O 19: Poster Surface Magnetism

Time: Monday 18:00–20:00 Location: P2

O 19.1 Mon 18:00 P2

Studying Higher-Order Interaction Driven Non-Coplanar Spin Structures Using SP-STM — •Arved Heilmann, Roland Wiesendanger, and Kirsten von Bergmann — Universität Hamburg, Germany

Complex magnetic order arises from competing interactions between magnetic moments. Higher-order interactions (HOI), involving more than two spins, can lead to three-dimensional magnetic configurations known as multi-Q states. Spin-polarized scanning tunneling microscopy (SP-STM) is a powerful tool for studying these systems, enabling real-space imaging of atomic-scale magnetic structures. HOI-driven hexagonal 3Q states have been observed at the atomic and nanoscale in Rh/Mn/Re(0001) and Fe/Rh/Ir(111), respectively [1,2].

To identify further HOI-driven magnetic states, we investigate other systems with Mn/Rh and Fe/Rh interfaces grown on Re(0001). Our findings reveal distinct spin structures that depend on the layer sequence of the pseudomorphic layers. Mn monolayers grown on single or double Rh layers form the Néel state, while Mn grown directly onto the substrate exhibits a non-coplanar 3Q state [3]. For Fe, deposition on two Rh layers results in a distorted quasi-hexagonal magnetic lattice, contrasting with the substrate's ideal hexagonal symmetry. This two-dimensional modulation of the spin texture suggests it also arises from HOI.

[1] F. Nickel, et al., Phys. Rev. B **108**, L180411 (2023).
[2] M. Gutzeit, et al., Nat. Commun. **13**, 5764 (2022).
[3] J. Spethmann, et al, Phys. Rev. Lett. **124**, 227203 (2020).

O 19.2 Mon 18:00 P2

Design of a STM/ nc-AFM head to quantify the magnetic exchange interaction between individual atoms — •Karoline Oetker, Zhengyuan Liu, Henning von Allwörden, Alexander A. Khajetoorians, and Nadine Hauptmann — IMM, Radboud University, Nijmegen, The Netherlands

STM methods are highly powerful tools to quantify the magnetic coupling between single adatoms and with the atom at the tip [1,2]. These current-based methods prohibit to probe the atomic-scale magnetic properties of adatoms on thick insulating layers. However, it was shown that thicker insulating layers with a 4-fold symmetry, as MgO, can prohibit single-electron induced ground state transitions and only allow higher-order excitation processes, which stabilizes the magnetic moment of the adatom [3]. Therefore, a force-based method, such as magnetic exchange force microscopy (MExFM), is a promising tool to quantify the different magnetic coupling mechanisms between individual adatoms on thick insulating layers. We present the design of a 1K STM/nc-AFM setup dedicated for MExFM measurements in magnetic fields up to 9T, based on the tuning fork design. Our goal is to quantify the different distance-dependent magnetic interactions between different magnetic atoms, e.g. 3d and 4f elements. We will utilize functionalized tips with different magnetic atoms, to probe the distance-dependent magnetic exchange force between the tip and adatoms on thick insulating layers. 1.Meier, F. et al., Science 320, 82-86 (2008), 2. Baumann, S. et al., Science 350, 417-420 (2015). 3.Donati, F. et al., Science 352, 318-321 (2016).