TUNNEL MAGNETORESISTANCE OF AN ORGANIC MOLECULE JUNCTION

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Coherent spin-dependent electronic transport is investigated in a molecular junction made of organic molecule (linear chain of benzene rings) attached to two the semi-infinite ferromagnetic (FM) electrodes with finite cross sections (Fig. 1). The work is based on the tight-binding Hamiltonian model and within the framework of a non-equilibrium Green's function (NEGF) technique. It is shown that tunnel magnetoresistance (TMR) of molecular junction can be large (over 60 %) by adjusting the related parameters, and depends on: (i) the applied voltages and (ii) the number of benzene rings.

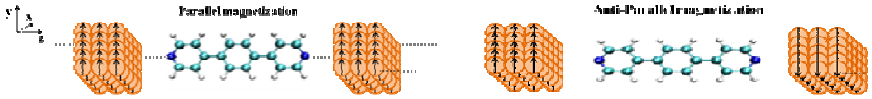

Fig. 1. A schematic representation of the FM/organic molecule/FM molecular junction in two configurations Parallel (P) and Anti-Parallel (AP) magnetization.

Hamiltonian for the system of two ferromagnetic electrodes joined by an organic molecule is proposed in the following form:

$$H = \sum_{i_\alpha,\sigma\in L,R} (\varepsilon_i - \sigma.h_\alpha) c^+_{i_\alpha,\sigma} c_{i_\alpha,\sigma} - \sum_{(i_\alpha,j_\alpha),\sigma} t_{i_\alpha,j_\alpha} c^+_{i_\alpha,\sigma} c_{i_\alpha,\sigma} + \sum_{\substack{i_\alpha,\sigma\in L,R \\ m,\sigma\in M}} (t_{i_\alpha\sigma,m\sigma} c^+_{i_\alpha,\sigma} c_{m,\sigma} + h.c.) + H_M ,$$

Hamiltonian for the molecular (H_M) is:

$$H_M = \sum_{m,\sigma\in M} \varepsilon_{m,\sigma} c^+_{m,\sigma} c_{m,\sigma} + \sum_{m,\sigma\in M} (t_{m,m+1} c^+_{m,\sigma} c_{m+1,\sigma} + h.c.),$$

The spin dependent Green's function is given as:

$$G_\sigma(\varepsilon,V) = \lim_{\zeta\to\infty} [(\varepsilon + i\zeta)I - H_M - \Sigma_{L,\sigma}(\varepsilon - eV/2) - \Sigma_{R,\sigma}(\varepsilon + eV/2)]^{-1},$$

where the self-energy matrices contain the information of the electronic structure of the FM electrodes and their coupling to the organic molecule[1].

References

[1] A. Yoshihiro and F. Hidetoshi, Phys. Rev. B 72 (2005) 085431.