Epitaxial Growth of van der Waals Heterostructures

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The successful experimental isolation of graphene in 2004 has propelled the study of layered materials, characterized by anisotropic covalent intra-layer and van der Waals (vdW) inter-layer bonding. Furthermore, vdW heterostructures of these layered compounds, formed by either mechanical assembly or epitaxial growth, provide a "bottom up" avenue for "materials by design" to achieve enhanced functionalities beyond the limitation of their bulk (or monolayer) counterparts.

In this talk, I will give a summary of our work on the epitaxial growth and atomic scale characterization of three classes of vdW heterostructures: 1) topological insulators Bi_2Se_3 and Bi_2Te_3 on epitaxial graphene, 2) superconductor FeSe on $SrTiO_3$; and 3) semiconductors MoS_2 and WS_2 on SiO_2. Our findings reveal unique challenges for the epitaxial growth of these vdW materials, as well as opportunities for engineering their physical and electronic properties by strain and electrical field.