Controlling the Spin Conductance in a Graphene Zigzag Hexagonal Quantum Ring Connected to Three Leads in the Presence of the Spin-Orbit Interaction and a Magnetic Field

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Abstract

In this work, we theoretically investigate the spin-dependent conductance and polarization in a hexagonal graphene ring (HGR) with zigzag edges connected to three semi-infinite leads in the presence of a perpendicular magnetic flux and Rashba spin-orbit interaction (RSOI). The results are obtained using the tight-binding model within the non-equilibrium Green's function formalism, and they suggest that in the absence of magnetic flux, for appropriate values of the Rashba strength and the energy of the incoming electrons, high spin-polarized conductances with the opposite direction can be obtained for right-up and right-down leads, respectively. In this case, the system can act as a spin-splitting device. In addition, it is found that by applying a magnetic flux to the central region of the HGR, it is possible to determine the magnitude and direction of the polarization in output leads due to the time reversal breaking, so the system can be considered as a good candidate for the spintronic applications.

Keywords: graphene quantum rings, Green's function formalism, spin polarization, spintronic

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