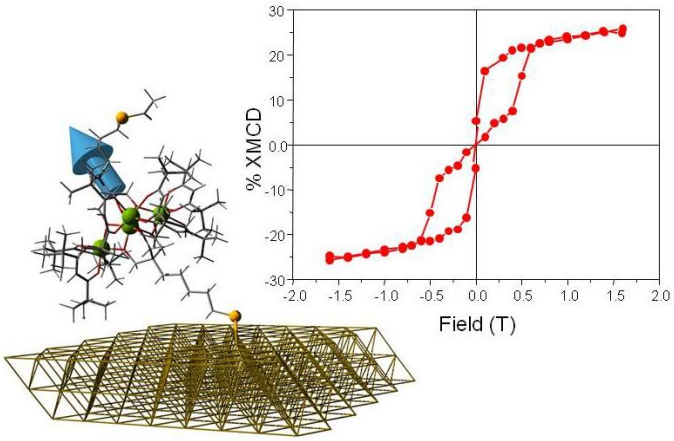
Magnetism of molecules at the nanoscale

M. Mannini,[1] A. Cornia,[2] Ph. Sainctavit,[3] and R. Sessoli[1]

[1] Laboratory of Molecular Magnetism (LA.M.M), ERC Advanced Research Laboratory "MolNanoMaS", Dipartimento di Chimica,Univeristà di Firenze & INSTM RU, Sesto Fiorentino (FI) Italy;
[2] Dipartimento di Chimica, Università di Modena e Reggio Emilia & INSTM RU, Modena, Italy;
[3] IMPMC-CNRS, Université Pierre et Marie Curie, France.
e-mail: matteo.mannini@unifi.it

A special class of molecules that behaves as tiny magnets have been discovered as the first example of hybrid classical-quantum magnetic objects [1]. Single Molecule Magnets (SMMs) are currently studied by chemist, physicist and material scientist for the development of future devices for data storage and molecular spintronics [2]. One of the most challenging tasks in this field is that of directly addressing individual molecule in order to exploit their small size to increase the density of the information as well as to access to the quantistic features of SMM. The simplest proposed architecture to study and to manipulate single molecule consists in the assembling of (sub)monolayers of SMMs on surfaces and addressing them with the tip of a Scanning Probe Microscope.[3]

In this talk we will describe the multidisciplinary approach adopted by our team [4] to assemble on surface chemically-modified SMMs clusters and to study their magnetic properties by X-Ray Circular Dichroism (XMCD), a synchrotron-based experiment carried out with an advanced setup working in extreme condition of temperature and magnetic fields [5]. Using this approach, for the first time it has been possible to observe the memory effect of a single layer of magnetic molecules[6] and occurrence of the resonant quantum tunneling effect at the nanoscale.[7] These results suggest the approach that must be pursued to further develop molecular magnetism toward a real use single molecules for technological purposes.



[1] D. Gatteschi, R. Sessoli and J. Villain *Molecular Nanomagnets* (Oxford University Press, Oxford, 2006).
[2] L. Bogani and W. Wernsdorfer *Nat. Mater.* 7 (2008) 179.
[3] D. Gatteschi, A. Cornia, M. Mannini, R. Sessoli *Inorg. Chem.* 48 (2009) 3408.
[4] A. Cornia, M. Mannini, Ph. Sainctavit, R. Sessoli *Chem. Soc. Rev.* (2011) in press.
[5] Ph. Sainctavit and J.-P. Kappler, *X-ray magnetic circular dichroism at low temperature* (Springer, Berlin, 2000).
[6] M. Mannini, F. Pineider, Ph. Sainctavit, C. Danieli, E. Otero, C. Sciancalepore, A. M. Talarico, M.-A. Arrio, A. Cornia, D. Gatteschi, R. Sessoli *Nat. Mater.* 8 (2009) 194.
[7] M. Mannini, F. Pineider, C. Danieli, F. Totti, L. Sorace, Ph. Sainctavit, M.-A. Arrio, E. Otero, L. Joly, J. Criginski Cesar, A. Cornia, R. Sessoli *Nature* 468 (2010) 417.