ABSTRACT

In our search for a conducting polymer having higher intrinsic conductivity, we have designed a processable narrow bandgap conducting polymer. The thesis reports the findings of the investigation on the synthesis, characterization and study of the electrical and optical properties of poly(2,6-pyridinedicarbonyl sulfide).

The polymer has been synthesized by polycondensation of 2,6-pyridinedicarbonyl dichloride and anhydrous sodium sulfide in NMP medium. The monomers used in the synthesis have also been prepared.

The polymer has been extensively characterized for confirming its chemical composition and structure. It is soluble in polar aprotic solvents like DMF, DMAc, DMSO, NMP etc., which allowed the study of its solution viscosity and the determination of its number-average molecular weight by conductometric titration. The structure of the polymer has been established by spectroscopic methods viz., IR, ^{1}H- and ^{13}C-NMR and XPS. A novel method of determining the number-average molecular weight of a polymer by end group analysis from XPS has been reported for the first time. Polymer morphology has been studied by XRD. The polymer is stable upto 200°C in nitrogen atmosphere, as observed from TGA and DSC studies.

The electrical and optical properties of the polymer have been studied on thin films, cast on glass substrate, by the solution spin coating technique. DC-conductivity of the polymer at room temperature is 3.5×10^{-5} Siemens/cm. The polymer exibits true metallic behavior through its negative temperature dependence of conductivity, which is being observed for the first time in conducting

polymers. Its conductivity also shows photosensitivity and decreases on exposure to light. Mechanistic explanations for the negative temperature dependence and the photosensitivity of electrical conductivity have been put forward. The conductivity of the polymer is stable in normal laboratory environment. Thermoelectric test shows the polymer to be p-type in nature. HCl-dopng increases its conductivity by one order of magnitude. The surface of the undoped and HCl-doped polymer film has been studied by SEM. Optical absorption study shows that the polymer has a narrow bandgap of 0.85 eV.

Key Words : Conducting Polymer, Processability, Narrow Bandgap, Number-Average Molecular Weight, Intrinsic Conductivity, Metallic Behavior, Photosensitivity.