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Growth and Characterization of Graphene-Boron Nitride Heterostructures[1]

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Graphene has been used to explore the fascinating properties of two-dimensional sp^2 carbon, and shows great promise for applications. Heterostructures of graphene (G) and hexagonal boron nitride (h-BN) have the potential for extended functionality, e.g., providing high carrier mobilities in graphene devices supported on h-BN and giving rise to emergent electronic behavior near in-plane G/h-BN junctions. While significant progress has been made recently in separate graphene and boron nitride growth on transition metals, the controlled synthesis of high-quality G/h-BN heterostructures poses new challenges. We discuss the fundamental growth mechanisms underlying the synthesis of G/h-BN heterostructures, studied by a combination of in-situ surface microscopy methods. Real-time low-energy electron microscopy (LEEM) provides a mesoscale view of the nucleation and growth of h-BN in the presence of graphene, and vice-versa. LEEM imaging together with diffraction and angle resolved photoemission spectroscopy (micro-ARPES) gives insight into the interaction between graphene and h-BN. Scanning tunneling microscopy has been used to probe intermixing and the atomic-scale structure of interfacial boundaries. Combining real-time and atomic-resolution imaging, we identify successful approaches for achieving atomically sharp G/h-BN junctions.

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