Spin texture for graphene layer induced by proximity to Bi_2Se_3

Presenting Author Kenan Song[1]
Co-Authors David Soriano[1], Roberto Robles[1], Aron Cummings[1], Pablo Ordejón[1], Stephan Roche[1,2]
[1]Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC and The Barcelona Institute of Science and Technology, Campus UAB, Bellaterra, 08193 Barcelona, Spain
[2]ICREA, Institució Catalana de Recerca i Estudis Avançats, 08070 Barcelona, Spain
Contact@E-mail: kenan.song@icn2.cat

Abstract

Due to the effect of spin-momentum locking, topological insulators (TI) have attracted a lot of attention for their application to spintronic devices [1,2]. However, the spin lifetime for TIs is very short, which limits their applicability.[3] On the other hand, the spin lifetime in graphene can be quite large (more than 10 ns) [4] but graphene itself does not exhibit spin-momentum locking around the *Γ* point because of the weak spin-orbit coupling (SOC). Recent studies pointed out that proximity to a TI could enhance the SOC strength in graphene and produce a topologically-protected state which is similar to that in TIs [5,6].

In this work, one monolayer of graphene with a $\sqrt{3} \times \sqrt{3}$ supercell was laid on top of a slab of Bi_2Se_3 with a thickness of six quintuple layers in order to examine the electronic structure and the spin texture induced in graphene. From DFT simulations, it was found that the spin texture in the graphene layer is quite similar to that of pure Bi_2Se_3 in the higher energy windows (fig *a*. and *c*.); while those in lower energy window (fig *b*. and *d*.) is analogue of Rashba-type texture with some warping and relatively large out-of-plane components. This work could serve as a guideline to experimentally achieve a measurable spin-to-charge (or charge-to-spin) conversion in a graphene/TI heterostructure via the Edelstein (or inverse Edelstein) effect [7,8].

References
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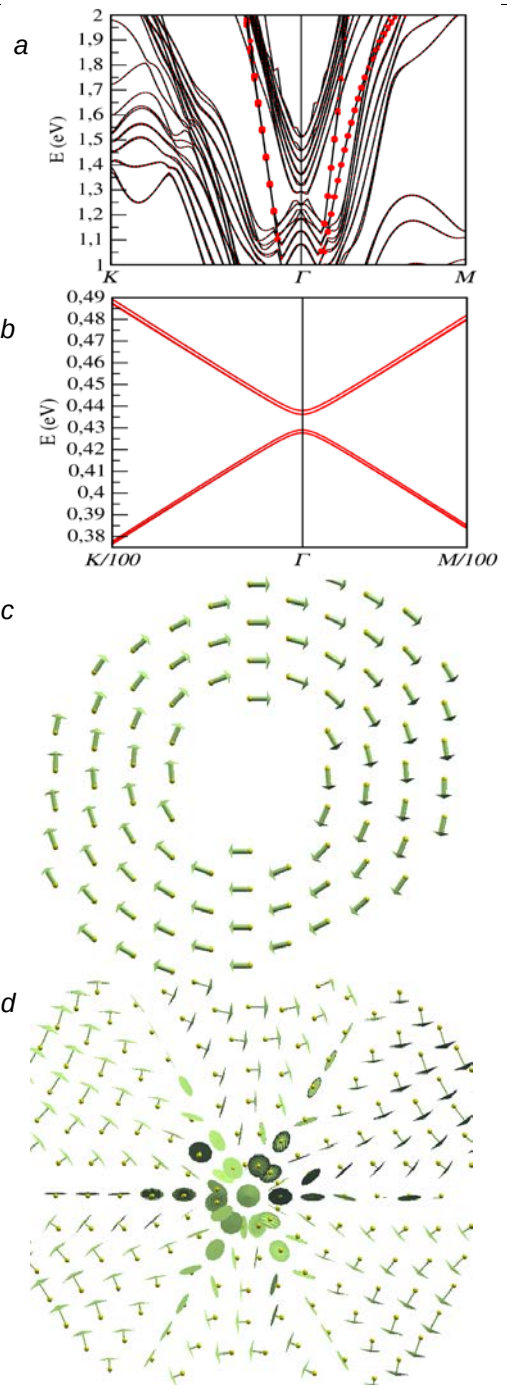

Electronic structure of the 6QLs Bi_2Se_3/graphene heterostructure. *a*, *b* – band structure and red color indicates the projection onto the graphene layer within different energy window; *c* and *d* – top view of spin texture corresponding to graphene band in *a* and *b* respectively.