The importance of doping carbon nanostructures: recent advances and applications

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By doping carbon nanotubes it is possible to alter significantly the electronic, mechanical and chemical properties of the tubes. This possibility opens up new avenues in the production of nanomaterials with desired properties using different dopants. Therefore, the controlled production of N-doped carbon nanotubes will be discussed. The field emission properties of doped tubes, their use as gas sensors or protein immobilizers will also be discussed. It will be also demonstrated that Ag and Au particles could be easily anchored on the surface of N-doped nanotubes. Possible mechanisms will be discussed.

We will present the first results related to the fabrication of CN_x nanotube–polystyrene (PS) composites, which were produced by a novel polymerization technique using a "grafting from" route using Nitroxide Mediated Radical Polymerization (NMRP) and atomic transfer radical polymerization (ATRP). We demonstrate using HRTEM and EELS that the tube material was covalently bonded to the PS chains, thus forming brush-like structures. These polymerized CN_x nanotubes form uniform dispersions in organic solvents. The results are novel and constitute will results in further developments related to the chemistry of CN_x nanotubes and fabrication of novel polymer composites.

The bio-applications of CN_x nanotubes will be discussed in detail. For example the toxicological effects of CN_x nanotubes on mice will be presented as well as other biocompatibility tests. We believe that CN_x nanotubes are more biocompatible when compared to undoped nanotubes (either single- or multi-walled).

[1] M. Terrones. *Ann. Rev. Mater. Res.* **33**, 419 (2003).
[2] M. Terrones, *Int. Mat. Rev.* **49**, 325 (2004).
[3] M. Terrones, A. Jorio, M. Endo, A.M., Rao, Y.A.. Kim, T. Hayashi, H. Terrones, J.-C. Charlier, G. Dresselhaus, M.S. Dresselhaus. *Materials Today Magazine* **7**, 30 (2004).
[4] K.Y. Jiang, L.S. Schadler, R.W. Siegel, X.J. Zhang, H.F. Zhang, M. Terrones, *Journal of Materials Chemistry* **14**, 37-39 (2004).
[5] K.Y. Jiang, A. Eitan, L.S. Schadler, P.M. Ajayan, R.W. Siegel, N. Grobert, M. Mayne, M. Reyes-Reyes, H. Terrones, M. Terrones, *Nano Letters* **3**, 275-277(2003).
[6] A.L. Zamudio, J.A. Elías, F. Rodríguez-Manzo, G. López-Urías, F. Rodríguez-Gattorno, M. Lupo, D.J. Rühle, H. Smith, D. Díaz Terrones, and M. Terrones. *Small*, i**2**, 346-350(2006).
[7] M. Dehonor, K. Masenelli-Varlot, A. González-Montiel, C. Gauthier, J.Y. Cavaillé, H. Terrones and M. Terrones. *Chem. Commun.,* 5349(2005).
[8] B. Fragneaud, K. Masenelli-Varlot, A. González-Montiel, M. Terrones, J.-Y. Cavaillé, *Chemical Physics Letters* **419**, 567-573 (2006).
[9] M. Endo, H. Muramatsu, T. Hayashi, Y.A. Kim, G. Van Lier, J.-C. Charlier, H. Terrones, M. Terrones, M. Dresselhaus, *Nano Letters* **5**, 1099-1105 (2005).
[10] Carrero-Sánchez, J.C., Elías, A.L., Mancilla, R., Arrellín, G, Terrones, H., Laclette, J.P., Terrones, M. *Nano Letters* **6**, 1609-1616 (2006).