Summary

Title of Project: Synthesis and physiochemical study of thin film of polymer composites.

A thin film is a layer of material ranging from fractions of a nanometer (monolayer) to several micrometers in thickness. Electronic semiconductor devices and optical coatings are the main applications benefiting from thin film construction. The act of applying a thin film to a surface is thin film deposition – any technique for depositing a thin film of material onto a substrate or onto previously deposited layers. "Thin" is a relative term, but most deposition techniques control layer thickness within a few tens of nanometres. Thin film technology is pervasive in many applications, including microelectronics, optics, magnetic, hard and corrosion resistant coatings, micro-mechanics, etc. Progress in each of these areas depends upon the ability to selectively and controllably deposit thin films - thickness ranging from tens of Ångströms to micrometers - with specified physical properties. This, in turn, requires control - often at the atomic level - of film microstructure and microchemistry. There are a vast number of deposition methods available and in use today. However, all methods have their specific limitations, and involve compromises with respect to process specifics, substrate material limitations, expected film properties, and cost.

Thin films have wide applications and recently have gained interest of researchers to exploit various ways for thin films synthesis for application in nanodevices. There are various deposition techniques and they fall into two broad categories, depending on whether the process is primarily chemical or physical. Among various chemical
deposition methods electrodeposition method is the most preferred. This process is also known as "electroplating" involves the electrochemical process and is typically restricted to electrically conductive materials. This process is also known as electrochemical method as it involves electrochemical process. The process is carried out in electrochemical cell via process called as electropolymerisation process. Electrochemical polymerization is normally carried out in a single compartment electrochemical cell by adopting a standard three electrodes configuration. A typical electrochemical bath consists of a monomer and a supporting electrolyte dissolved in appropriate solvent. In this section we introduce the basic components of electrochemical instrumentation. The simplest electrochemical cell uses two electrodes. The potential of one electrode is sensitive to the analyte concentration, and is called the working electrode or the indicator electrode. The second electrode, which we call the counter electrode, completes the electrical circuit and provides a reference potential against which we measure the working electrode potential. Ideally the counter electrode potential remains constant so that we can assign to the working electrode any change in the overall cell potential.

In this present work PPy, PPy/MWCNTs, have been synthesized by electrochemical method. All these as-synthesized materials have been characterized by SEM, FTIR. SEM revealed the surface morphology indicating the high porosity of PPy and entrapment of CNTs by PPy in nanocomposite. FTIR revealed the shift of bands to lower frequencies in the nanocomposites spectra as compared with PPy suggesting that an interaction between the polymer and CNT occurs. The composites with CNT shows enhanced conductivity as compared to pure polypyrrole. UV-Visible spectroscopy was performed to ascertain the interfacial interaction of PPy/CNT nanocomposites. The UV-
Visible spectra of PPy and PPy/CNT are shown in Fig. The pure polypyrrole shows two distinct bands at 294 nm and 420 nm. These two transitions corresponded to the transitions from valence bond to polarons and bipolarons of the oxidized form of polypyrrole. The characteristics band for the polaronic transition around 420 nm and the peak around 294 nm represents the $\pi-\pi^*$ electron orbital transition along the backbone of the polymer chain. As CNTs were incorporated into polymer, the characteristic peaks assigned to the polaron-$\pi^*$ transition and $\pi-\pi^*$ transition of polymer chain shifted to shorter wavelengths, indicating the interaction between polymer chain and CNTs. The conductivity of pure pyrrole was found to 0.5 S/cm and the conductivity of polypyrrole composite was found to be 1.3 S/cm. The specific capacitance of PPy/CNT composite was found to be more than that of pure PPy indicating suitability of nanocomposites for supercapacitor.