Twistronics of rhombohedral graphite

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Abstract

We study the topology of flat bands at surfaces and twist stacking faults in rhombohedral graphite [1]. Unlike Bernal graphite, rhombohedral graphite hosts flat surface states near Dirac points due to intrinsic chiral symmetry [2], characterized by a quantized Zak phase. Twisting introduces moiré periodicity, modifying bandwidth and interface flat bands through the interplay with Zak phase topology. In the low-energy effective model [3], the Chern number of flat bands scales linearly with layer count, but even minor impurities and defects disrupt this scaling since the bandgap exponentially decays with layers. We quantify impurity effects, showing the Chern number in twisted rhombohedral graphite eventually converges. Our findings highlight the limits and tunability of flat-band topology in rhombohedral graphite.

References

[1] Devakul, Trithep, et al. *Science Advances* 9.36 (2023): eadi6063.
[2] Zhang, ShengNan, et al. *Nano Letters* 23.7 (2023): 2921-2926.
[3] Liu, Jianpeng, et al. *Physical Review X* 9.3 (2019): 031021.

Figures

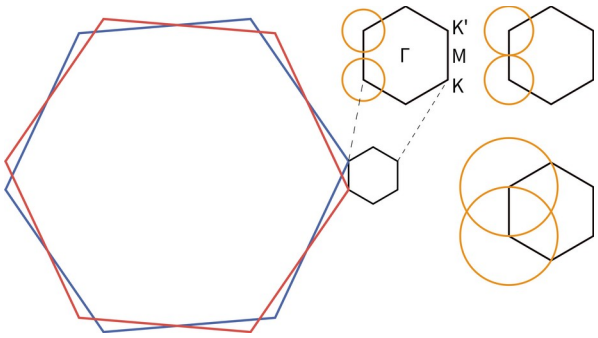

Figure 1: The Brillouin Zone of twisted rhombohedral graphite with different twisted angles, the yellow rings indicate the region where Zak phase Z=π resides.

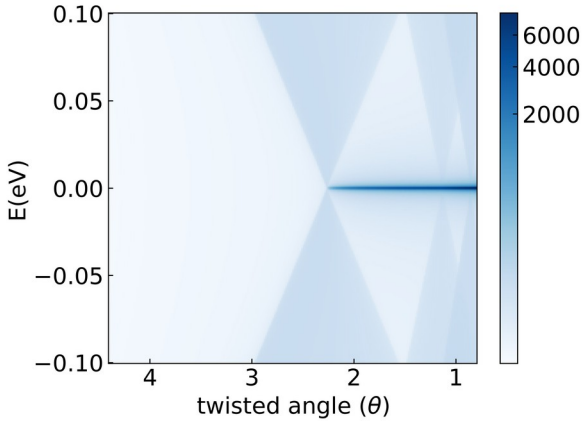

Figure 2: Evolution of the bandwidth of interface states in chiral limit, the twist angle from 4.4° to 0.8°.