CARBON NANOELECTRONICS: UNZIPPING TUBES INTO GRAPHENE RIBBONS

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Quite recently, two experimental groups announced simultaneously a promising way to fabricate narrow graphene nanoribbons (GNR) using carbon nanotubes as starting material[1,2]. These two groups propose to longitudinally unzip carbon nanotubes (CNTs) to make nanoribbons, either by chemical attack[1] or by plasma etching[2], with very high yields. Unzipping carbon nanotubes appears as a promising way to fabricate narrow nanoribbons needed for nanoelectronic applications. Also, a partially unzipped carbon nanotube, Fig.1, can be regarded as a seamless junction of a tube and a nanoribbon.

In this communication, we report on the transport properties of unzipped carbon nanotubes[3]. We find that graphene nanoribbons act at certain energy ranges as a perfect valley filters for carbon nanotubes, with the maximum possible conductance. Our results show that a partially unzipped carbon nanotube is a magnetoresistive device, with a very large value of the magnetoresistance. We explore the properties of several structures combining nanotubes and graphene nanoribbons, demonstrating that they behave as optimal contacts for each other, and opening a new route for the design of mixed graphene/nanotube devices.

[1] D. V. Kosynkin, A. Higginbotham, A. Sinitskii, J. R. Lomeda, A. Dimiev, B. K. Price, and J. M. Tour, Nature 458, (2009), 872.
[2] L. Jiao, L. Zhang, X. Wang, G. Diankov, and H. Dai, Nature 458, (2009),877.
[3]H.Santos, L.Chico and L.Brey, arXiv:0904.3676

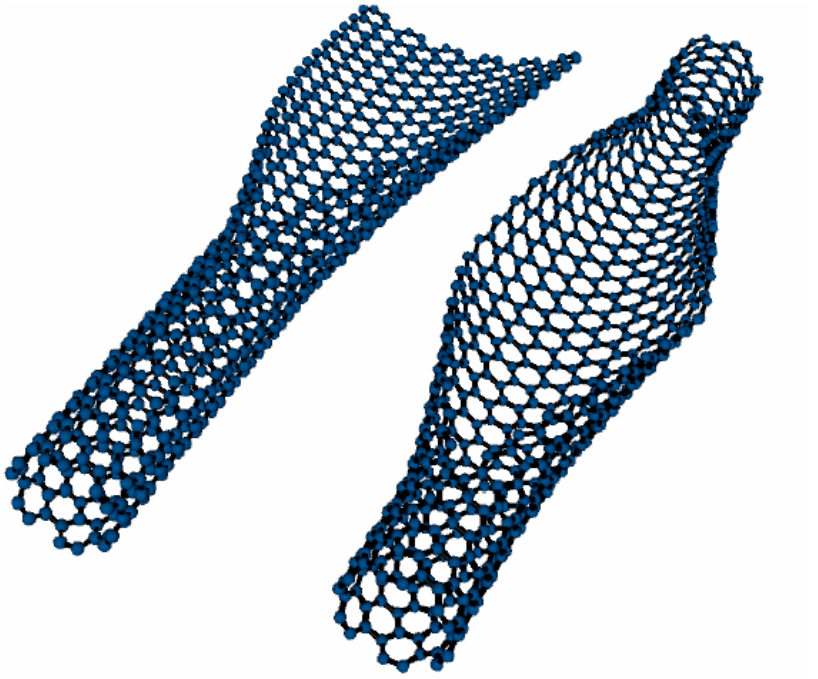

Fig.1. Geometry of two partially unzipped nanotubes. Left: a (6,6) armchair nanotube unzipped into a 12-ZGNR, making a CNT/GNR single junction. Right: the same nanotube unzipped in its central part, yielding a zigzag nanoribbon quantum dot connected to armchair nanotube contacts.