Synthesis and characterization of doped polyaniline.

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ABSTRACT

This paper aims to synthesis and investigation of the dc electrical conductivity of doped polyaniline synthesized by simple chemical oxidative polymerization method. To know the role of dopant with varying concentration and varying temperature on the dc electrical conductivity has been studied. The Infrared spectrum used for molecular studies .

Keywords: Composites; Polyaniline, Dc conductivity, Cadmium Iodide.

Introduction:

There is continuous interests in conducting polymers due to their potential applications in various fields. Among all the conducting polymers ,polyaniline is easy of synthesis in doped and undoped forms.,It is environmentally stable and variability of its conductivity through doping[1-4]

PANI has become a suitable candidate for a variety of technological applications [5-7], such as solar cells, electromagnetic shielding, electrodes for rechargeable batteries, sensors, etc. These composites have the ability to enhance their material properties with desirable mechanical and physical characteristics. The most preferred method for synthesis polyaniline composites is to use either HCL or H_2SO_4 with ammonium peroxidisulphate as an oxidant [8].
The present study focuses on the synthesis and investigation of the dc conductivity as well as IR spectra of pure and doped polyaniline.

Materials and Methods:

All the materials were obtained from well known companies. All materials were used as provided. Aniline hydrochloride was dissolved in distilled water in a volumetric flask to 50 mL of solution. Ammonium peroxydisulfate was dissolved in distilled water also to 50 ml of solution. Both solutions were kept for 1 h at room temperature, then mixed in a beaker, briefly stirred and left at rest to polymerize. Next day, the precipitated polyaniline was filtered by conventional method. The polymer was washed with distilled water several times. The polyaniline samples obtained in powder form were dried first at room temperature for few hours and then finally dried in an oven kept at 60^oC- 90^0C for 1/2-1 hours. The dried polymer powder was then preserved for sample preparation[9,10]. Doping was done with Cadmium Iodide of different concentrations. Solutions were prepared in the aqueous medium with aniline hydrochloride.

Measurement:

IR spectroscopy is important and useful technique for determining functional groups present in a compound. Studies were carried out in order to confirm the presence of Cadmium Iodide in the polyaniline/doping concentration of polyaniline with different dopants. IR spectroscopy can distinguish between benzenoid rings and quinoid rings in the 1300 to 1600 cm-1 region of the spectrum; this region of the spectrum is most useful for distinguishing between oxidation states in the undoped polymer, as the quinoid stretches disappear on doping. IR spectra of the samples was taken using a spectrometer (SHIMADZU IRAFFINITY1).The characteristic absorption bands thus obtained are shown in Figure 3. Our results show that ,there is a shift in the responses after doping the samples with Cadmium iodide, giving rise to a good comparison between the doped and undoped polymer.

DC conductivity :

The dc electrical conductivity of all composite pellets was measured by using two probe methods in the temperature range 318 to 358 K. The pellet of composite was kept between the electrodes of specially designed sample holder which was kept in a muffle furnace. The heating rate of the sample was 1^oC/min and it was controlled by using dimmerstat. The potential applied to the sample was kept constant (1 V) and temperature increases with the rate 1^o C/min and corresponding current was observed with the help of Pico-ammeter. The thickness of the pellet was measured by DIGIMATIC micrometer having least count 0.001mm. Finally the electrical conductivity of all pellet was calculated by using the formula.

$$\sigma dc = t/RA \qquad (1)$$

Where, t is the thickness of the pellet, A is the area of the sample and R is the resistance of the pellet sample .

Results and discussion

Temperature dependence of dc conductivity

The variation of dc electrical conductivity with temperature (log σdc Vs 1/T) for all doped polyaniline composite pellet in the temperature range 318 to 358 K shown in figure 1. From it is observed that the dc conductivity of doped polyaniline composite pellets depends on temperature. The dc electrical conductivity of these pellets increases with increase in temperature, indicating negative temperature coefficient (NTC) of resistance

Figure 2 shows the variation of activation energy with concentration of cadmium iodide . Composites of cadmium iodide show changes in the conductivity with the change in weight percentage of cadmium iodide.

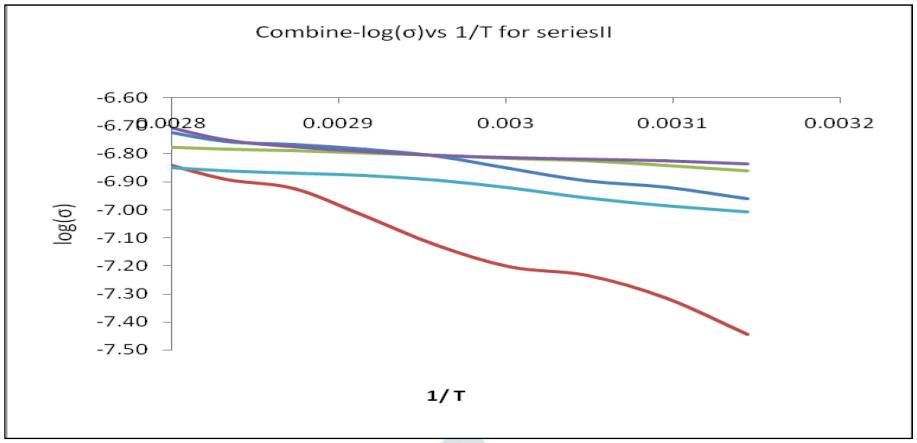

Fig.1- The variation of dc electrical conductivity with temperature (log σdc Vs 1/T) for all doped polyaniline composite pellet in the temperature range 318 to 358 K.

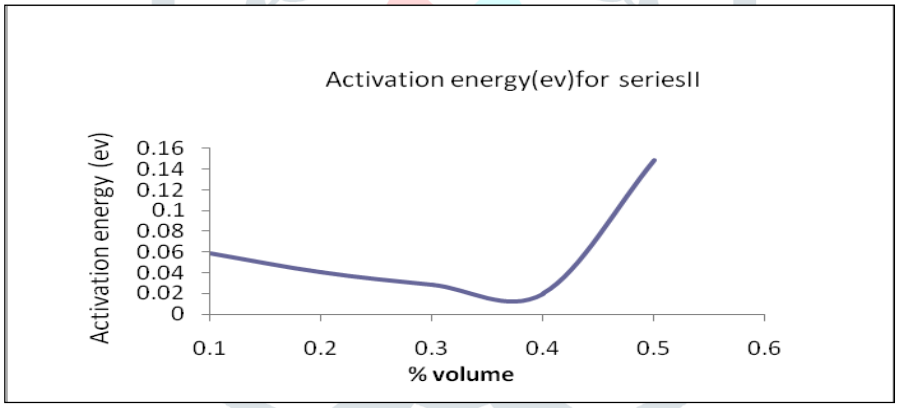

Figure 2: Variation of activation energy with wt % of Cadmium Iodide.

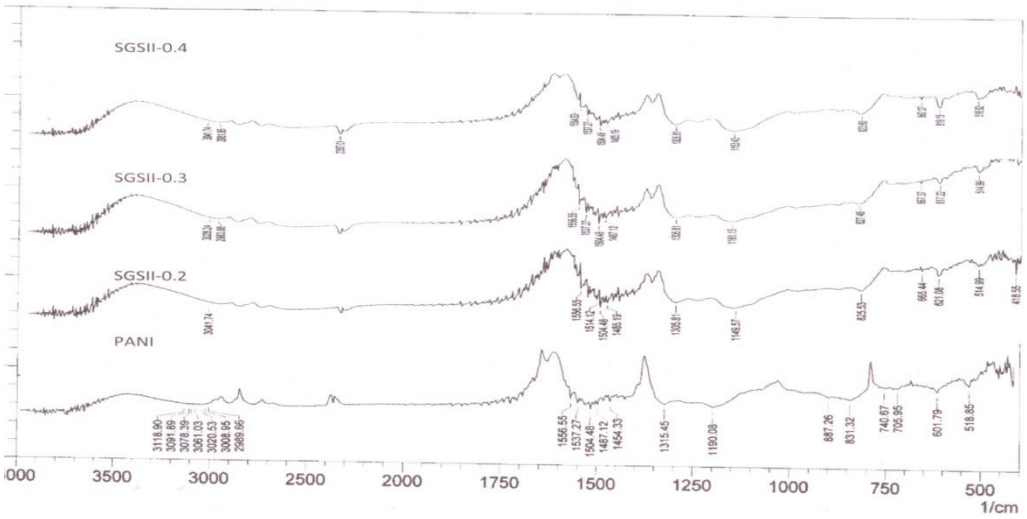

Figure 3:IR Spectra of pure and doped polyaniline.

Conclusion

Doped polyaniline prepared by using chemical oxidation for different concentration of cadmium iodide shows the increase in dc conductivity and conductivity is found to be maximum for 30% composition of cadmium iodide.
The dc electrical conductivity of these pellets increases with increase in temperature, indicating negative temperature coefficient (NTC) of resistance.

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