

Functionalization of CNTs with Maleic Anhydride

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The outstanding properties of carbon nanotubes (CNTs) [1] are mainly related with their unique structural features. However, the high π - π stacking 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 [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 μ L of DMSO- d_6) was followed by ¹H RMN upon addition of 0.166 mmol of DCI (40 % weight in D₂O) (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.

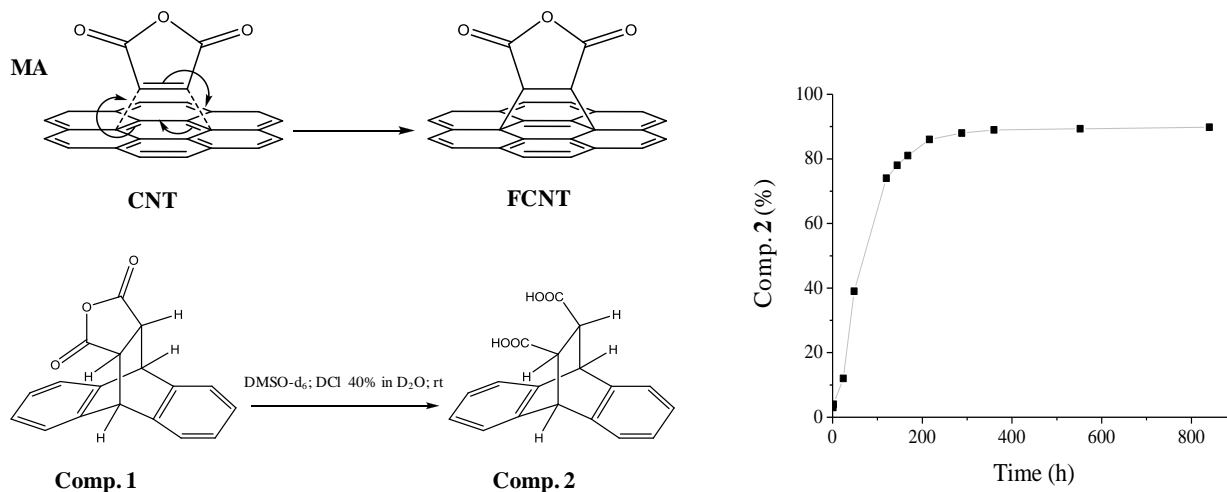


Figure: Reaction of maleic anhydride with the CNT surface and hydrolysis reaction of model compound 1.

References

- [1] R. H. Baughman, A. A. Zakhidov, W. A. Heer, *Science* 2002, 297, 787.
[2] J. M. Schnorr, T. M. Swager, *Chem. Mater.* 2011, 23, 646.