Comprehensive overview of electronic transport in graphene published

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Researchers from the University of Maryland and the CNST's Shaffique Adam have recently published a detailed review of the electronic transport properties of two-dimensional graphene.

In the Reviews of Modern Physics article, the collaborators compare the electronic transport properties of graphene to other two-dimensional materials such as semiconductor heterostructures, quantum wells, and inversion layers.

They detail how, after adjusting for doped graphene's gapless, massless, chiral Dirac spectrum, the mechanisms for its electron motion, including its density and temperature-dependent carrier transport, are similar to these other, more conventional, materials.

Graphene, however, has unique transport regimes, including a robust metallic state at vanishing carrier density and unusual quantum motion that appears when it is configured in short ballistic devices.

The 64 page article, which has 38 figures and 473 references, provides a comprehensive review of recent experiments and theory, and has been well-received.

Although published in May 2011, a preprint of the article posted online in March 2010 has received over 60 citations, making it among the most cited graphene papers of the year.

More information: Electronic transport in two-dimensional graphene, S. Das Sarma, S. Adam, E. H. Hwang, and E. Rossi, *Reviews of Modern Physics* 83, 407 (2011). rmp.aps.org/abstract/RMP/v83/i2/p407_1

Abstract
A broad review of fundamental electronic properties of two-dimensional graphene with the emphasis on density and temperature-dependent carrier transport in doped or gated graphene structures is provided. A salient feature of this review is a critical comparison between carrier transport in graphene and in two-dimensional semiconductor systems (e.g., heterostructures, quantum wells, inversion layers) so that the unique features of graphene electronic properties arising from its gapless, massless, chiral Dirac spectrum are highlighted. Experiment and theory, as well as quantum and semiclassical transport, are discussed in a synergistic manner in order to provide a unified and comprehensive perspective. Although the emphasis of the review is on those aspects of graphene transport where reasonable consensus exists in the literature, open questions are discussed as well. Various physical mechanisms controlling transport are described in depth including long-range charged impurity scattering, screening, short-range defect scattering, phonon scattering, many-body effects, Klein tunneling, minimum conductivity at the Dirac point, electron-hole puddle formation, p-n junctions, localization, percolation, quantum-classical crossover, midgap states, quantum Hall effects, and other phenomena.

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