Mode splitting in zigzag carbon nanotubes

Jhon González[1], Gilles Buchs[2], **Dario Bercioux**[3,4], Andres Ayuela[1,3]

[1]Centro de Física de Materiales (CFM-MPC) Centro Mixto CSIC-UPV/EHU, E-20018 Donostia-San Sebastián, Spain
[2]Centre Suisse d'Electronique et de Microtechnique (CSEM) SA, Rue de l'Observatoire 58, CH-2002 Neuchâtel, Switzerland
[3]Donostia International Physics Center, E-20018 Donostia-San Sebastian,Spain
[4]IKERBASQUE, Basque Foundation of Science, E-48011 Bilbao, Spain

dario.bercioux@dipc.org

Abstract

We investigate theoretically the electron scattering properties of defected and freestanding zigzag single-walled carbon nanotubes. The variation of the chemical potential, realized in the suspended region, produces quasi-bound states, which compete with the ones created by multiple defects [1,2]. We show that a particular configuration of the tube defects produces a degeneracy lifting in the metallic branches of a zigzag nanotube. As a consequence we observe a doubling or splitting of the quasi-bound states. We also observe a particle-hole symmetry breaking due to selection rules associated to the interplay of tube and defects [3]. Our predictions are supported by an experimental case where a partially suspended zigzag tube that shows split quasi-bound states between defects induced by Ar^+ ions [1,2]. We propose that our results can find applications in angular momentum filtering as well as in THz optics [4].

References

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Figure
Sketch of the zigzag carbon nanotube suspended between a terrace of Au(111), on the right, and a rope of other tubes, on the left. It is also represented the tip of an STM that is employed for visualizing the local density of states.