Increased nucleation density of WSe_2 caused by interlayer dislocations in bilayer graphene towards WSe_2/graphene vertical heterostructure formation

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Over the past few years, chemical vapor deposition (CVD) grown mono- to multi-layer graphene gained prominence as a template to grow transition metal dichalcogenide (TMD) overlayers. The resulting two-dimensional (2D) TMD/graphene vertical heterostructures are expected to exhibit van der Waals bonding between the two layers. However, microstructural features of graphene like defects, stacking changes and relative twisting angle between graphene layers could affect the growth behavior of TMD overlayers and alter the properties of resulting vertical heterostructures. This necessitates a thorough understanding of microstructure of graphene, especially multilayer graphene, substrate. Here, we employed dark field transmission electron microscopy (DFTEM) and high-resolution transmission electron microscopy (HRTEM) techniques to systematically study the presence of interlayer dislocations in bilayer graphene. We discovered the interlayer dislocations and the induced stacking changes are only present in Bernal stacked bilayer graphene but not in twisted bilayer graphene. Furthermore, we observe a direct empirical correlation between the presence of interlayer dislocations and increased nucleation density of WSe_2 triangles in the TMD overlayer. The poster will also highlight how ReaxFF molecular dynamics simulations performed on the WSe_2/graphene system support this observation.