Biaxial Strain Effect on Moiré Superlattices

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Two decades have passed since monolayer graphene was first exfoliated.[1] A variety of two-dimensional (2D) materials with excellent properties have been produced and assembled into heterostructures held by van der Waals (vdW) interaction in these two decades. Moiré superlattices with large periodicity emerge in vdW heterostructures because of lattice mismatch and/or twist angle between layers of 2D materials. Strongly correlated phenomena including unconventional superconductivity[2] and nontrivial topology[3] discovered in moiré superlattices are spectacular and promising. Strain engineering is good for research of 2D materials because they can withstand high strain and their properties can be significantly modified by small strain. In this project, we will stretch thick and thin flexible substrates to apply biaxial homogeneous tensile strain on heterostructures constructed by graphene and monolayer hexagonal boron nitride (hBN). We will use a "spin and peel off" method to fabricate the heterostructures with clean surfaces. Raman spectroscopy of graphene can be an effective method to calibrate the strain in heterostructures because there is a linear relation between strain and Raman peak shift for some peaks of graphene. We will use atomic force microscopy (AFM) to image the moiré patterns to study their periodicity, symmetry, and homogeneity under strain. Our work will contribute to deeper understanding of the relation between physical properties and moiré superlattices.

References

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Figures

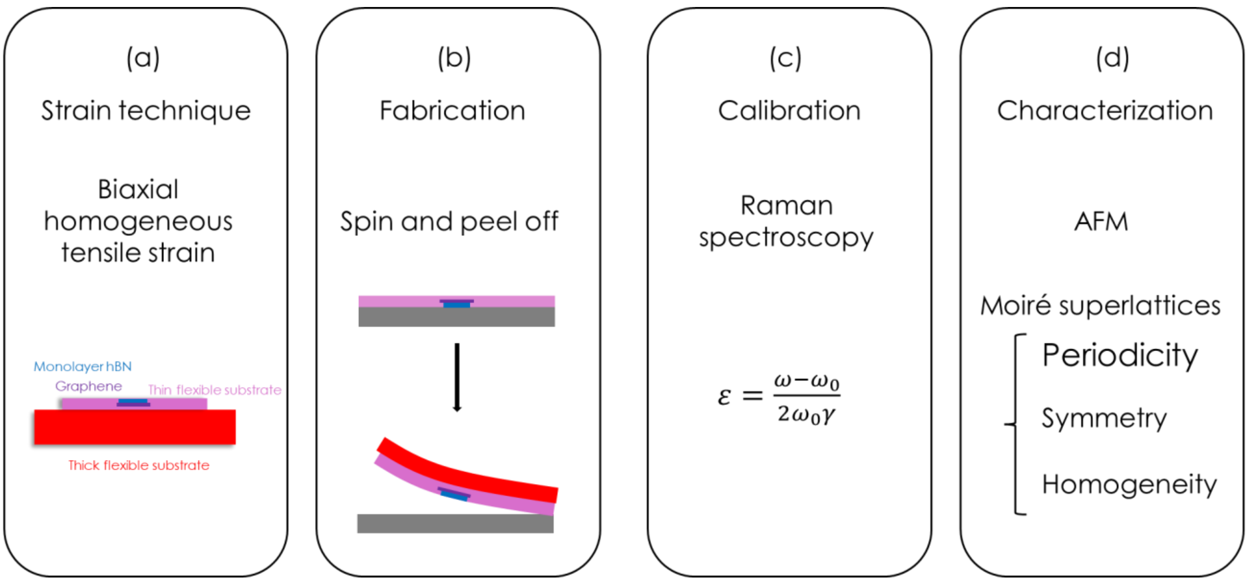

Figure 1: Schematics of main contents of project including (a) strain technique, (b) fabrication, (c) calibration, and (d) characterization.