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Information encoding and energy harvesting using the ferromagnetic metal /molecule interface in quantum spintronic vertical nanodevices

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Abstract:

Molecular spintronics is emerging as a vibrant field that utilizes the properties of magnetic molecules toward additional device functionalities that can exploit quantum physics. One spectacular property is the high spin polarization of the ferromagnetic metal/molecule interface, measured at 300K using spectroscopy [1] and magnetotransport [2] experiments.

The magnetism of this so-called spinterface [3] can be controlled using an underlying ferroelectric [4], and can in principle be combined with a molecular function (e.g. spin crossover) by inserting a noble metal spacer layer [5,6] (see Weber talk). The spinterface formation entails changes to the magnetic properties of the interface constituents, from magnetic hardening of the metal [7] to the magnetic stabilization of otherwise paramagnetic molecular spin chains borne by phthalocyanine (Pc) molecules [8]. These effects enable the encoding of information into the quantum state of a molecular spin chain within vertical solid-state nanojunctions[9]. This constitutes a promising applicative implementation of first results on STM-assembled and laterally-assembled model junctions [10].

The interaction between the spinterface and a molecular spin chain also lays the groundwork for a molecular implementation [11] of our recent proposal [2] (www.spinengine.tech) to harvest the energy of thermal fluctuations on paramagnetic centers using spintronics and quantum thermodynamics. The observed output power, and industrial maturity of spintronics, suggest[2] that this technology could be very competitive relative to the harvesting of other natural (e.g. solar cells) and artificial (e.g. wifi/GSM).

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