UV and ZETA Spectroscopic characterization of MWCNTs

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Multiwalled carbon nanotubes (MWCNTs), unique nanomaterials with extraordinary mechanical, electronic and optical properties, have attracted the material industry and academic society. According to Iijima, an ideal carbon nanotube consists of multiple rolled layers of graphite, derived from unusual carbon structure by metal oxidation catalyst. Owing to their great possibilities, MWCNTs are expected to substitute a variety of classical materials in the near future. However, MWCNTs with their high van der Waals force, surface area, high aspect ratio inevitably cause self-aggregation.
The improvement of dispersion has become a challenge to maximize the properties of MWCNTs. In order to overcome self-aggregation, chemical modification of MWCNTs surface or utilization of surfactants is regarded as an effective way to improve their wettability and adhesion to host matrix materials. When surfactants are employed in MWCNT dispersions, surfactant molecules work by adsorption at the interface and self-accumulation into supramolecular structures, which help CNT dispersion retain a stable colloidal state. Coulombic or hydrophobic attraction plays a key role in achieving stable colloidal systems in ionic or nonionic surfactants, respectively.
Functionalization of two types of MWCNTs obtained by pyrolisis and chemical vapour deposition was performed in acid (HNO_3) and alkali ($NH_4OH+H_2O_2$) media. In this work, UV-vis and ZETA potential measurement techniques of MWCNTs have been analysed in details. Zeta potential measurements were carried out with a 1cm cell on a Zeta Potential Analyzer from Brookhaven Instruments Corporation. 100 µl MWNT dispersion was put into the cell and diluted to 1 ml water in the presence of SDS surfactant. The experiments were repeated at least three times for averaging. UV-vis spectrum were recorded using Variant spectrophotometer in quartz cell with a path length of 1cm.
The results have shown that nn improved dispersion stability results for oxidized MWCNTs in polar media. When the CNTs are modified with carboxylic anion groups, the dispersion stability in polar solvents was significantly enhanced due to the combination of polar–polar affinity and electrostatic repulsion. The presence of electrostatic repulsion was found from the conductivity and zeta potential of the modified MWCNTs.

Keywords: MWCNTs, Zeta potential, UV spectroscopy, Functionalization