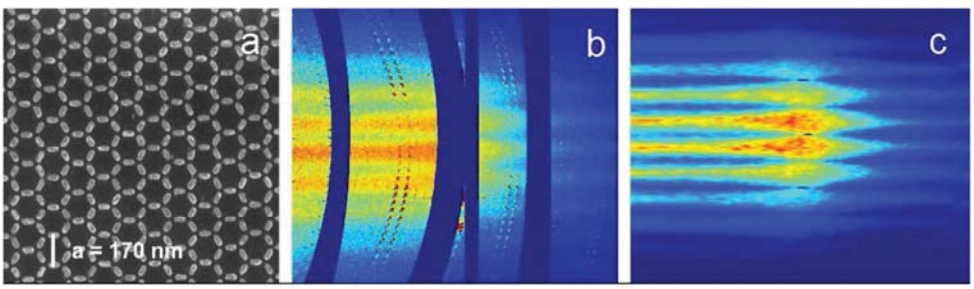
CANCELLED **X-ray magnetic scattering in thermally active artificial spin ice**
O. Sendetskyi, L. Anghinolfi, V. Scagnoli, A. Alberca, G. Möller, J. Perron, N. Leo, N. Jaouen, J. Kohlbrecher, U. Staub, J. Lüning and L. J. Heyderman

10:00 Magnetic interactions at metal-organic interfaces
J. Nowakowski, J. Girovsky, M. Baljozovic, C. Wäckerlin, S.-X. Liu, K. Tarafder, H. Rossmann, F. Ravani, A. Kleibert, P. M. Oppeneer, S. Decurtins, N. Ballav and T. A. Jung

10:30 Soft-x-ray ARPES investigation of Chromium dioxide: more insight into the electronic correlation
F. Bisti, V. A. Rogalev, S. Paul, A. Gupta, G. Güntherodt, G. Profeta, V. N. Strocov

11:00 Coffee

11:15 Strain-based control of multiferroic behaviors in o-REMnO$_3$ films revealed by resonant and off-resonant X-ray diffraction
Y. W. Windsor



X-ray magnetic scattering in thermally active artificial spin ice

Sendetskyi O.[1,2], Anghinolfi L.[1,2], Scagnoli V.[1,2], Alberca A.[2], Möller G.[3], Perron J.[4], Leo N.[1,2], Jaouen N.[5], Kohlbrecher J.[2], Staub U.[2], Lüning J.[4] and Heyderman L. J.[1,2]

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Artificial spin systems consist of mesoscopic single domain magnetic islands typically arranged on a two-dimensional lattice and coupled together via magnetostatic interactions. Such systems have attracted considerable interest due to their complex magnetic phase diagrams [1] and moment excitations which resemble emergent magnetic monopoles [2, 3]. Here, we apply X-ray Resonant Magnetic Scattering (XRMS) to look at zero-field magnetic correlations in thermally active artificial kagome spin ice with sub-70 nm islands, see fig. 1a. The energy of circularly polarized X-rays was tuned to the Fe L_3 absorption edge, yielding sensitivity to the magnetisation. Magnetic diffuse scattering was observed at zero-field and room temperature in a thermally active kagome array (fig. 1b). Experimental data can be understood using Monte Carlo simulations and subsequent numerical calculation of scattering patterns using kinematic scattering theory [4, 5], see fig. 1c. Magnetic diffuse scattering indicates zero-field spin ice correlations of the kagome ice phase with “two moments in – one moment out" and vice versa at each vertex. They are reminiscent to the field-induced correlations in atomic spin ice that produce magnetic diffuse scattering with pinch points or bow ties [6, 7]. Preliminary results obtained from the measurements at RESOXS endstation of the SIM beamline at the SLS will be presented.

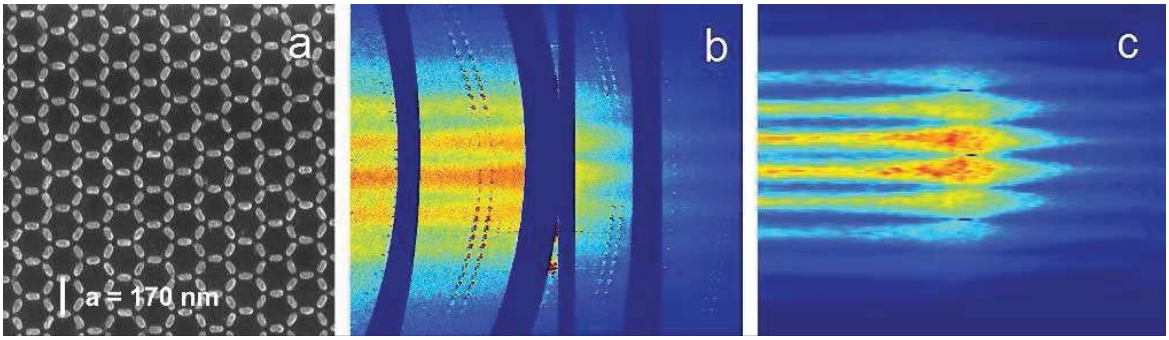

Figure 1: (a) SEM image of the artificial kagome spin ice with sub-70 nm islands. (b) Experimental scattering pattern from artificial kagome spin ice obtained at Fe L_3 edge. (c) Numerical calculation of the magnetic scattering pattern using moment configurations from Monte Carlo simulations. Magnetic scattering is well reproduced indicating a zero-field kagome spin ice magnetic phase.

References

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[2] - S. Ladak et al., *Nature Physics*, **6**, 359, (2010)
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Magnetic interactions at metal-organic interfaces

Jan Nowakowski,[a] Jan Girovsky,[a] Milos Baljozovic,[a] Christian Wäckerlin,[a] Shi-Xia Liu,[b] Kartick Tarafder,[d] Harald Rossmann,[a] Foteini Ravani,[a] Armin Kleibert,[c] Peter M. Oppeneer,[d] Silvio Decurtins,[b] Nirmalya Ballav[e] and Thomas A. Jung[a]

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Self-assembly and reactions at surfaces provide a powerful means to design and manufacture surfaces and interfaces with specific molecular, electronic and spin architectures. The focus of this talk is put on the investigation of spin systems and their specific interactions with the environment by combined X-ray Magnetic Circular Dichroism (XMCD) and local-probe measurements.
Metal-organic molecules (e.g. MTPP, MPc) can be magnetically coupled to a ferromagnetic substrate [1], and this interaction can be tuned/switched using various approaches [2-3]. All previous studies, however, reported exclusively ferromagnetic ordering between the paramagnetic molecules and bare ferromagnetic substrates. Here, we report an unexpected antiferromagnetic coupling of CrTPP molecules to a ferromagnetic Co substrate [4]. Studying magnetic properties of paramagnetic molecules does not always require a ferromagnetic substrate or a strong magnetic field, as the magnetic coupling between paramagnetic molecules can be mediated via a non-magnetic substrate. By creating a supramolecular chessboard-like assembly of two metalorganic molecules with different metal centers (Mn and Fe) we were able to create a 2D ferrimagnet in which molecules are coupled via intermolecular RKKY-type interactions [5]. These cases demonstrate how the investigation of specific sample architectures by design provides insight into the interplay of different fundamental interactions at surfaces and interfaces.

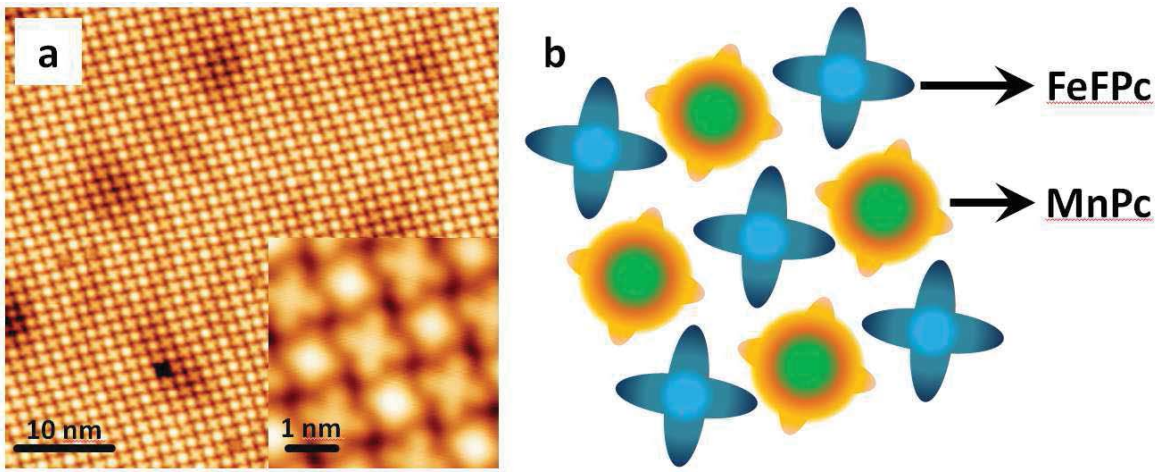

Figure 1 (a) STM micrograph of the chessboard-like assembly of FeFPc and MnPc molecules on a Au(111) substrate as well as (b) a model of the molecular chessboard.

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Soft-x-ray ARPES investigation of Chromium dioxide: more insight into the electronic correlation

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In a group of mostly antiferromagnetic insulating 3d transition-metal oxides, the chromium dioxide (CrO_2) is the only one presenting a metal ferromagnetic phase with fully spin-polarized conduction electrons (resulting in so-called "half-metallic" behavior). One of the most controversial issues about this material is the role of the electron correlation. Indeed, the introduction of an on-site Coulomb correlation term (U) in the density functional theory (DFT) calculations has found positive and negative supporting arguments in experimental studies [1].

In this context the favored experimental technique would be the angle-resolved photoemission spectroscopy (ARPES). However the CrO_2 surface is metastable at normal condition, and immediately after the synthesis becomes covered by an amorphous insulating film of antiferromagnetic Cr_2O_3. Therefore, its band structure is not accessible to ARPES technique in the usual, and mostly common, photon-energy range (20-200 eV).

In this talk, we present how the larger probing depth of soft-X-ray ARPES [2] can finally reveal the band structure of the CrO_2. The obtained Fermi surface and band dispersion along main reciprocal space direction have been used as a benchmark for different DFT calculations. Interference effects from the ARPES matrix element complicate the comparison, requiring to unfold the calculated band structure beyond the translation symmetry limit. The Fermi surface results to be appropriately described under generalized gradient approximation (GGA). On the other hand, improvements in the description of the less dispersive (and thus stronger correlated) fully-occupied bands can be obtained using the U value as a fitting parameter, for getting the best agreement.

References

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