Visualizing deformations and dynamics of the moiré pattern in twisted bilayer graphene

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Abstract

The discovery that magic angle twisted bilayer graphene (MABLG) is a superconductor, yields the promise of exciting new solid state physics [1]. However, the influence of inhomogeneity of twist angle, strain and defects on charge transport properties in these exfoliated, torn and stacked flakes remains an important open question.
Here, we demonstrate that Low Energy Electron Microscopy (LEEM) can directly image MABLG moiré patterns on the full device scale, identifying specific areas of the magic twist angle. We map the moiré pattern at 2 nm resolution over large areas of several micrometers. Using this data, local variations in twist angle and strain are extracted by geometric phase analysis [2]. Beyond static imagery, we study the dynamics of the moiré pattern at elevated temperatures. We observe the existence of random fluctuations of the moiré lattice corresponding to collective movement of the atoms over distances of less than 70 pm. The direct observability of these properties establishes the potential of LEEM to the field of twisted van der Waals materials [3].

References

[1] Y. Cao, et al., Nature 556.7699 (2018): 43-50.
[2] T. Benschop, T.A. de Jong, et al., Phys. Rev. Research 3, 013153 (2021)
[3] T.A. de Jong et al., *in preparation*
[4]

Figures

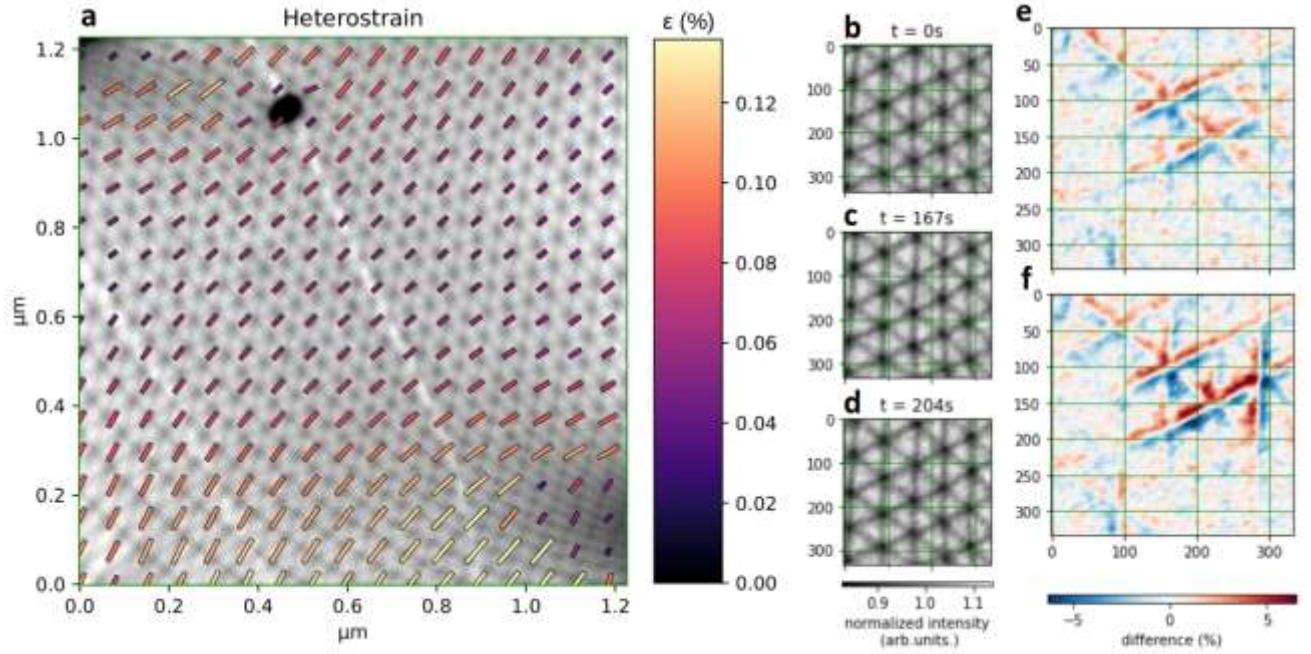

Figure 1: a) LEEM image of TBG with the extracted heterostrain overlayed. **b-d)** Three LEEM images of the same area at subsqequent times. **e-f)** Difference of the subsequent images compared to t=0s.