Epitaxial Graphene Interfaces: From Atomistic Understanding to Band Structure Control

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The burgeoning field of two-dimensional (2D) materials offers exciting opportunities for fundamental research and nanoscale applications. However, the development of next-generation devices is intrinsically linked to our ability to precisely control their electronic landscapes. This talk focuses on graphene, which remains at the forefront of 2D research due to its behavior of graphene-derived π-states near the Fermi level, which exhibit linear dispersion around the K-points of the Brillouin zone. While these attributes enable excellent charge and spin transport, they also present significant challenges for device integration [1].

To address these challenges, interface engineering between graphene and functional substrates has emerged as a powerful tool for band-structure manipulation [2,3]. Crucially, this interaction is reciprocal: while the substrate can induce novel phases in graphene, graphene itself can significantly modify the electronic properties of the underlying material. A persistent challenge in these heterostructures is engineering the interface to achieve desired functionalities without destroying the characteristic Dirac cones.

In this talk, I will discuss several representative examples – from a theoretical perspective – that illustrate how the graphene's interaction with various substrates impacts the properties of the resulting system. Particular attention will be given to recent findings regarding interface effects in complex heterostructures [4,5], highlighting how atomistic insights can guide the design of stable, high-performance 2D interfaces.

References:
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