

Electronic properties of Dirac materials: graphene/ Bi₂Se₃ systems

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Graphene is a representative of a new class of materials in which one dimension is reduced to a single layer – the so called two-dimensional materials (2D). However, what determines its uniqueness is related to its electronic structure. Graphene has a linear dispersion relation which causes that the charge carriers can be treated as massless Dirac fermions. Materials whose nontrivial properties emerge as a direct consequence of the Dirac spectrum have been called “Dirac Materials”. This group also includes topological insulators. A topological insulator is a material with trivial topological order that behaves as an insulator in its interior but whose edge or surface contains conducting states protected by symmetry. The presence of protected surface electronic states with linear dispersion relation allows for spin polarized charge transport without scattering as it is in the case of charge transport in graphene.

The results of investigations of electronic properties of hybrid Dirac materials based on graphene and topological insulators (Bi₂Se₃) will be presented, with particular emphasis on the phenomena occurring at nanoscale. These

findings will be compared with the results obtained using global techniques. In particular, the influence of inter-layer interactions on the modification of the electronic properties of each of the hybrid components will be shown. The experimental data were compared with the calculations performed within the density functional theory, which enabled a complete description of the physical phenomena occurring at the interface between the layers.

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References

- [1] P. Dabrowski, M. Rogala, I. Pasternak, P. Krukowski, J.M. Baranowski, W. Strupinski, I. Lutsyk, D.A. Kowalczyk, S. Pawłowski, Z. Klusek, Carbon 149 (2019) 290-296

Figures

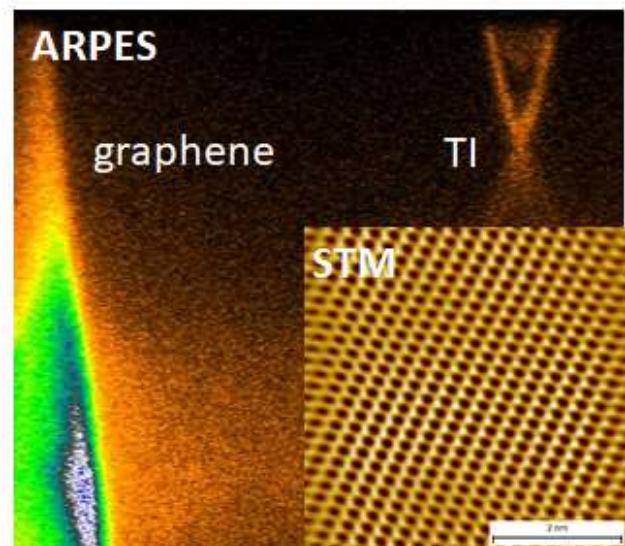


Figure 1: The ARPES and STM results of graphene/Bi₂Se₃ hybrid structure