Mardi 07/01/2014, 14h00

INSTN, Bât.399, salle B6, CEA-Saclay

Covalent and Non-Covalent Functionalization of Carbon Nanotubes and Graphene

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During the last decade, the rapid rise of nanosciences brought new paradigms for developing renewable energy sources and lowering the consumption of electronic devices. For many applications, the fabrication of hybrid materials (*e.g.* organic/inorganic, organic/nano, nano/bio, etc...) is required. Thus the control over the association of two chemically different subunits has to be performed with methods that can preserve the integrity and functionality of the building blocks. Thanks to their outstanding physical and chemical properties, carbon nanotubes and graphene are among the most promising materials for future technologies. The intrinsic electronic properties of these materials: metallic/semiconducting characters, high carrier mobility as well as their structures in which all the constituting atoms are in contact with the external media, high specific surface and high aspect ratio make them suitable objects for the fabrication of electronic and optoelectronic devices, (bio)sensors, supercapacitors, as electron donors or acceptors for photovoltaic applications and as conducting support for electro- or photocatalysis.

In order to facilitate the manipulation of CNT and graphene in solution and to bring new functionalities on the sp^2 carbon framework, chemical functionalization is of great interest and mainly two methods are available: (i) the covalent functionalization *via* the grafting of molecules onto the sp^2 carbon atoms of the π-conjugated skeleton; (ii) the non-covalent functionalization based on the adsorption of polycyclic aromatic compounds or surfactants *via* π-stacking and/or hydrophobic interactions on the carbon framework. It is well established that the covalent grafting of molecules onto the CNT and graphene gives rise to robust conjugates; however, the transformation of carbon atoms hybridized sp^2 into sp^3 induces a sizeable loss of their electronic properties. On the contrary, the non-covalent functionalization permits to better preserve the electronic properties of the materials. However, this approach suffers from a major drawback which is the lack of stability of the resulting assemblies. The covalent and non-covalent methods exhibit both advantages and disadvantages and the method of functionalization must be chosen carefully depending on the final application envisioned for the material.

Finally, there is still a real need for original chemical reactions allowing the functionalization of CNT and graphene in an efficient, simple and reproducible way. Here, I will summarize my research activity around the chemistry of graphene and carbon nanotubes and I will show some examples of functionalization that we developed and which combine the advantages of the covalent and non-covalent methods without their respective limitations.

Vous êtes tous cordialement conviés au pot qui suivra