Observation of flat bands in 57° twisted bilayer WSe_2

Gianmarco Gatti
J. Issing, F. Margot, L. Rademaker, A. Tamai, F. Baumberger

Department of Quantum Matter Physics, Quai Ernest-Ansermet 24, Geneva, Switzerland (CH)
gianmarco.gatti@unige.ch

Recent transport experiments revealed a correlated insulating phase and quantum criticality points in twisted transition metal dichalcogenides (TMDs)[1,2] that were predicted to host flat Moiré mini-bands [3,4]. Despite these exciting experimental observations and theoretical predictions, no direct measurements of the band structure of twisted TMD are available to date. We report here for the first time on the direct observation of flat band in twisted TMDs investigating 57° twisted bilayer WSe_2 by micro-focused angle-resolved photoemission spectroscopy. We resolve multiple Moiré mini-bands with strongly reduced dispersion and significant mini-gaps. By comparison with effective continuum band structure models, we attribute the origin of the flat states to a moderate Moiré potential of ≈50 meV emerging from the stacking of the two semiconducting layers. Our results establish a reference for future theoretical and experimental studies of the Moiré physics in twisted TMDs.

References

[1] A. Ghiotto *et al.* Nature **597** (2021), 345-349
[2] L. Wang *et al. Nat. Mater.* **19** (2020), 861–866
[3] Naik M. H. *et al.* Phys. Rev. Lett. **121** (2018) 266401
[4] M. Angeli and A. H. MacDonald, Proc. Natl. Acad. Sci. USA **118** (2021) 1–5

Figures

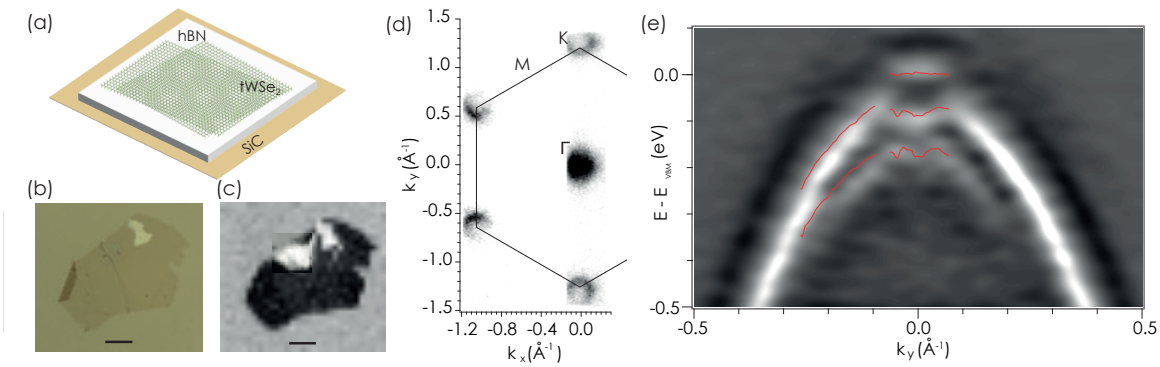

Figure 1: (a) Sketch of the 2D heterostructure. (b) Optical microscopy image of the heterostructure. (c) Real space mapping of the heterostructure by photoemission. The scale bar is 10 µm. (d) Momentum space mapping of the electronic structure 200 meV below the valence band maximum. (e) Close-up of the band dispersion along the K-Γ-K direction near the valence band maximum. Red curves indicate the fitted positions of the dispersing states.