Spin-Polarized Electrons in Bilayer Graphene Flakes

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In the last years, there has been much interest in exploring the unique properties of nanostructures for spintronic devices [1]. To this end, novel ways of generating and detecting spin-polarized currents have been explored. For instance, *Song et al.* [2] described how a spin filter might be achieved in open systems by exploiting the Fano-like resonances occurring in their transmission characteristics. The idea is to tune the system so that a transmission resonance for one spin channel coincides with an antiresonance for the opposite spin. In this way, a spin-polarized current arises.

Previous works have shown that graphene bilayer flakes exhibit Fano antiresonances in the transmission [3]. In this context, in this work we propose to exploit these antiresonances to produce spin-polarized currents in a graphene-based system by putting graphene bilayer flakes in contact with a magnetic insulator, such as EuO [4]. Exchange splitting is induced in the graphene flake due to the magnetic proximity effect [5]. This produces an opposite energy shift in the spin-up and down antiresonances in the conductance, yielding a spin polarization of the current. The feasibility of spin-polarized currents in graphene devices is important for the development of all-graphene electronics, which is one of the goals in the research.

We have describes the considered system by using a one-orbital tight-binding model, which we solve analytically within the single-mode approximation. We obtain an analytical solution for the spin-dependent transmission through bilayer graphene flakes. The comparison of this analytical result to the numerically computed transmission, obtained by a recursive Green function method, is excellent in the one-mode energy range. The analytical expression for the transmission allows us to explore thoroughly the parameter space, locating the most advantageous system sizes to obtain a net spin current.We have found that the maximum spin polarization is obtained when sharp antiresonances are produced in a plateau with maximum transmission. These correspond to quasi-localized states in the bilayer graphene flake. Thus, the tuning of the flake length is important to obtain a net spin current [6].

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