RESEARCH PAPER

X-RAY DIFFRACTION STUDY OF POLYPYRROLE/$LACL_3$ 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 Lanthanum Chloride ($LaCl_3$) in the presence of oxidizing agent ammonium peroxydisulphate to synthesize polypyrrole/Lanthanum Chloride (PPY/$LaCl_3$) composites. The PPY/$LaCl_3$ composites were synthesized with various compositions of viz., O.1 M and 0.02 M $LaCl_3$ 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.

Key words : PPy, PPy/$LaCl_3$,, APS.

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 $LaCl_3$ 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.

Experimental:-

The 0.1 M solution of AR grade pyrrole was contained in a beaker which was placed on a

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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, 0.1 M solution of $LaCl_3$ was added and mixed thoroughly, further 0.06 M ammonium persulphate was continuously added drop-wise with the help of a burette to the above solution to get PPy/0.1 M $LaCl_3$ composite. Similarly PPy/0.02 M $LaCl_3$ is also prepared by following the above procedure. The pure PPy and PPy/$LaCl_3$ thin films were prepared by bath deposition technique.

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

Result and Discussion:

The XRD diffractogram of PPy and PPy/$LaCl_3$ composites is given in fig.1

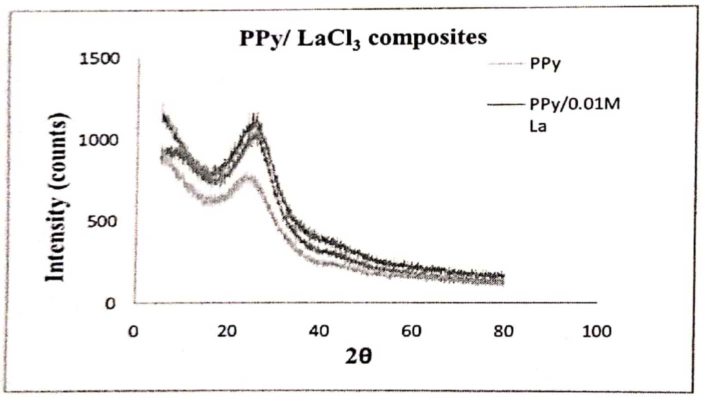

Fig.1 X-ray diffractogram of PPy/ $LaCl_3$ composite

From the X-RD analysis of the polypyrrole and PPy/$LaCl_3$ composites, it is observed that the film exhibited broad scattering peaks at 2θ value around 20-30°, which suggests that the polypyrrole and PPy/$LaCl_3$ composites are amorphous in nature. X-ray scattering studies of polypyrrole films have been reported to be highly disordered and non-crystalline.

The structural information was deduced from XRD pattern of PPy and PPy/$LaCl_3$ composites which indicates that the peak at 24.67^0 corresponds to basic polymeric chain of PPy. This broad peak at about 2θ= 24.67° is due to the pyrrole intermolecular spacing and the pure PPy is amorphous in nature.

The XRD patterns of PPy/$LaCl_3$ composites show similarity to the pattern of PPy indicated basic polymeric chain pattern is retained in the composite material. The XRD patterns of PPy/$LaCl_3$ composites show similarity to the pattern of PPy indicated basic polymeric chain pattern is retained in the composite material while the peaks are shifted to lower diffraction angle (24.20 and 22.29 in 0.01 M and 0.2 $LaCl_3$ dopant concentrations respectively). The shifting of peak towards lower diffraction angle is attributed to formation of quasi particle polarons and bipolarons which improves and enhances Polypyrrole morphology.

The reflection intensity decreases with increasing concentration of dopant $LaCl_3$ indicates less ordered structure of PPy after doping. This change in XRD pattern in the PPy after doping indicates variation in morphology of PPy. The XRD pattern reveals that the resulting structural and morphological properties of PPy/$LaCl_3$ composite are improved and enhanced.

4. Conclusion

Efforts have been made to synthesize the polypyrrole/Lanthanum chloride 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.

5. References

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