Modulation of the Spin Conductance in a Magnetic Superlattice

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We study the spin miniband structure and the ballistic spin-polarized transport of a magnetic superlattice [1], formed by inhomogeneous magnetic field in a semiconductor nanowire. Based on the transfer matrix theory and Bloch's theorem, we calculate the energy dispersion having spin-minibands and spin-minigaps due to Bloch periodicity and spin-dependent ballistic conductance [2] for various geometrical and physical parameters. Results show that full spin-polarization in the ballistic conductance of the system occurs clearly for each spin, and that the fully spin-polarized range for each spin can be enhanced by modulation of geometrical and physical parameters. For a spin device application of a magnetic superlattice, we also investigate the optimal condition to get a fully spin-polarized current with sizable ballistic conductance. We obtain such a condition by analyzing energy miniband dispersion and a spin dependent transmission probability for each channel. From the results, we propose an optimized aspect ratio of size parameters of a quasi-one dimensional magnetic superlattice as a spin filter to generate currents having simultaneous full spin-polarization and sizable ballistic conductance.

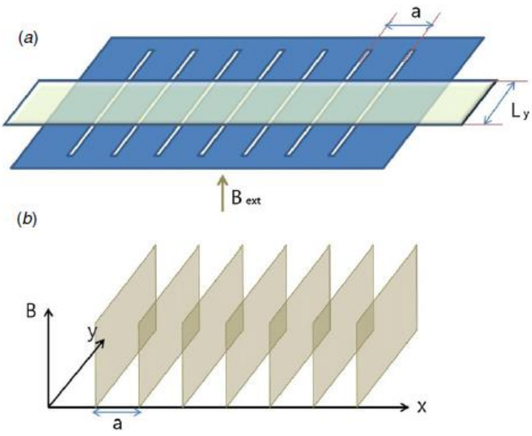

Figure 1. (*a*) Schematic diagram of the spin filter. A quasi-one-dimensional wire is placed on the top of a gridded superconducting mask. *a* is the grid spacing, i.e. the lattice constant and L_y is the width of the wire. External magnetic field is applied. (*b*) Periodic magnetic field profile, applied to the wire.

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