Exploring the Magnetism of Molecules at the Nanoscale using Synchrotron and Scanning Probes-Based Techniques

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The next generations of devices for spintronics[1,2] and quantum computing[3,4] will be based on molecular and inorganic nanostructures with peculiar magnetic properties. The development of these devices requires the know-how to properly assemble each building blocks and, primarily, to control the magnetism of these objects at the nanoscale. It is thus fundamental to adopt specific characterization tools featuring the required sensitivity to study these materials at the nanoscale and to make correlations between the observed behavior and the chemical nature and structural arrangement of each component in the hybrid architectures.

An overview of this approach and recent results obtained on molecular systems will be provided evidencing how X-ray circular magnetic dichroism (XMCD) experiments and oter spectroscopic tools based on large scale facilites may lead to fundamental steps forward in this demanding exploration by directly accessing to static and dynamic magnetic properties ultra-thin deposits of molecular layers[5] as well as to carefully evaluate the role of different substrates that may alter also the behavior of the molecular species. In parallel scanning probe microscopies operated analogously at cryogenic temperatures may allow to explore the individual nanostructures constituted by single molecules and arrays of molecules. The comparison and the combination of XMCD results achieved on a large area with the local properties extracted from the analysis of the data achieved using Inelastic Energy Tunneling Spectroscopy (IETS)-STM[6,7] and Magnetic Force Microscopy (MFM)[8] can now pave the way for prototyping hybrid nanodevices embedding these objects with an increased knowledge of their magnetism.

References

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