Wavefunction Engineering in Graphene Systems

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Graphene systems present unique opportunities for engineering of the electron wavefunction. This would pave the way towards devices and applications that are conceptually entirely new, such as lateral devices based on quantum interference or new classes of configurable wiring and electron guides. I will focus on two routes for achieving such wavefunction tailoring: through quantum interference phenomena at lateral interfaces and edges within multi-stacked graphene systems (providing different electron behavior at "hard" and "soft" edges, while interference patterns are controlled by the stacking sequence) [1], and through controlling and modulating the surface potential of the graphene sheet at nanoscale/atomic level via insulating substrates and their nanostructures, naturally-occurring or bottom-up engineered [2,3]. Experimental evidence is collected from scanning probe microscopy studies (Scanning Tunneling, non-contact Atomic Force and Kelvin Probe Micro scopies), while theoretical support comes from an extended DFTB approach [4], as well as full ab-initio and semi-classical calculations. More generally, inorganic nanostructures provide routes for designing/controlling potentials and electronic superstructures in a variety of graphene systems, including carbon nanotubes with encapsulated nanowires [5].

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