Investigation of poly (3-hexylthiophene) and modified multi-wall carbon nanotube composites for photovoltaic applications

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The use of thin film organic π-conjugated polymers in organic solar cells is on the increase. Polythiophene based composites are in the forefront. Carbon nanotubes are the most recently tried electron acceptor materials. In the case of carbon nanotubes because of the anisotropy and presence of semiconducting tubes, the realization of its full potentiality is still a challenging task. Recently, people have attempted to bring in directionality to the orientation of the carbon nanotubes and attempts made to separate out metallic part of single walled carbon nanotubes exploiting the differential interaction with planar aromatic molecules, such as free-based porphyrin or pyrene with long alkyl chains [1]. Also, the transport properties of conducting polymers are known to be greatly influenced by the chemical instauration surrounding the polymer backbone, besides favorable conformation of the side chains present. Polymeric composites with multi-walled carbon nanotubes (MWNT) can provide a good conductive path at relatively low carbon contents, as these have high aspect ratio, specific surfaces and cost effective [2]. Hence their uses in various applications such as organic LED, solar cells, super capacitors etc. are very much anticipated. In this respect, poly(3-hexylthiophene) and modified (functionalized and silanized) MWNT composites have been prepared through in-situ polymerization process in chloroform medium with $FeCl_3$ oxidant at room temperature. The composites were characterized through Fourier transfer infrared spectroscopy (FT-IR), Raman and X-ray diffraction (XRD) measurements to probe the nature of interaction between the moieties. The optical properties of the composites are measured from ultraviolet-visible (UV-Vis), photoluminescence (PL) and photoelectron spectroscopy. The conductivity of the composites is followed by four probe technique to understand the conduction mechanism. The ultimate goal is to go for the construction and testing of photovoltaic devices for improved efficiency.

References:

1. Wei Wang et al., J. Am. Chem. Soc., 2008, 130, 1415-1419.
2. Mohammad Rezaul Karim et al., Mater. Lett., 2007, 61, 1688-1692.