Functionalization of CNTs with Maleic Anhydride

R. Araújo\textsuperscript{a}, M. C. Paiva\textsuperscript{b}, M. F. Proença\textsuperscript{a}, C. J. Silva\textsuperscript{a}

\textsuperscript{a} Departamento de Química, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal
\textsuperscript{b} Instituto de Polímeros e Compósitos/I3N, Universidade do Minho, Campus de Azurem, 4800-058 Guimarães, Portugal
e-mail: mcpaiva@dep.uminho.pt

The outstanding properties of carbon nanotubes (CNTs) \cite{1} are mainly related with their unique structural features. However, the high $\pi$-$\pi$ staking between the tubes is a major drawback for their manipulation and interaction with other materials. Chemical functionalization has been used as a convenient tool to improve their performance in various applications \cite{2}.

The work reports the functionalization of multi-wall carbon nanotubes (MWCNTs) with maleic anhydride via a Diels-Alder addition reaction, performed in dimethyl sulfoxide (190 °C) or 2-chlorotoluene (150 °C) for 24 hours. The product was characterized by thermogravimetric analysis (TGA) and the weight loss at 800 °C was 11.9 and 3.7 % respectively. Potentiometric titration suggests that CNTs modified at 190 °C remain predominantly in the anhydride form, while for CNTs modified at 150 °C, the extent of hydrolysis is approximately 40 %. Maleic anhydride was also reacted with a model compound (anthracene) in dimethyl sulfoxide (190 °C) and the hydrolysis of the product (0.025 mmol in 650 µL of DMSO-d\textsubscript{6}) was followed by 1H RMN upon addition of 0.166 mmol of DCl (40 % weight in D\textsubscript{2}O) (graphic in figure). The anhydride 1 was easily regenerated from the dicarboxylic acid 2 when this compound was heated at 185 °C for 10 minutes. A similar behavior is expected for the modified CNTs.

Figure: Reaction of maleic anhydride with the CNT surface and hydrolysis reaction of model compound 1.

References
\cite{1} R. H. Baughman, A. A. Zakhidov, W. A. Heer, Science 2002, 297, 787.