Controlled alignment of supermoiré lattice in double-aligned graphene heterostructures

Hu Junxiong[1,2]
Junyou Tan[2], Mohammed M. Al Ezzi[1,2], A. Ariando[1,2*]
1Department of Physics, National University of Singapore, Singapore 117542
2Centre for Advanced 2D Materials and Graphene Research Centre, National University of Singapore, Singapore 117551
*Corresponding author: ariando@nus.edu.sg

Abstract: The supermoiré lattice, built by stacking two moiré patterns, provides a platform for creating flat mini-bands and studying electron correlations [1-3]. An ultimate challenge in assembling a graphene supermoiré lattice is in the deterministic control of its rotational alignment, which is made highly probabilistic due to the random nature of the edge chirality and crystal symmetry of each component layer. In this work [4], we present an experimental strategy to overcome this challenge and realize the controlled alignment of double-aligned hBN/graphene/hBN supermoiré lattice, where graphene is precisely aligned with both the top hBN and the bottom hBN. Remarkably, we find that the crystallographic edge of neighboring graphite can be used to better guide the stacking alignment, as demonstrated by the controlled production of 20 moiré samples with an accuracy better than ~0.2°. Employing this technique, we are the first to fabricate the perfect double-aligned graphene supermoiré lattice and to observe the sharp resistivity peaks at band filling of 0, -4 and -8 electrons per moiré unit cell. Finally, we extend our technique to other strongly correlated electron systems, such as low-angle twisted bilayer graphene and ABC-stacked trilayer graphene, providing a strategy for flat-band engineering in these moiré materials. This work is supported by the MOE Singapore Tier 2 Grant No. MOE-T2EP50120-0015.

References

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Figures

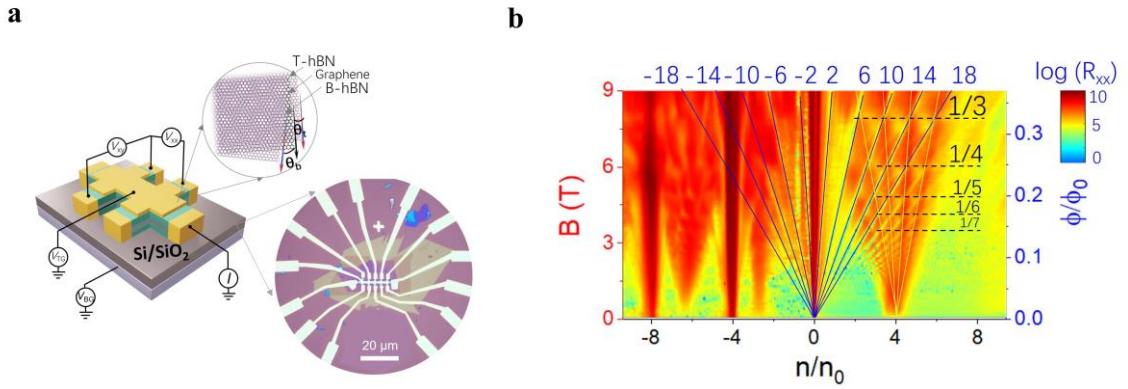

Figure 1: Double-aligned hBN/graphene/hBN heterostructure. a, Schematics of the dual-gate device with supermoiré lattice. **b**, Landau fan diagram showing the Brown-Zak (BZ) oscillations in a perfect double-aligned device.