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Research Paper

Optical Study of Polyaniline without metal doping

Physics

KEYWORDS : Polyaniline (PANI), Doping, conducting polymer, electrochemical performance

Dr. Mahendra Kumar Assistant Professor, Deptt. of Physics, University of Lucknow.

ABSTRACT

The Polyaniline is widely study conducting polymer due to its applications in several devices such as biosensor, Gas sensor & Solar cell. This deals with synthesis and characterization of Polyaniline. The characterization has been divided into three categories viz. transmittance by UV-Visible spectroscopy (UV-Vis-NIR V670JASCO).

1. Introduction

The change in physico - chemical properties of Polyaniline (PANI) and its derivatives occurring in response to various external stimuli have been used in different applications e.g. in organic – electrodes, sensors and actuators [1-3]. Other uses are based on the combination of electrical properties typical of semiconductors with material parameters' characterization of polymers. The examples being the electrochromic devices [4], plastic microelectronics systems [1,2] , tailor made composite systems [5,6] and smart fabrics [7]. The establishment of the physical properties of PANI, prepared under different conditions is thus of fundamental importance. The study of electrical property of polymeric materials has become interesting area of research because these materials have great potential application . Most of the polymeric materials are poor conductors of electricity because they don't have free electrons to participate in the conduction process. The Polyaniline is widely study conducting polymer due to its applications in several devices such as biosensor, Gas sensor & Solar cell. Polyaniline (PANI) is an important conducting polymer due to its facile synthesis, environmental stability, and controllable physical and electrochemical properties by oxidation and protonation . PANI has been used in cathode materials of the lithium secondary batteries.

2. Synthesis and Characterization of Polyaniline without metal doping

The basic material required was prepared through chemical synthesis and UV-visible characterization were made, in different samples, as described in the following:

2.1 Chemical Synthesis of Polyaniline (PANI)

Synthesis of Polyaniline done by chemical prepared was dark green in colour. It had a high molecular weight and very few (<0.5%) oligomers could be extracted from it for 24 hours. The yield of polymer was more than 50% after washing & drying.

2.2 Characterization of PANI without metal

The results of different characterization are given as in the following:

2.2.1 UV- Visible spectra

The UV-Visible spectrum of chemically synthesized PANI without metal doping, when dissolved in 1-methyl 2-pyrrolidene (NMP) was recorded with the reference cell containing NMP alone taking the help of a JASCO spectrophotometer, model V-670. Fig.(a) shows the UV- Visible spectrum, thus recorded , for the PANI samples as above.Two absorption peaks of good oscillator strengths are clearly seen in the optical absorption spectrum at 330 nm and 633 nm. These are characteristic of emeraldine base form of PANI [8]. It thus seems that deprotonation of salt had occurred in the PANI samples before recording the spectrum. This is in conformity with the studies of Pruneau et al [8] who have reported that a large excess of NMP leads to the deprotonation of dissolved PANI salt to the emeraldine base form, due to C = O groups in NMP forming hydrogen bonds with the dopant and thus withdrawing the proton of PANI. It may be mentioned that no deprotonation has been reported for solvents of different type, such as methanol and acetonitriteThe 330 nm band can now be assigned to $\pi - \pi^*$ transition in the benzenoid structure [10]. The absorption in the visible range, at 633 nm, is ascribed to excitation formation in the quinoid rings [11].Finally, the highest energy shoulder peak at 270 nm may be attributed due to $\pi - \pi^*$ charge transfer in aniline monomer [12] left over in the solution after the polymer formation.It may be mentioned that the present optical absorption recordings were for PANI dissolved in NMP, wherein it had got deprotonated and thus no polaron assisted peaks [13] could be expected.

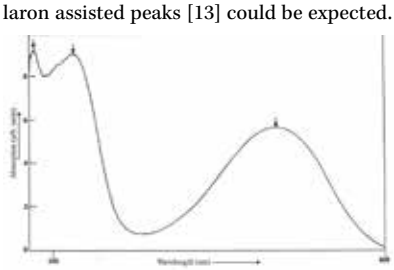

Fig. (a) UV- Visible absorption spectra of PANI without any metal doping

Conclusion

The conclusion derived from various studies on characterization of PANI without metal doped may be summarized as below.

UV- Visible absorption

The UV-Visible absorption spectra obtained, after dissolving the sample in a solvent, indicate that these get modified in its character due to hydrogen-bond formation with the solvent molecules. The protonation had thus disappeared and the observed spectra represented the emeraldine base form of PANI in its both metal-doped and no metal doping varieties. The optical absorption spectra obtained however, for the film varieties of PANI support the theoretical predictions of Stafstrom et al [13].

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