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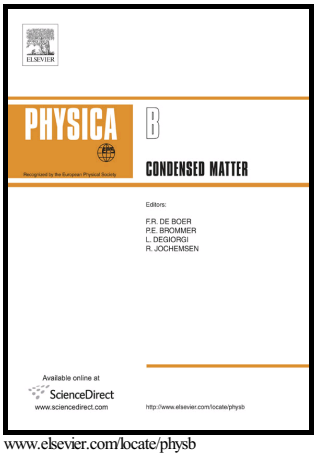

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The role of Rashba spin-orbit coupling in valley-dependent transport of Dirac fermions

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Abstract:

At this work, spin- and valley-dependent electron transport through graphene and silicene layers are studied in the presence of Rashba spin- orbit coupling. We find that the transport properties of the related ferromagnetic/normal/ferromagnetic structure depend on the relevant parameters. A fully valley- and spin- polarized current is obtained. As another result, Rashba spin-orbit interaction plays important role in controlling the transmission characteristics.

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Keywords: spin and valley-dependent transport, graphene, silicene, Rashba spin-orbit coupling, ferromagnetic tunnel junctions, magneto-resistance.

1. Introduction

Graphene has drained a great deal of interest from the fundamental and applied physics community [1-3]. It is a two-dimensional allotrope of carbon with honeycomb lattice in which the valence and conduction bands meet each other at Dirac points, K and K'. This zero gap semiconductor has many unique and fantastic properties such as half-integer quantum Hall effect [4, 6, 7], Klein tunneling [8-16] and minimum conductivity [5].

Controlling the spin-orbit interaction (SOI) plays a key role for application of graphene-based structures in spintronics [20-22]. Intrinsic SOI is weak in a free-standing graphene sheet [23] so we neglect it in this paper [41]. Rashba coupling (or extrinsic SOI) arises from the structural inversion asymmetry (SIA) of the system that is caused e.g. by applying gate voltage, curvature and substrate effects [24-26]. In order to induce ferromagnetic correlation in the thin layers like graphene and silicone a metallic ferromagnetic material is used as substrate [40].