

Composite super-moiré lattices in double aligned graphene heterostructures

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Van der Waals heterostructures, as vertical stacks assembled by different 2D crystals, have been widely used to produce combinations with predetermined functionalities. Apart from the selection and the sequence of 2D crystals, controlling the twist angle between stacking layers opened the use of another degree of freedom, especially for two crystals with similar lattice mismatch, which forms moiré pattern. Unlike the singly aligned heterostructures with one moiré pattern, we reported a doubly aligned structure in which fully encapsulated graphene simultaneously aligned to the top and bottom hBNs.[1] In this case, two periodic potentials due to the moiré pattern are applied on graphene simultaneously (which can be proved by two secondary Dirac points in transport measurement and two sets of hexagonal patterns in Fourier transformation of AFM image as shown below and their differential will create another set of supermoirés, among which the one with largest period can be independent of the difference in the lattice constants between two crystals and break through the restrictions of this lattice mismatch to achieve the period much larger than 14nm. This would open up the prospect for the design of graphene band reconstruction at arbitrary low Fermi energies.

REFERENCES

[1] Yankowitz et al., Emergence of superlattice Dirac points in graphene on hexagonal boron nitride. Nat. Phys. 8, 382-386 (2012).

FIGURES

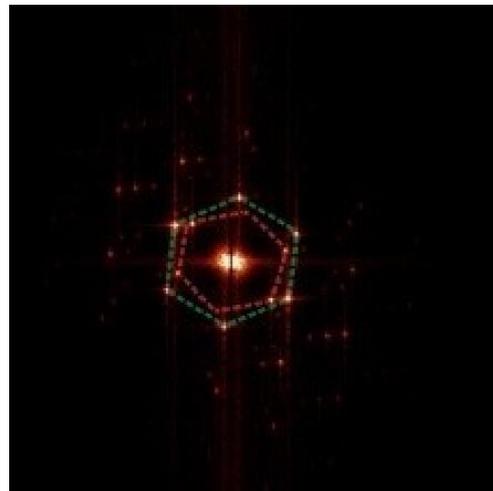
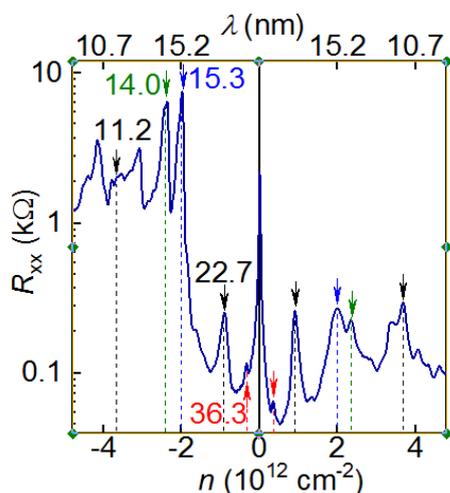


Figure 1: R_{xx} as a function of carrier concentration n with two moiré periods 15.3nm (blue), 14.0nm (green). The moiré and super-moiré peaks marked by arrows and labelled with their periods in the unit of nanometres. Largest supermoiré with the period 36.3nm, marked by red.

Figure 2: Fourier transform of the AFM image showing two sets of distinct hexagonal patterns (red and green dashed hexagons).