Functionalization of carbon nanotubes using eutectic mixtures: A promising route for enhanced aqueous dispersibility and electrochemical activity

Ali Abo-Hamad, Maan Hayyan, Mohammed AbdulHakim AlSaadi, Mohamed E.S. Mirghani, Mohd Ali Hashim

PII: S1385-8947(16)31670-9
DOI: http://dx.doi.org/10.1016/j.cej.2016.11.108
Reference: CEJ 16109

To appear in: *Chemical Engineering Journal*

Received Date: 30 July 2016
Revised Date: 6 November 2016
Accepted Date: 15 November 2016

Please cite this article as: A. Abo-Hamad, M. Hayyan, M. AbdulHakim AlSaadi, M.E.S. Mirghani, M. Ali Hashim, Functionalization of carbon nanotubes using eutectic mixtures: A promising route for enhanced aqueous dispersibility and electrochemical activity, *Chemical Engineering Journal* (2016), doi: http://dx.doi.org/10.1016/j.cej.2016.11.108

Functionalization of carbon nanotubes using eutectic mixtures: A promising route for enhanced aqueous dispersibility and electrochemical activity

Ali Abo-Hamad[a,b], Maan Hayyan*[a,c], Mohammed AbdulHakim AlSaadi[a,d], Mohamed E.S. Mirghani[e], Mohd Ali Hashim[a,b]

[a]University of Malaya Centre for Ionic Liquids (UMCiL), University of Malaya, Kuala Lumpur 50603, Malaysia.
[b]Department of Chemical Engineering, University of Malaya, Kuala Lumpur 50603, Malaysia.
[c]Institute of Halal Research University of Malaya (IHRUM), University of Malaya, 50603, Kuala Lumpur, Malaysia
[d]Nanotechnology & Catalysis Research Centre (NANOCAT), University of Malaya, Kuala Lumpur 50603, Malaysia.
[e]Department of Biotechnology Engineering, Faculty of Engineering, International Islamic University Malaysia, Kuala Lumpur 50728, Malaysia.

*Tel./fax: +60 379675311. E-mail: maan_hayyan@yahoo.com, maan.hayyan@gmail.com

Abstract

Eutectic mixtures (EMs) were used for functionalization of carbon nanotubes (CNTs). The process consists of two main steps: a pretreatment with an acidic $KMnO_4$ solution followed by an ultrasound treatment of CNT with the EM as a new class of environmentally-friendly solvents. Various ammonium and phosphonium based-EMs were used in the process and changes were recorded with respect to the functional groups on the CNT surface. Raman spectroscopy and X-ray diffraction analysis confirmed successful covalent functionalization without substantial damage to the structure. Accurate characterization of CNT dispersions was also carried out using UV-Vis spectroscopy and zeta potential. Studying the dispersion behavior of CNTs in aqueous solutions showed that modified-CNTs presented different dispersibility due to the changes in hydrophilicity after functionalization. The suspension stability of all