Epitaxial graphene: designing a new electronics material

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Since 2001 research at Georgia Tech with various collaborators has, demonstrated the extraordinary transport properties of epitaxial graphene, which is graphene that is grown on single crystal silicon carbide (SiC). Monolayer graphene can be grown on the silicon face of hexagonal SiC.

Multilayered epitaxial graphene (MEG), consists of up to 100 graphene sheets, grows on the carbon face of SiC. MEG. Surprisingly its properties correspond to those of monolayer graphene rather than to those of graphite. The MEG structure as been extensively studied using a variety of probes, including STM, STS, AFM, LEED, XRD, IR spectroscopy.

For example, its band structure is defined by a "Dirac cone"; it exhibits a non-trivial Berry's phase; weak anti-localization; and quantum confinement effects. Long (μm) phase coherence lengths have been measured. Transport properties confirm that the graphene chiral nature of the carriers in the material, which distinguishes it from Bernal graphite.

Landau level spectroscopy exhibits record-breaking room temperature mobilities and well resolved Landau levels well below 1 T, indicating extremely low carrier densities, good homogeneity of the material and very weak electron-phonon coupling.

MEG has recently successfully been converted in situ, to multilayered graphene oxide which is a semiconducting form of MEG.

All these properties indicate that epitaxial graphene is an ideal platform for graphene-based electronics as well as for fundamental Dirac electron physics. Recent results on large scale patterning of FETs will also be presented.