Spin Transport and Spin Rectification in Organic Molecular Devices

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We investigate the spin polarization transport in a metal/organic ferromagnet/metal molecular device and spin current rectification in a metal/magnetic-nonmagnetic/metal one with the spin-dependent Landauer-Büttiker formula. A large spin-polarized current is predicted due to the existence of spin-density wave (SDW) in the ferromagnetic molecule, which is dependent upon the property of the organic ferromagnetic interlayer as well as the interfacial interactions between the metal electrode and the organic molecule. By reversing the applied electric bias, it is found that the charge current and spin current may be rectified at the same time or separately with the spatial symmetry of the molecular structure. The spin rectification is discussed in detail. Also it is obtained that both the charge and spin currents will be modulated when the SDW is excited. Total current through the device is suppressed by the spin excitation of the molecule, through which a conductance switch function may be realized. Finally, Thermal effect on the spin transport and spin rectification is studied and we conclude that an organic ferromagnetic device can hold a high spin polarization when temperature is not too high.

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