Rhombohedral graphite with a twin boundary defect: Flat bands, ferroelectricity, and spectroscopic signatures

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Abstract
Materials featuring flat bands, like twisted bilayer graphene or rhombohedral graphite, often exhibit rich correlated physics, due to their high electron density at the Fermi level. In this presentation, I will analyse one such material: rhombohedral graphite with a twin boundary. In this material, two rhombohedral graphite films are stacked on top of each other with a different stacking orientation, leaving an ABA-stacked trilayer buried inside the structure [Fig.1 (a)]. Its band structure features two pairs of nearly flat bands localised at the surfaces and the twin boundary [Fig.1 (b)]. I present an effective model to describe these bands [1] and demonstrate how this class of materials can host ferroelectricity due to the lack of inversion symmetry [2]. Finally, I will discuss several spectroscopic techniques, such as optical absorption or Raman scattering, can be used to characterise these materials, with emphasis on the smallest member of this family: ABCB tetralayer graphene [3].

References

[1] A. Garcia-Ruiz, S. Slizovskiy, and V. I. Fal'ko, Adv. Mat. Int., **7**, (2023), 2202221.
[2] A. Garcia-Ruiz, V. V. Enaldiev, A. McEllistrim, and V. I. Fal'ko, accepted in Nano Lettes (2023).
[3] A. McEllistrim, A. Garcia-Ruiz, Z. Woodwin, V. I. Fal'ko, arXiv:2302.07374, accepted in Phys. Rev. B (2023).

Figures

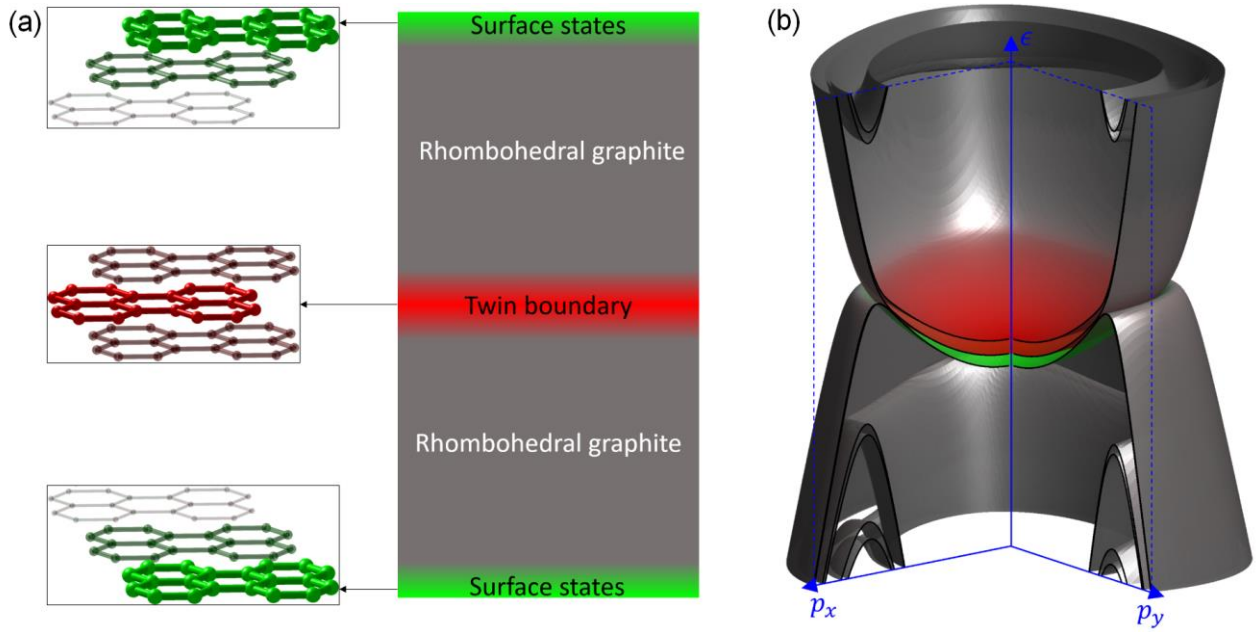

Figure 1: (a) Rhobohedral graphite with a twin boundary. The top and bottom insets present the characteristic ABC-stacking of rhombohedral graphite, while the middle inset presents the only ABA-stacking order in the film. (b) Band structure of thombohedral graphite with a twin boundary, coloured according to the localisation of the wavefunction. The red bands, localised inside the film, could induce correlated phases protected from environment.