Magnetism in graphene induced by defects

E. J. G. Santos, D. Sánchez-Portal, and A. Ayuela

Donostia International Physics Center (DIPC)
Centro de Física de Materiales, Centro Mixto CSIC-UPV/EHU,
Paseo Manuel de Lardizabal 5, 20018 San Sebastián, Spain

Ferromagnetism in otherwise nonmagnetic materials has been experimentaly reported for a number of nanoscale systems [1-4]. A recent line of research concerns with carbon-based materials aiming to the field of spintronics. Most of these experiments on magnetic carbon are related to lattice imperfections or disorder. Some examples of defects are obtained in thin carbon films irradiated with protons [1, 2], nanodiamond with implanted nitrogen- and carbon-ions [5], or multilayered graphene with vacancies [7] as seen by scanning tunneling microscopy. In this contribution we focus on ab initio density functional calculations to explore the magnetism induced by several types of defects in graphene and graphenic nanostructures. In particular we deal with vacancies [7] in such structures, and their doping using transition metals [8-10].

[1] P. Esquinazi, D. Spemann, R. Höhne, A. Setzer, K. H. Han and T. Butz, Phys. Rev. Lett. 91, 227201 (2003).
[2] H. Ohldag, T. Tyliszczak, R. Höhne, D. Spemann, P. Esquinazi, M. Ungureanu, and T. Butz, Phys. Rev. Lett. 98, 187204 (2007).
[3] P. Crespo, R. Litrán, T. C. Rojas, M. Multigner, J. M. de la Fuente, J. C. Sánchez-López, M. A. García, A. Hernando, S. Penadés and A. Fernández, Phys. Rev. Lett. 93, 087204 (2004).
[4] A. Ayuela, P. Crespo, M.A. García, A. Hernando, P. M. Echenique, arXiv:1101.4109.
[5] S. Talapatra et al., Phys. Rev. Lett. 95, 097201 (2005).
[6] M. M. Ugeda, I. Brihuega, F. Guinea and J. M. Gomez-Rodriguez, Phys. Rev. Lett. 104, 096804 (2010).
[7] E. J. G. Santos, D. Sánchez-Portal, and A. Ayuela, arXiv:1012.3304v1.
[8] E. J. G. Santos et al., Phys. Rev. B 78, 195420 (2008).
[9] E. J. G. Santos, D. Sánchez-Portal, and A. Ayuela, Phys.Rev. B 81, 125433 (2010).
[10] E. J. G. Santos, A. Ayuela, and D. Sánchez-Portal, New J. Phys. 12, 053012 (2010).