Rhombohedral graphite junctions as physical realisations of topological defects in the Su-Schrieffer-Heeger model

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Topology, the study of properties invariant under continuous deformations, plays an important role in categorising distinct phases of matter. In a topological insulator, an insulating bulk is accompanied by conducting edge states robust to perturbations that do not close the bulk band gap [1]. The Su-Schrieffer-Heeger (SSH) model, a one-dimensional chain with alternating strong and weak couplings between nearest neighbour sites, provides the simplest model to explore the physics of edge states [2]. Such states have been observed on the surface of rhombohedral graphite flakes [3]. We show that junctions between rhombohedral graphite crystals provide a realization of a distinct set of defects in an SSH chain, and explain that the presence or absence of topologically protected states relates to the atomic stacking and local symmetry at the junction. Furthermore, we find that such junctions provide an opportunity to track the evolution of topological interface states from the topologically non-trivial to trivial phases as the crystals are shifted with respect to one another.

References

[1] A. Bansil et al, *Rev. Mod. Phys.*, **82** (2010) 3045.
[2] W. Su et al, *Phys. Rev. Lett* **42** (1979) 1698-1701.
[3] S. Slizovskiy et al, *Commun. Phys.* **2** (2019) 164.

Figures

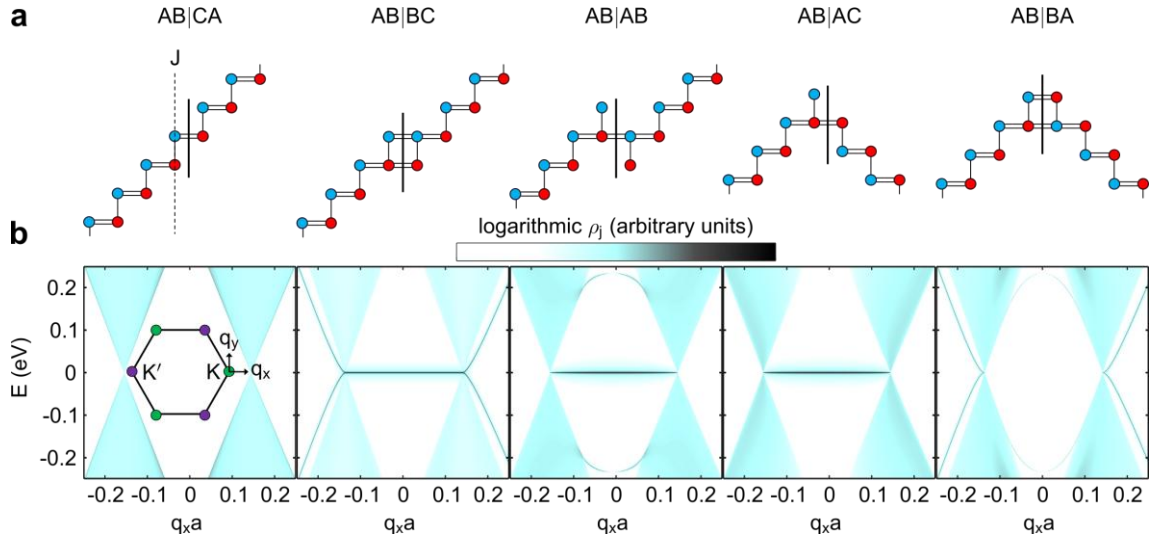

Figure 1: a. Schematic of the five distinct junctions formed by commensurate alignment of two rhombohedral graphite half-crystals. The layer directly to the left of the interface is denoted as layer J. The red (blue) circles indicate the two inequivalent atomic sublattices in each layer and the single and double bonds represent the intralayer (weak) and interlayer (strong) coupling between sites, respectively. **b.** The low-energy electronic density of states on the blue sublattice in layer in the vicinity of the corner *K* of the two-dimensional Brillouin zone, where *q* is an in-plane wave vector measured from the valley centre and *a* is the in-plane lattice constant. Topologically protected junction states are represented by a dark line at E = 0.