ELECTROSTATICS OF CARBON NANOTUBES AND GRAPHENE: ELECTRIC CHARGES AND DEFORMATION.

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We present a detailed study of the static enhancement effects of the electric charges in carbon nanotubes (CNTs), by using theoretically an atomic charge-dipole model and experimentally electrostatic force microscopy. Our studies reveal that the charge enhancement ratio decreases with the tube length and increases with the tube radius. Quantitative agreement is obtained between theory and experiment [1,2].

The distribution of net electric charge in graphene is also investigated, using both a constitutive atomic charge-dipole interaction model and an approximate analytical solution to Laplace's equation. We demonstrate a strong size dependence of the charge distributions in finite-size, infinitely-long and multi-layered rectangular graphene sheets, respectively. It is found that the edge charge enhancement effect becomes more significant when the length, the width or the number of layer of graphene increases [3].

We demonstrate the strong dependence of the electrostatic deformation of CNTs on the field strength and the tube length, using molecular simulations. Metallic nanotubes are found to be more sensitive to an electric field than semiconducting ones of the same size. For a given field, the induced deformation increases with tube length but decreases with tube radius. Furthermore, it is found that nanotubes can be more efficiently bent in a center-oriented transverse electric field [4].

References:

[1] Z. Wang, M. Zdrojek, Th. Mélin, and M. Devel, Phys. Rev. B **78** (2008) 085425.
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[3] Z. Wang and R. W. Scharstein, *to be published*.
[4] Z. Wang and L. Philippe, Phys. Rev. Lett. **102** (2009) 215501.

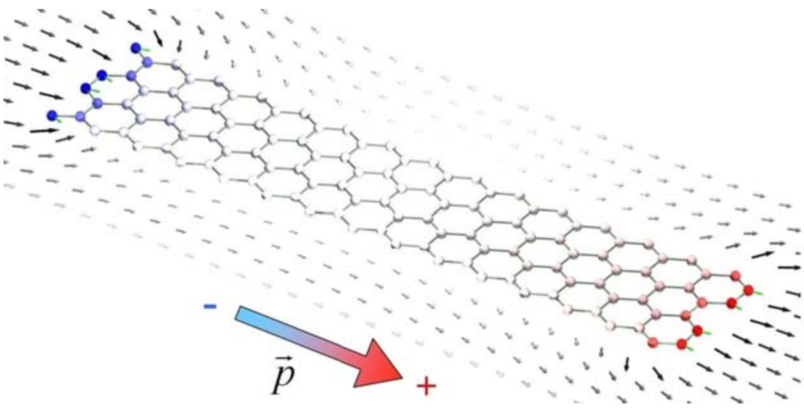

Figure 1: *When an electric field is applied through a graphene.*