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X-Ray Diffraction Study of Polypyrrole/Fluoroscein Composite Synthesized By Chemical Method

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ABSTRACT

In-situ chemical oxidative polymerization of pyrrole (Py) was carried out by doping it with Fluoroscein in the presence of oxidizing agent ammonium peroxydisulphate to synthesize polypyrrole/Fluoroscein dye composites. The PPY/ composites were synthesized with various composition of fluorescein dye in pyrrole. Morphological characterization of synthesized composites was carried out by powder X-ray diffraction (XRD) analysis. These studies suggest that they exhibit amorphous behavior and change in surface morphology due to insertion of dopant.

Keywords : PPy, APS.

I. INTRODUCTION

Over the last few decades polymers have attracted considerable interest in research for the development of advanced materials. The organic materials that generally possess an extended conjugation of Π-electron system along a polymer backbone chain are recognized as electroactive conducting polymers.[1] These materials with interesting electron-transport behavior to a material exhibits immense potential in technological applications such as in electrochromic devices, non-linear optical system OLEDs, photoelectrochemical devices, gas sensors, biomechanical sensors.[2]

Among the number of conducting polymers, Polypyrrole (PPy) is profoundly studied material due to its superior conductivity, good thermal and environmental stability, electrochemical reversibility, high polarizability and the ease of preparation through chemical or electrochemical routes.[3] However, PPy is limited in practical use due to its very fragile structure and insolubility. It exhibits poor processability and lacks essential mechanical properties.[4] These properties and applicability of polypyrrole can be improved by some suitable modifications of existing polymers structures.[5] This can be achieved by judicious choice of making composites of PPy by doping it with suitable dopant material in order to prepare multifunctional molecular structures that open possibilities for almost any desired applications.[6-7]

The association of PPy with fluorescein in order to prepare its composite which combine the properties of both materials is one very promising way to obtain the specific requirements of physical properties for each type of application.

II. METHODS AND MATERIAL

The 0.1 M solution of AR grade pyrrole was contained in a beaker which was placed on a magnetic stirrer. 0.1 M ammonium peroxydisulphate solution was continuously added drop-wise with the help of a burette to the above 0.1 M pyrrole solution. The reaction was allowed for 6 hours under continuous stirring by maintaining a temperature of 0°C to 5°C. The precipitated polypyrrole was filtered and dried in hot air oven and subsequently in a muffle furnace at 100 °C. For 0.1 M pyrrole solution, 0.0001 M solution of Fluorescein was added and mixed thoroughly, further 0.06 M ammonium peroxydisulphate was continuously added drop-wise with the help of a burette to the above solution to get PPy/0.0001 M Fluorescein composite. Similarly PPy/0.00001M Fluorescein is also prepared by following the above procedure. The pure PPy and PPy/ Fluorescein thin films were prepared by bath deposition technique.

The synthesized composite materials were subjected to morphological studies through X-ray diffraction analysis.

III. RESULTS AND DISCUSSION

The X-ray diffractogram of PPy/Fluorescein dye composite is shown in following fig

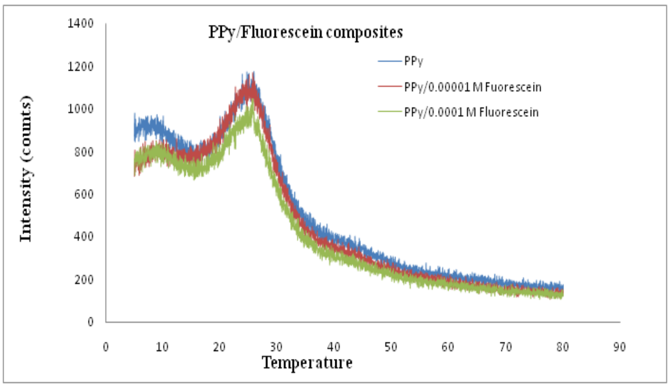

Fig 4.58: X-ray diffractogram of PPy/fluorescein dye composites

PPy (pure), exhibits a broad characteristic peak at around 2θ =25.73º, this peak is corresponding to highly disordered region, which is indicates amorphous nature of PPy. This strong diffraction peak associated with the chain–to-chain stacking distance at about 2θ = 25.73° can be attributed to scattering from all over chains due to the amorphously packed PPy polymer composites. The peak pattern obtained in PPy composites of Fluorescein is same as PPy which indicates basic polymer structure is retained after doping.

The long chains of the PPy makes it difficult for the orderly packing of chemically modified PPy and thus the crystalline nature of the chemically modified PPy is not possible. Thus chemically modified polypyrrole with fluorescein dye is in amorphous nature.

With the variation of Fluorescein concentrations i.e., from 0.01-0.2 M the PPy spectra look almost similar but with peaks shifted towards lower diffraction angle (25.68º and 24.66º in case of 0.00001 and 0.0001M dopant concentration of Fluorescein respectively) as compared to PPy (Pure). The shifting of peak towards lower diffraction angle is attributed to formation of quasi particles polarons and bipolarons which improves and enhances Polypyrrole morphology.

IV. CONCLUSION

Efforts have been made to synthesize the polypyrrole/Fluorescein dye composites to tailor the structural, morphological, and electrical properties of polypyrrole. Detailed morphological characterizations of the synthesized composites through XRD studies indicate the incorporation of dopant into the polymeric chain. The XRD study indicates the amorphous nature of the samples and the presence of hump in the diffractogram indicates the homogeneous nature of the polymer.

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