Establishment of a correlated ferromagnetic glass in Co thin films interfaced with molecules

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Hybrid interfaces composed of ferromagnetic materials and organic molecules are a powerful tool for the engineering of magnetic properties of both constituents. A key ingredient in this interfacial engineering in transition ferromagnetic (FM) materials is the hybridization of the molecular π-orbitals with the metallic d-orbitals, leading to major modifications of the magnetic parameters such as magnetic anisotropy, local magnetic moment, etc. [1-3]

In this work we show that such hybrid interface can strongly modify a few nm thick Co layers, causing the collapse of the domain structure and the establishment of a Correlated Ferromagnetic Glass (CFG) state [4]. This state is characterized by a colossal magnetic hardening detected in cobalt films interfaced with different molecular species, such as Fullerene C_{60}, Gallium-Quinoline Gaq_3, sexithiophene T6 and others, where with respect to reference Co samples, a considerable, molecule-dependent hardening was observed [4,5], reaching at least a factor 10 increase in the T range 100-150 K (see **Fig. 1 a**). Intriguingly the CFG exhibits an unusual magnetization dynamic, violating the Rayleigh-law-derived standard domain nucleation and motion [6].

These unusual features are well explained and fitted by a joint DFT-micromagnetic model, showing that molecular adsorption results in the establishment of an additional, local in-plane anisotropy K_R, randomly oriented but correlated over distances (r_c) comparable to the domain wall width (Δ). The magnetic structure then moves from domain-like (**Fig. 1b**) to glassy-like (**Fig. 1c**) mode, with no sharp distinction between domains and domain walls. The model also predicts the presence of vortex structures with out-of-plane component (**Fig. 1d**), successfully observed by MFM imaging at RT [4].

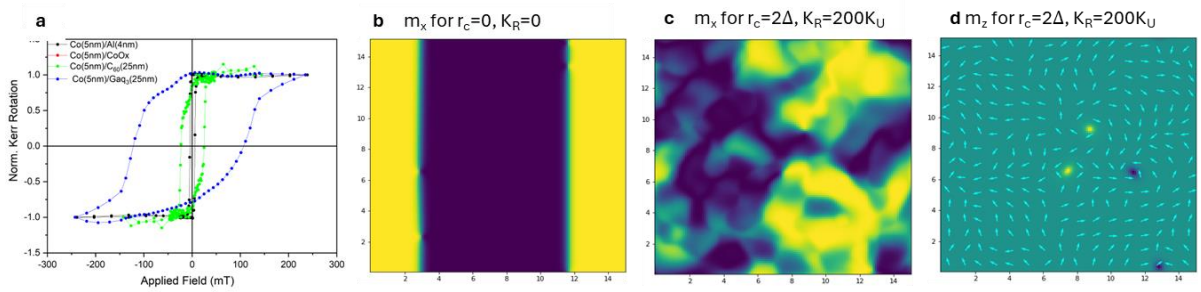

Fig. 1. a hysteresis loops at 150 K for Co/Al, Co/CoOx, Co/C_{60} and Co/Gaq_3. **b** 2D map of the in-plane m_x component without and with (**c**) K_R. In this case (**d**) the magnetic configuration presents vortex structures with non-zero values of m_z,

References

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