Local nanomechanical properties in twisted double bilayer graphene

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Van der Waals heterostructures are tremendously versatile designer materials whose functionality can be engineered to an extend that goes far beyond the properties of the individual materials the heterostructure consists of [1]. In particular, by twisting two graphene layers, it is possible to induce an atomic reconstruction in the two-dimensional stack, which leads to a dramatic modification of the lattice symmetry [2]. This has important repercussions on its mechanical and electro-mechanical properties [3,4]. Here we investigate the local mechanical properties of double bi-layer graphene twisted by an angle ~1.1°. To this end, we employ three force microscope techniques, Piezoresponse Force Microscopy, Ultrasonic Force Microscopy and Electric Heterodyne Force Microscopy, respectively. We demonstrate that these methods are reliable and effective to visualize the Moiré pattern, to evidence the presence of strain solitons [5], and – for the first time – to extract the local Young's modulus in such systems. Our results bring on a comprehensive study of such complex structures and unlock critical understanding of these materials.

References

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Figures

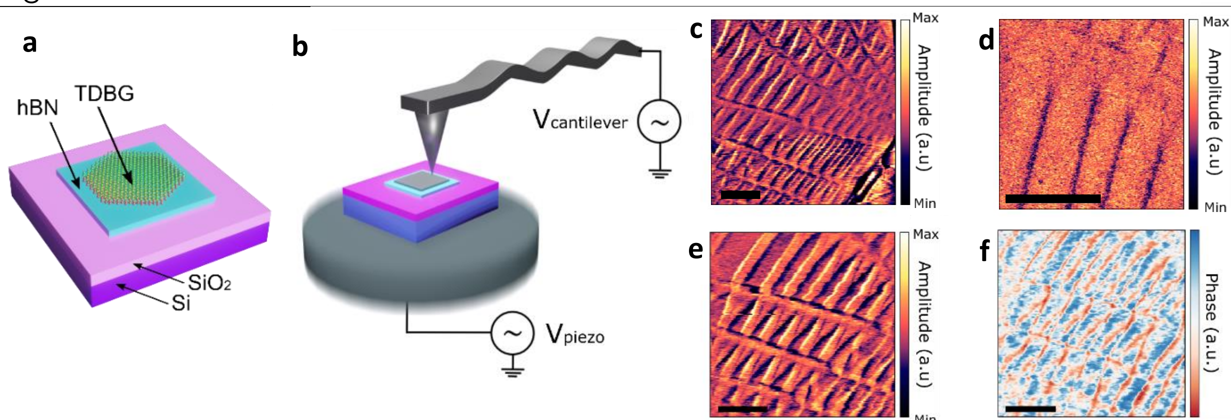

Figure 1: (a) Structure of the measured sample. (b) Schematic of the measurement system to image Moiré pattern in Twisted Double-Bilayer Graphene. (c) Piezoelectric Force Microscopy, (d) Ultrasound Force Microscopy and (e,f) Electric-Heterodyne Force Microscopy amplitude and phase, respectively. Scalebars: 200 nm.