Simple strategies for stable aqueous suspensions of carbon nanotubes

M. Paiva[a], R. Araújo[b], E. Cunha[a], J. Gonçalves[a], M. Melle-Franco[c], M. Pereira[a,b], M. Proença[b]

[a]*Instituto de Polímeros e Compósitos/I3N, Universidade do Minho, Guimarães, Portugal*

[b]*Centro de Química, Universidade do Minho, Braga, Portugal*

[c]*Centro de Ciências e Tecnologias de Computação, Universidade do Minho, 4710-057 Braga, Portugal*

Email of presenting author: mcpaiva@dep.uminho.pt

Carbon nanotubes (CNT) are attractive nanoparticles for biological applications due to their broad absorption of light in the UV-Vis-NIR, NIR photoluminescence, unique Raman signature, photothermal response, and large surface area for the covalent and non-covalent conjugation of contrast agents and drugs, DNA/RNA. However, pristine CNT are highly hydrophobic and not biocompatible, requiring functionalization with hydrophilic molecules in order to form stable aqueous suspensions. Here, simple functionalization methods of perylene bisimides and pyrene, to render these polyaromatic molecules amphiphilic, will be presented. Bolaamphiphilic perylene bisimides (PBI) were prepared by the reaction of perylenetetracarboxylic dianhydride with α-amino acids in good yield, using a simple protocol and avoiding complex purification methods. [1] Pyrene was modified by nitration followed by amination, and further reacted with maleic anhydride yielding carboxylic acid-functionalized pyrene. The CNT aqueous suspensions were studied by absorption and emission spectroscopy. Theoretical calculations were used to support the experimental observations.

The possibility of CNT double functionalization (covalent and non-covalent) will be discussed based on CNT solubility studies in surfactant aqueous solutions. Pristine and covalently functionalized CNT, at different functionalization yields, were compared. The CNT were functionalized by the 1,3-dipolar cycloaddition of azomethine ylides. [2] The ability of CNT to adsorb surfactant molecules was reduced by the covalent functionalization. Nevertheless, depending on the extent of covalent functionalization, a high concentration of CNT in water could be attained, in comparison to that of pristine CNT.

References

[1] R. Araújo, C. Silva, M. Paiva, M. Melle Franco, M. Proença, *RSC Advances,* **3** (46), 2013, 24535.

[2] M. Paiva, F. Simon, R. Novais, T. Ferreira, M. Proença, W. Xu, F. Besenbacher, *ACS Nano*, **4** (12), 2010, 7379.