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Title: Electrical and Structural Properties of Conjugated Polymers Synthesized by RF Plasma Polymerization and Other Methods

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After 2000 Nobel Prize for conducting polymers, a lot of research groups focused their research interest on conducting polymers and several methods have been investigated in order to modify the physico-chemical properties of these polymers and their composites. The search is still on, on light-weight electronic material and coating material for space environment. Present review of literature reveals that doped materials induce changes in the properties of materials and polymers undergo drastic modification with doping concentrations. Doping of polymeric semiconductors is different from that of inorganic or conventional semiconductors. Doping of conducting polymer involves random dispersion or aggregation of dopants in molar concentrations in the disordered structure of entangled chains and fibrils. The present thesis entitled Electrical and Structural Properties of Conjugated Polymers Synthesized by RF Plasma Polymerization and Other Methods" is divided into 6 chapters:

Chapter 1 gives introduction of conducting polymers and doping agents, conduction mechanism, charge transport and effect of doping on polymers. Conducting polymer composites and nanocomposites, activated inorganic compound, carbon nanotubes and Zinc Oxide, with the emphasis to the electrical and dialectical properties and their applications in devices has been discussed. An overview of conducting polymers and nanoparticles with the historical back ground has been investigated.

Chapter 2 outlines the understanding of the synthesis and characterization of conducting polymers, using with appropriate oxidizing agent prepared, using the Chemical Oxidation method. Various characterization techniques XRD, FTIR, DC conductivity, UV-Visible, SEM, and Photoluminance are used. XRD, FTIR and SEM are given for the structural, morphological, and microscopic studies. Synthesis of polymer composites using different monomers (like polyaniline, Derivtives of polyaniline) from chemical oxidation methods is also mentioned. The thin films of conducting polymers produced by RF Plasma polymerization method and modify RF home built setup are also mentioned.

Chapter 3 Conducting polymer composites of poly (aniline)/vanadium pentoxide (PANI/V_2O_5) and poly (o-toluidine)/vanadium pentoxide (POT/V_2O_5) have been synthesized by polymerization of aniline and o-toluidine with V_2O_5 using $(NH_4)_2\ S_2O_8$) as an oxidant. The V_2O_5 is varied in three different weight percentages of PANI in PANI/V_2O_5 composites and varied in five different weight percentages of POT in POT/V_2O_5 composites. The synthesized polymer composites are characterized by dc conductivity; UV–Visible absorption spectroscopy, SEM and

XRD techniques. Electrical conductivity of the compressed pellets depends on the concentration of V_2O_5 in polymer. The optical band gap of composites increases with increase in the weight percent of V_2O_5 in case of PANI/V_2O_5 composites. On the other hand optical band gap decrees in POT/V_2O_5 composites. X-ray diffraction pattern shows increases in the crystallinity which is due to interaction of polymer with V_2O_5. The DC conductivity of these polymer composites increases with increases weight percent of V_2O_5. This conduction mechanism in theses polymer composites by thermally activated process.

Chapter 4 gives the preparation of thin films of conducting polymers by RF Plasma polymerization method. Plasma polymerized thin films of different monomers like (o-toluidine, NN-dimethylaniline and 3-methylthiophene) on ultrasonically cleaned glass and silicon wafer substrates were obtained by polymerizing of (o-toluidine) monomer (99.9 % purity) under radio frequency (RF) plasma discharge in a home built set up. The deposition rate is found to be 3.33 nm/min. The films are characterized by dc conductivity, UV-Visible, FTIR and XRD techniques. The dc conductivity of the thses thin films has been analyzed in the temperature range from 312 to 435 K and is found to increase with temperature. The Arrhenious plot of DC conductivity shows straight line behaviour. The optical band gap has been estimated from UV–visible absorption spectrum. From FTIR, the formation of polymer has been confirmed. It is found that the synthesized polymer is cross-linked. Thickness of the polymer films has been measured by ellipsometry. XRD shows the amorphous nature of the prepared films.

Chapter 5 In this chapter, the Oxidative polymerization method has been used to synthesize polymer nanocomposites and studies the unusual dielectric response in these nanocomposites. Here, we have extended our study from bulk micron sized polymers to the nanocomposites using a very fast synthesis route. The Single wall carbon nanotubes and Zinc Oxide nano materials used as dopants. Samples were prepared in the form of pellets by using hydraulic press at a pressure of 767 kPa then charecterised by FTIR, XRD, DC conductivity, UV- Visible studies and dielectric properties. The correlative results were used to investigate the physical and chemical phenomenon responsible for its dielectric response in polymer nanocomposites.

Overall achievements of the investigations have been summarized in the last *Chapter 6* along with general discussion and conclusion. The chapter states that the results are good in consistent agreement with the available experimental data.