Hybrid Spinterfaces for Organic Antiferromagnetic Spintronics

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Spinterfaces, i.e. interfaces between an organic semiconductor (OS) and a ferromagnetic (FM) substrate, have been raising an ever-increasing interest in the last two decades, first through the realization of organic spintronics prototypical devices, then by showing new intriguing phenomena related to the formation of hybridized interface states (HIS) [1]. As a promising development of the spinterface approach within the rapidly developing fields of Antiferromagnetic (AF) Spintronics and AF Magnonics [2], we have been extending those concepts to OS/AF interfaces, with the aim of creating a novel form of transducer between electromagnetic radiation (visible and near-IR) and spin waves (SW), based on the magnetic character of the HIS at the AF spinterface. It is well-known that AF materials are particularly suited as propagating media for SW at THz frequencies, while the light-induced perturbation of the magnetic moment associated to the HIS would allow for an electrode-free excitation of the nearby AF moments, otherwise hardly accessible by external stimuli. These ideas are under development in the ongoing EU-FET project SINFONIA [3], during which we have been investigating different combinations of AF oxides, in particular Cr2O3, NiO and CoO (grown on different substrates), with suitable molecular materials. The latter include several different organic molecules, ranging from well-known ones like C60 and Pentacene, to more complex compounds, such as Metal-Tetra Phenyl Porphyrins (MTPP; e.g., CoTPP) and Metal Phthalocyanines (MPc; e.g., FePc) [4], both of which are ideal candidates for building spinterfaces, since their ion core can have its own magnetic moment, due to the presence of unpaired spins [4,5].Here, we are going to present in the concept of our project and a series of results related to the growth and characterization (including crystalline, morphologic, and electronic properties) of the mentioned AF oxides and of related spinterfaces. An example of the surface morphology of a molecular 2D layer of CoTPP on FeO/Fe is reported in the Figure. Concerning magnetism at the spinterfaces, by X-ray Magnetic Circular Dichroism we were recently able to show the long-range ordering of molecules in specific cases. The understanding of such observations is also supported by computational results based on first-principle theoretical approaches, which have been performed for selected AF spinterfaces [6].

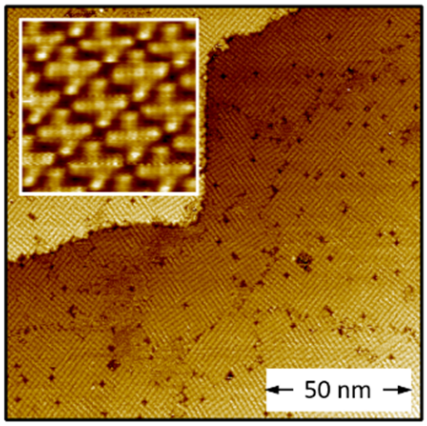

Figure 1. STM image of 1 ML CoTPP on Fe(001)-p(1x1)O. Inset: high resolution scan 5.3x5.3 nm2.

References

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