SYNTHESIS AND CHARACTERIZATION OF POLYTHIOPHENE – CARBON NANOTUBE COMPOSITE

UGC Minor Research Project

(MRP(S)-210/12-13/KLCA033/UGCSWRO)

Final Report

Submitted By

Ms. Anne Jose M

(Principal Investigator)

Assistant Professor, Dept. of Physics

Little Flower College, Guruvayoor

To

University Grants Commision

South Western regional office

Bangalore

2016

Summary Of The Project

The project entitled "synthesis and characterization of polythiphenes-carbon nanotube composite" has carried out as two phases. In first phase the Polythiophenes were prepared and characterized. Important conclusions of first phase are as follows:

Polythiophenes were prepared by chemical oxidative polymerization using an anionic surfactant AOT in non aqueous chloroform medium. The characterization studies of PTs (PT-0, PT-25, PT-50, PT-75, and PT-100) were done by FTIR, CHNS and WXRD. Important conclusions of the present investigations are i) FTIR spectra of the samples show characteristic peaks of polythiophenes ii) However the dopant peak were missing from the samples, especially the C=O peaks from AOT. iii) The sulfur content obtained from CHNS analysis also indicates that there was only 5% difference between PT-0 and other samples (PT-25, PT-50, PT-75 and PT-100). Poor doping of anionic surfactant could attributed to low amount of dopant taken in the present condition or week electrostatic interaction between polymer and dopant iv) Powder x-ray diffraction studies indicate with increase in surfactant amount there was increase the solid state ordering v) The four probe solid state conductivity of the samples were in the range 7×10^{-3} to 1×10^{-3} Scm^{-1}. The SEM micrographs indicate that the morphology of most of samples has spherical nature with size in the range 1μm ±200 nm , but PT-0 have irregular bulk morphology vi) polymer samples have

shown a 10 % weight loss around 200˚C. In nut shell, we have synthesized polythiophene in presence of an anionic surfactant which plays crucial role in solid state crystalline packing and on the morphology formation.

In second stage Polythiophene-MWCNT nanocomposites were synthesized and characterized. Conclusions of second phase are as follows:

Polythiophene-multiwalled carbon nanotubes nanocomposite (PT-CNTs) were prepared by in-situ chemical oxidative polymerisation of thiophene and multiwalled carbon nanotubes using ferric chloride as oxidising agent using bis (2-ethylhexyl) sodium sulfosuccinate (AOT) as anionic surfactant in chloroform solvent. Before the in-situ synthesis of the PTCNTs, polythiophene (PT-25) alone was prepared which utilized as standardized condition for the synthesis of the former. The following are the important outcome of the present investigation. i) FT infrared spectroscopy and elemental analysis of confirms the formation of the PT and PTNCTs ii) PTCNTs samples were shown peak characteristic of carbon nanotube at 26.48 corresponding to (002) diffraction MWCNT. iii) the amorphous domain of the polymer peak was completely vanished due to the supramolecular interactions between MWCNT and conducting polythiophene. iv) AOT plays a significant dual role as dopant and as selective template for polythiophene and polythiophene- multiwalled nanocomposite morphology formation v) SEM of the PTCNTs reveals that nanofiber morphology of PTCNT

composites similar to MWCNT. vi) The TEM images clearly indicated the formation of core shell nano-structured tubes with shell of the composite with thicker coating and core being hollow. vii) The good dispersibility of the PTCNT samples in chloroform allowed us to do the uv-visible absorption spectroscopy. viii) two characteristic peaks at 340 nm and 230 nm were shown by PTCNT nanocomposite corresponds to π- π^* transition and to the absorption of multiwalled carbon nanotube (MWCNT). ix) The formation mechanism of core-shell nanostructure composite proposed and shown as scheme. x) The PTCNTs were shown good electrical conductivity which was due to better electrical transport in nanocomposite which was made up two electrically conducting materials. xi) the increase in electrical conductivity was of the order of approximately 1.5 times higher in magnitude than the PT-25 samples. Thus in the nut shell, we were able to synthesis polythiophene-MWCNT core-shell nanostructured composite via simple one step oxidative polymerization of thiophene in presence of MWCNT using AOT as anionic surfactant and ferric chloride as oxidant in chloroform. The morphology, solid state ordering and absorption spectroscopy (uv-visible) and dispersibility were studied systematically.