Silicene-based spin filter device: Impact of random vacancies.

L. Rosales[1], C. D. Nuñez[1], P. A. Orellana[1], F. Domínguez-Adame[2], R. A. Römer[3]

[1] Departamento de Física, Universidad T. Federico Santa María, PO box 110V, Valparaíso, Chile,
[2] GSIC, Departamento de Física de Materiales, Universidad Complutense, E-28040 Madrid, Spain,
[3] Department of Physics and Center for Scientific Computing, University of Warwick, Coventry, CV4 7AL, United Kingdom.

luis.rosalesa@usm.cl

Abstract

In this work we propose a hybrid spin-filter device based on a silicene nanoribbon. A ferroelectric polymer grown on top of the nanoribbon splits spin-up and spin-down electron bands and gives rise to spin polarisation of the conductance. In particular, we study the effects of a random distribution of vacancies on the performance of this spin-filter device. Disorder induces Anderson localisation of electrons and we find that the localisation length strongly depends on the electron spin. By adjusting the Fermi level of the source contact, only electrons with one spin orientation can reach the drain contact because their localisation length is larger than the length of the device. Electrons with opposite spin are largely back reflected. Electric conductance then becomes spin polarised and the device behaves as a quasi-half-metal. We conclude that a moderate concentration of vacancies has little impact on the spin-filter capabilities of the device, opening the possibility to using it as a tuneable source of polarized electrons [1].

References

[1] C.D. Nunez, F. Domínguez-Adame, P.A. Orellana, L. Rosales, R. A. Römer, 2D Materials (2016), and All references therein.

Figures