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Spin transistors based on single-molecule magnets

Individual magnetic molecules embedded into electric circuits are envisaged as functional components in the emerging field of molecular spintronics. Single-molecule magnets (SMM), with high spin and high magnetic anisotropy are interesting candidates.
We study three-terminal charge transport through individual Fe4 SMM. In these transistors, an Fe4 molecule is linked to two gold electrodes fabricated by self-breaking electromigration of a gold nanowire [1]. A third gate electrode is used to access different redox states of the molecule.
The measurements reveal that the magnetic properties of the molecule are preserved and can be reversibly modified by adding a single electron into the molecule [2,3]. Interestingly, we observe that the current through the molecule can be significantly tuned by the presence of small transverse magnetic anisotropy perturbations [4] and individual vibrational modes of the molecule [5]. These two properties are of special relevance to use SMM as memory elements or qbits and opens the door to study quantum properties of the SMM such as quantum tunnelling and quantum interferences at the single molecule level.
As a further step in the control of individual molecular spins, we work on ferromagnetic-functionalized graphene electrodes to inject spin-polarized currents into magnetic molecules.
[1] H. Park et al., Appl. Phys, Lett., 1999, 75, 301; K. O'Neil et al., Appl. Phys. Lett. 2007, 90, 133109. [2] E. Burzurí et al, Phys. Rev. Lett, 2012, 109, 14203. [3] E. Burzurí et al, J. Phys.: Condens. Matter., 2015, 27, 113202 [4] M. Misiorny, E. Burzuri et al, Phys. Rev. B. 2015, 91, 035442. [5] E. Burzuri et al, Nano Lett, 2014, 14, 3191.

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