Electronic Properties of Graphene

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Abstract

Winding a graphene sheet around itself creates periodic boundary conditions, perpendicular to the nanotube axis. Therefore a limited number of wave vectors are allowed in this direction. It depends on the diameter and the winding of the graphene sheet on itself [1]. If the edge conditions include the corners of the Brillouin zone, the behavior of the nanotube is metallic. This is the case for all "chair" type nanotubes and a third of "chiral" [2] and "zig-zag" nanotubes. In other cases, the band structure has a band gap, as a first approximation, inversely proportional. at the radius of the nanotube.

These properties have been confirmed experimentally by measuring the tunnel current between the tip of an STM (Tunnel Effect Microscope) and a nanotube, which provides a direct estimate of electron density.

In addition, STM makes it possible to image the atomic structure of nanotubes and therefore to determine their chirality and their diameter. The transport properties can thus be correlated with the structure of the nanotube. Metal nanotubes have only two one-dimensional conduction bands that cross the Fermi level: all current flows through these two bands and the theory predicts the conductance G0 = 2e2 / h, equal to twice the unit of fundamental conductance.

Keywords: Graphene, STM, Nanotube

References:

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