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Charge transport in disordered graphene

E. Rostampour
Islamic Azad University, Iran

Since the exploration of fullerenes (C_{60}), carbon-based materials have the subject of intense research, which led to the exploration of carbon nanotubes and the fabrication of individual one-atom thick graphene layers. These systems share a similar underlying electronic structure, whose exact details depend on confi nement effects, crucial differences emerge when disorder becomes into play. The transport properties of these materials considered with particular affirmation on the case of graphene nanoribbons which the presence of the edges exposes the system to further sources of disorder. The electronic transport properties of boron doped armchair ribbons shown, by means of ab initio calculations, to depend strongly on the symmetry of the ribbon, as B-induced potentials that preserve the parity of the wavefunctions do not affect the conductance of odd indexed ribbons at low energies. Scattering investigete by certain defects might be repressed, provided that the defects preserve the underlying symmetric geometry of the ribbon. Transport properties in graphene-based materials also turn out to be strongly affected by disorder, which can originate from impurities such as charges trapped in the oxide, chemical impurities, etc., topological defects such as vacancies, edge disorder..., or long range deformation modes (ripples) in 2-D graphene. The analytical expressions for the elastic mean free path of carbon nanotubes and graphene nanoribbons, and discuss the onset of weak and strong localization regimes, which are genuinely dependent on the transport dimensionality. The effects of edge disorder and roughness for graphene nanoribbons consider in relation to their armchair or zigzag orientation. The study with Anderson disorder indicates that even in the strongest case of short range scattering potential (with possible short range potential fluctuations as large as 1 eV), the computed 2-D localization lengths remain in the range of several hundred nanometers to microns. The results show to observe weak and strong localization regimes, the presence of edges as well as a reduced lateral size are essential factors. Nanoribbons with zigzag symmetries are even more spectacularly sensitive to disorder owing to the edge state-driven lower transport dimensionality. In contrast, for charge carrier energies lying in the higher energy subbands, the properties of nanotubes and ribbons provied similar features, with strong energy dependence of elastic mean free paths and localization phenomena.

el_rostampour@yahoo.com