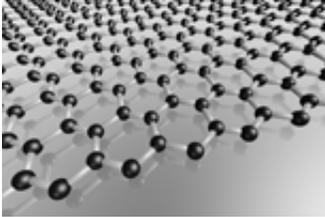


Graphene nanoribbons as electronic switches

April 8 2014



One of graphene's most sought-after properties is its high conductivity. Argentinian and Brazilian physicists have now successfully calculated the conditions of the transport, or conductance mechanisms, in graphene nanoribbons. The results, recently published in a paper in *European Physical Journal B*, yield a clearer theoretical understanding of conductivity in graphene samples of finite size, which have applications in externally controlled electronic devices.

When the [conductivity](#) is high, the electrons, carriers of electrical current, are minimally hampered during transport through [graphene](#). One aspect of conductivity is the electron transport gap, which is the minimal energy required for electric current to pass through the material. The electron transport gap is an important factor for applications in [electronic devices](#), because when the transport gap is controllable, it can be used as a switch in transistors – the main components of any electronic device.

To study the [electron transport](#) gap, scientists prefer to use graphene nanoribbons, which can have variable crystallographic structures at their edges. In this *EPJ B* paper, the authors found that the transport gap is larger when the ribbon is narrower in width and that it is independent of the [crystallographic orientation](#) of the ribbon's edges.

The team found that the transport gap is inversely proportional to the ribbon's width and is independent of the crystallographic orientation of the ribbon's edges. Also, the conductance varies with the applied external voltage. These findings confirm previous theoretical and experimental results.

In addition, the authors focused on direct current conductivity, which is expected to jump through well-defined sharp steps, and referred to as quantisation. However, the authors' theoretical models present a somewhat different picture: the steps are not equally spaced and are not clearly separate but more blurred. By comparison, the conductance quantisation in [graphene nanoribbons](#) was previously observed experimentally in several works.

Unfortunately, none of the experiments can yet resolve the form of the steps. Further, the precision of existing measurements cannot yet clearly discriminate between different predictions for quantisation. More precise theoretical models are now required for a better understanding of the experimental behaviour of nanoribbons.

More information: C. G. Beneventano, I. V. Fialkovsky, E. M. Santangelo and D. V. Vassilevich (2014), Charge density and conductivity of disordered Berry-Mondragon graphene nanoribbons, *European Physical Journal B*, [DOI: 10.1140/epjb/e2014-40990-x](https://doi.org/10.1140/epjb/e2014-40990-x)

Provided by Springer

Citation: Graphene nanoribbons as electronic switches (2014, April 8) retrieved 21 September 2024 from <https://phys.org/news/2014-04-graphene-nanoribbons-electronic.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.