Heterostrain effect on magic-angle twisted graphene layers flat-bands

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In twisted bilayers of graphene (TBLG), the interference of two rotated atomic lattices results in a moiré pattern. Previous research [1,2,3] has shown that the moiré and its electronic structure are not only controlled by the rotation between the layers but also by the relative strain between them (heterostrain). Besides, Scanning Tunneling Microscopy (STM) is the ideal tool to probe the electronic properties on a nanometer scale while imaging the Moiré and deducing the exact stacking arrangement of the graphene layers. In this context, it is of huge interest to look at the prolific STM data available in recent literature from the perspective of heterostrain. One can use commensurability analysis[4] combined with tight binding calculations to explore the effects of strain magnitude and direction on the electronic properties of TBLG systems near magic angle. This meta-analysis work, combined with calculations, demonstrates that heterostrain dominates twist in determining the flat-bands near the magic angle, which are further renormalized by electronic correlations effects.

References

[1] L. Huder et al., Ph. Rev. Lett. 120, 156405 (2018)
[2] H. Shi et al., Nature Comm. Vol. 11, 371 (2020)
[3] G. Yu et al., npj compumats, 5:122 (2019)
[4] A. Artaud et al., Sci. Reports vol. 6, 25670 (2016)

Figures

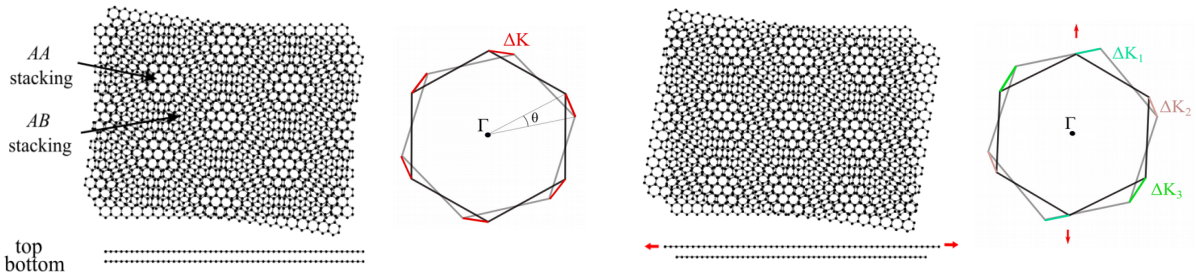

Figure 1: Sketch of a TBLG with (left) and without (right) heterostrain, with their respective brillouin zones. The stress is applied to the top (grey) layer as represented by the red arrows.

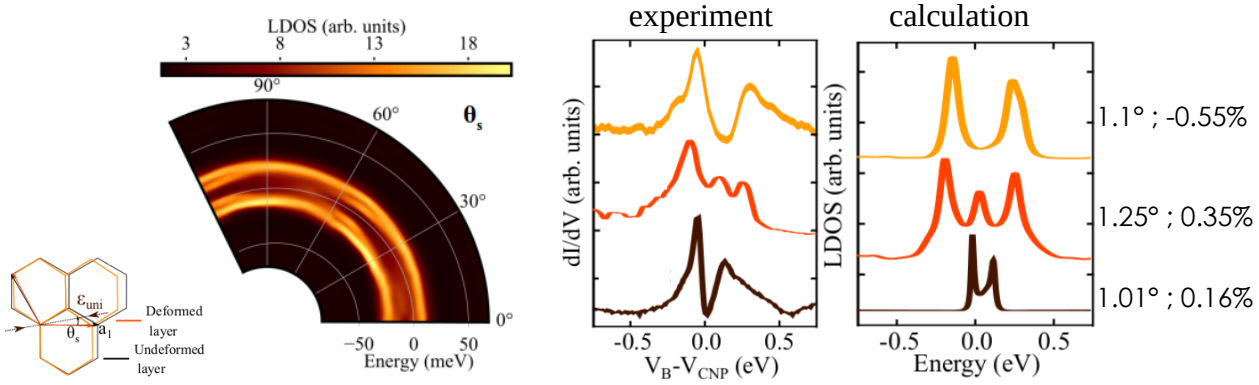

Figure 2: Tight-binding calculated LDOS of 1.10° TBLGs in AA zone, depending on the direction of application θ_s of a 0.4 % uniaxial strain (**Left**) ; and their comparison to experiment for several stacking configurations (**Right**)