STM/STS Studies of Molecule-2D Heterointerfaces

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Graphene, an atomically thin layer of carbon, is a semi-metal that can be used in applications such as transparent conducting electrodes in flexible electronics. The electronic and chemical properties of graphene can be engineered through a variety of methods such as by molecular adsorption [1,2], or fabricating graphene nanoribbons [3,4]. Unlike graphene, transition metal dichalcogenides (TMDs) such as MoS_2 and WSe_2, are semiconductors with tunable direct bandgaps dependent on the number of atomic layers, and have potential electronic and optoelectronic applications. We use high resolution scanning tunneling microscopy/spectroscopy (STM/STS) to study the atomic structure and intrinsic electronic properties of MoS_2 layers (mono-, bi-, tri-) directly deposited on HOPG substrates by chemical vapour deposition (CVD) [5]. We report an unexpected bandgap tunability with distance from the grain boundary in single-layer MoS_2, which also depends on the grain misorientation angle. We have similarly investigated the atomic scale electronic properties of CVD-grown WSe_2 monolayers as well as their interactions with molecules [6].

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