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Polycrystalline Graphene with Single Crystal Electronic Structure EDWARD B. LOCHOCKI, LOLA BROWN, Cornell University, JOSÉ AVILA, SOLEIL Synchrotron, CHEOL-JOO KIM, YUI OGAWA, ROBIN W. HAVENER, DONG-KI KIM, ERIC J. MONKMAN, DANIEL E. SHAI, HAOFEI I. WEI, MARK P. LEVENDORF, Cornell University, MARÍA ASENSIO, SOLEIL Synchrotron, JI-WOONG PARK, KYLE SHEN, Cornell University — Stacking two-dimensional materials is a promising method for creating and controlling vertical heterostructures with atomic precision. The relative rotation angles between layers can sensitively tune these structures' electronic and optical properties, so constituent layers with well-defined lattice orientations are critical for any practical application. Here we report the growth of large scale graphene and hexagonal boron nitride on commercial copper foils, where the resulting films display multiple nucleations yet exhibit a uniform orientation. We characterize the copper and graphene lattices on sizes ranging from nanometers to several centimeters using a multitude of probes including dark field transmission electron microscopy and angle-resolved photoemission spectroscopy. These measurements reveal that each individual graphene grain exhibits an identical electronic structure and orientation consistent with single crystalline graphene. Finally, we create stacked bilayer graphene with a homogeneous interlayer rotation angle, demonstrating a versatile approach for scalable fabrication of layered superlattices with accurate structures.

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