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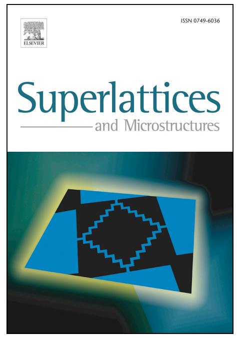

Fano factor for Dirac electrons in a supperlattice of normal/ferromagnetic/normal silicene junction

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Fano factor for Dirac electrons in a supperlattice of normal/ferromagnetic/normal silicene junction.

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Abstract

We investigate the electron transport in the presence of electric field and gate potential in a supperlattice of normal/ferromagnetic/normal silicene junction. We compute the total conductance and Fano factor using the transfer matrix method and Landauer-Buttiker formula. The total conductance and Fano factor of the silicene contain interesting information of the transport properties of the charge carriers. The dependence of the Fano factor behavior on the electric field strength, the gate potential, the thickness of the ferromagnetic region and more importantly the dependence on the number of barriers have been plotted. Our aim is to achieve a more accurate picture of the dependence of the Fano factor on parameters mentioned above. In this junction, Fano factor oscillates with the thickness of the ferromagnetic region, the electric field strength and the gate voltage in the ferromagnetic regions. Also we found that diffusive transport($F = 1/3$) occurs by taking large enough length of the ferromagnetic regions and tiny electric field strength. Another remarkable point is that Fano factor attains the full Poissonian value ($F = 1$), by controlling the electric field strength and the length of the ferromagnetic regions. We see that with remaining intact the conductance, we can change the transport from Poissonian to diffusive transport by controlling the length of the ferromagnetic regions. However, these findings occur exactly in the case of $\frac{\Delta_z}{E} = 0.5$ when the number of barriers is large enough. Moreover, with considering dependence of the Fano factor on the electrostatic potential and electric field strength, we have proved that these parameters are controllable parameters on the kind of transport. It is said that Fano factor is very sensitive to the mentioned parameters and can be controlled by these parameters. In fact, we show that the value of Fano factor is a valuable tool for distinguishing the behavior of transport whereas this kind of information cannot be extracted from the conductance.

Keywords: A. Silicene Superlattice, B. Landauer Buttiker formula, C. Transfer matrix method, D. Fano factor, E. Poisson Transport, F. Diffusive Transport.

Contents

1. INTRODUCTION

The electronic properties of the new-born two-dimensional material, silicene, is a very active research field in recent years. Silicene, a sheet of silicon atoms, has been synthesized recently[1].It is a suitable candidate for its potential applications in nano-electronic because it has a strong spin-orbit coupling (SOC) and adjustable band gap[2,3,4].Both first-principle and tight-binding calculations demonstrated that an energy gap as 1.55meVcould be induced in silicene[3,4,5]via SOC. Silicene is buckled[2];this feature stems from an electric field that is exerted perpendicular to the plane which results in on-site potential difference between the A and B sublattices. This picture distinguishes silicene from graphene and leads to extraordinary features in silicene[6,7,8,9,10,11].Various