

Probing the magnetism of topological end-states in armchair graphene nanoribbons

Dimas G. de Oteyza^{1,2,3}

James Lawrence, Alejandro Berdonces, Pedro Brandimarte, Mohammed S. G. Mohammed, Daniel Sánchez-Portal²

¹ Donostia International Physics Center, 20018 San Sebastián, Spain

² Centro de Física de Materiales, 20018 San Sebastián, Spain

³ Ikerbasque, Basque Foundation for Science, 48013 Bilbao, Spain

d_g_oteyza@ehu.es

Materials purely made up of non-magnetic atoms can display magnetic properties. One such example are aromatic hydrocarbon structures. Following Lieb's theorem, if the number of atoms in each carbon sublattice is different, the molecular structure will hold a net spin. However, even in the absence of net spin, polyradicals can be generated on graphitic structures subject to particular edge topologies. In addition to the edge topologies, also the structure's size determines the presence or absence of such radical states, whose corresponding spin, if present, is furthermore predicted to display a specific relative alignment. These interesting predictions are hard to verify because of the difficulty in the synthesis of appropriate nanographitic structures with atomic precision. In this respect, on-surface synthesis under vacuum conditions has appeared as an extremely promising approach. Making use of it, we have synthesized a variety of nanosized aromatic hydrocarbon structures with well-determined shapes and sizes, including graphene nanoribbons with different edge morphologies, widths and lengths. For the particular case of 5 atoms wide armchair graphene nanoribbons we describe, based on scanning tunneling microscopy and spectroscopy, combined with theoretical calculations, their electronic properties and the magnetism associated to its topologic end-states.

Figures

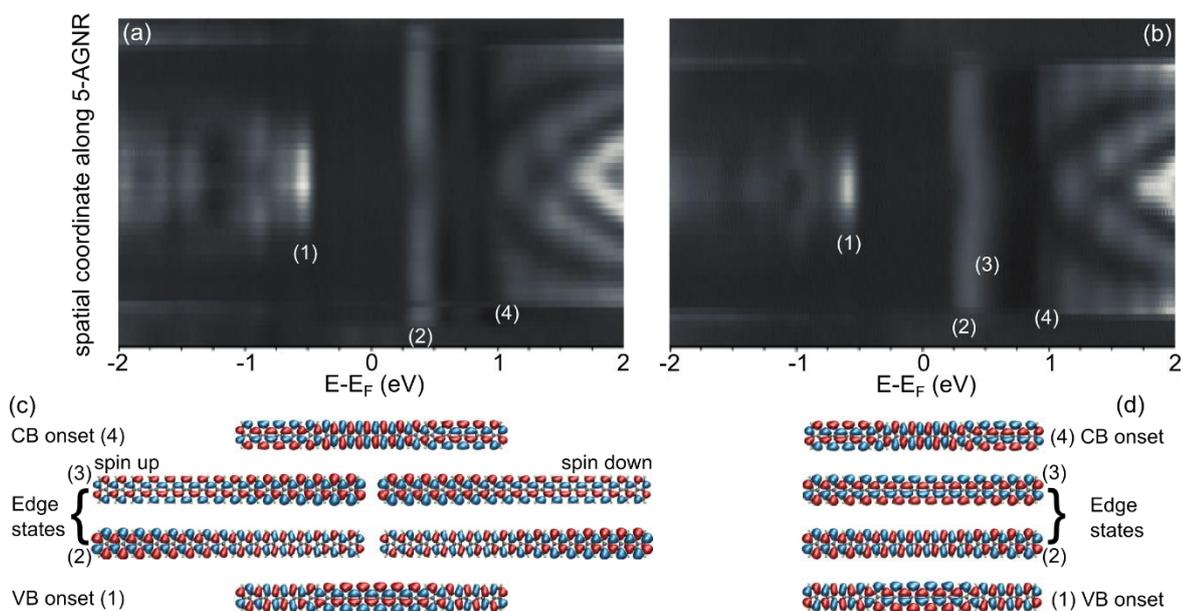


Figure 1. Size-dependent spin polarization of edge states in 5-aGNRs. (a) Stacked dI/dV point spectra along a 5-aGNR made up by (a) 8 and (b) 7 reactant molecules, as well as the corresponding calculated wave functions for the edge states, valence band and conduction band onset [(c) and (d)] appropriately labelled in upper and lower panels for correspondence.