Single molecular spintronics: spin transport through a single molecule by means of spin-polarized STM

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Abstract

Exploring spin-polarized transport characteristics of single molecules is a promising direction of research with an outlook for potential application in future nano-scale electronic devices the functionality of which will employ not only charge but also the electron's spin. As the first step towards this goal, we present giant magneto-resistance (GMR) measurements of single hydrogen phthalocyanine (H_2Pc) molecules contacted by two ferromagnetic electrodes. Using a spin-polarized scanning tunnelling microscopy (STM) at 4K, single molecules were addressed and their conductance in dependence of the magnetization of the electrodes was measured. Magnetic Co nano-islands on Cu(111) and Co coated W tips were used as ferromagnetic electrodes to make a Co/H_2Pc/Co single molecular junction. A GMR of +60% was observed [1]. Layerwise antiferromagnetic Mn(001) thin films and Fe coated W tips were used as antiferromagnetic and ferromagnetic electrodes, respectively, to make a Mn/H_2Pc/Fe single molecular junction. A GMR of -50% was observed [2]. Strong hybridization between 3d spin-polarized states and molecular π-orbitals is the origin of magnetoresistance [3,4]. Details will be shown.

References:

[1] Nature Nanotechnology, 6, 185-189 (2011).
[2] Nano Letters, 12, 5131-5136 (2012).
[3] Nanotechnology, 24 395704 (2013).
[4] Jap. J. Appl. Phys, 52 110115 (2013).