Entanglement of single molecule magnets via radical spins

Single molecule magnets (SMMs), made of metal ions stabilized by appropriate ligands, participate in promising strategies of encoding information. Arguments in favor of SMMs as building blocks for quantum computing are based on the possibility of synthesizing billions of perfectly identical units that can be integrated in devices by a bottom-up approach. The ability to assemble weakly interacting single molecule magnets (SMMs) is a prerequisite for implementing quantum information processing through controlled entanglement. The mastering of such qubit interactions by appropriate linkers and the addressing of individual molecules by means of an STM tip necessitates a perfect control of the geometrical arrangement of elemental qubits.

Recently we have investigated the terbium bis-phthalocyonato complex ($TbPc_2$), which contains two spin systems: a central J=6 high-spin with an intrinsic anisotropy arising from the Tb^{3+} 4f-electrons and a S=1/2 pi-radical due to a singly occupied orbital that is delocalized over the two Pc ligands. In a recent work, it was shown that the conjugated pi-system of the Pc-ligands could be used as a read-out quantum dot of the nuclear spin information, evidencing the link between the two spin systems [1]. The present project therefore aims at studying the technically relevant interaction of surface confined SMMs via the overlap of the pi-orbitals of their ligands. The training will consist in the positioning and addressing the SMMs by STM. In particular, we will investigate the singly occupied orbital of the Pc ligands, which manifests itself by the experimental observation of a zero bias peak in the dI/dV above the molecule.

[1] S. Thiele et al. Science 344, 1135 (2014).

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