Supramolecular spin valve based on terbium nanomagnets and carbone nanotube

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Molecular quantum spintronics is an emergent field linking the principles of spintronics, molecular electronics and quantum information processing. On the one hand, molecular nanomagnets (MNM) are promising candidates for single spin experiments due to their exciting properties [1]. On the other hand, carbone nanotube quantum dots (QD) are very interesting platforms to deal with spins, notably because its very long spin coherence length. We developed an original device geometry based on a three terminal carbone nanotube QD, laterally coupled to several MNMs [2] through supramolecular interactions. The latters act on the conduction electron through the QD as spin polarizer and analyzer. This spin-valve effect gives access to the behavior of a single localized spin by standard electrometry. Here we report a full characterization of a single Terbium molecule at low temperature (40mK). In particular, we show for the first time stochastic tunneling between entangled electronic and nuclear spin states [3]. [1]

[1][1] Wernsdorfer, W. and Sessoli, R. Science 284, 133-135 (1999) [2] Bogani L. and Wernsdorfer W. Nature Mat. 7, 179 - 186 (2008) [3] M. Urdampilleta, J.-P. Cleuziou, S. Klyatskaya, M. Ruben, W. Wernsdorfer, to be published in Nature Materials