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# AC CONDUCTIVITY STUDY OF POLYANILINE / $NiCuFe_2O_3$ COMPOSITES

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## ABSTRACT

The PANI/ $NiCuFe_2O_3$ composites have been synthesized by Insitu polymerization of aniline in the presence of $NiCuFe_2O_3$ by chemical oxidation method with various compositions viz., 10, 30, and 50 Wt. % of $NiCuFe_2O_3$ in PANI. The AC conductivity was studied in the frequency range $10^2$–$10^7$ Hz. The dimensions of $NiCuFe_2O_3$ particles in the matrix have a greater influence on the conductivity values.

**Keywords:** AC conductivity, Polyaniline, $NiCuFe_2O_3$, Composites.

## 1. INTRODUCTION

Polymers have become increasingly attractive because of its large number of applications inapplied and basic science. Conductive polymer composite (CPC) materials result from the mixture of conductive particles dispersed in an insulating phase. The filler is usually a metal powder, carbonblack, fiber of carbon black, metal fibers, etc and the insulating phase can be a thermosetting resin, thermoplastic, elastomer, etc. The composite material combines both the intrinsic properties of the fillers (mechanical, electrical, magnetic, and thermal) and of the matrix (elasticity, easy to manipulate, low cost). The various conductive properties of CPC have allowed them to find a variety of industrial applications. They are used, for example, as protection devices against electromagnetic radiation and for the dissipation of electrostatic discharge, and in microelectronics as electrical conductive adhesive for electrical connections. The control of the conductivity of CPC is also interesting for applications including sensor, electrochemical actuators, electromagnetic shielding, polymeric batteries etc. The conductivity of these composites depends strongly on the nature and interaction of the filler with the polymeric matrix [1-6]. Therefore mixed ferrites ($NiCuFe_2O_3$) was selected as filler due to its interesting electrical properties, this paper emphasize on the effect of $NiCuFe_2O_3$ addition on transport properties of polyaniline.

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## 2. EXPERIMENTAL

All Chemicals used are analytical grade (AR) and were procured, used as received. The monomer aniline was doubly distilled prior to use. Synthesis of Polyaniline / $NiCuFe_2O_3$ composites has been carried out by single step in situ polymerization technique. 0.1 mol of aniline was dissolved in 1 M of Hydrochloric acid to form aniline hydrochloride. Fine grinded powder of $NiCuFe_2O_3$ is added in the weight percent of 10, 30 and 50 to the above solution with vigorous stirring to keep$NiCuFe_2O_3$ suspended in the solution. To this reaction mixture, 0.1 M of oxidizing agent ammonium persulphate $[(NH4)_2S_2O_8]$ in 1 M of Hydrochloric acid was added slowly with continuous stirring for 4-8 hr at $0\text{-}5^0$ C to polymerize. The precipitated powder was recovered, vacuum filtered and washed with deionised water. Finally, the resultant precipitate was dried in an oven for 24 hr to achieve constant weight. In this way, three different PANI /$NiCuFe_2O_3$ composites with different weight of $NiCuFe_2O_3$(10, 30 and 50) in PANI have been synthesized [7-11].

### 2.1 Preparation of pallets

The pellets of 10 mm diameter are formed with thickness varying upto 2 mm by applying pressure of 10 Tons in a UTM – 40 (40 Ton Universal testing machine). For conductivity measurement, In this experiment, three different samples of each composite varying in their weight percentage are investigated for their frequency dependent Dielectric constant.

## 3. RESULTS AND DISCUSSIONS

Figure 1 shows the variation of ac conductivity as a function of frequency for polyaniline – $NiCuFe_2O_3$ composites (different wt %). In all the cases, it is observed that, the ac conductivity is quite low for lower frequency and increases with increase in applied frequency but 30wt% of composite shows maximum value. The observed behavior may be due to Debye like relaxation mechanism taking place in all these materials.

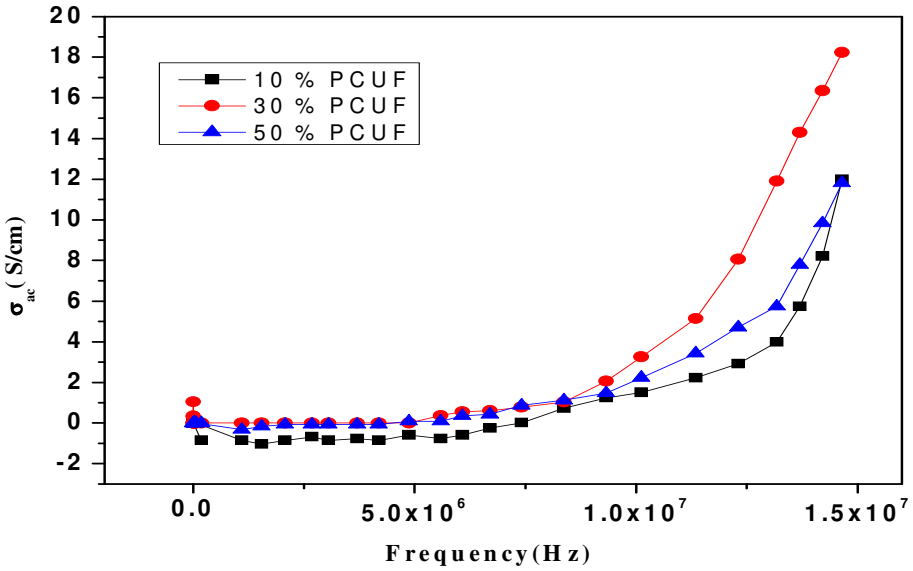


**Figure 1: Variation of ac conductivity as a function of frequency for Polyaniline- $NiCuFe_2O_3$**

## 4. CONCLUSION

Polyaniline composites with different weight percentages of $NiCuFe_2O_3$ in PANI were synthesized by chemical oxidative polymerization of monomer aniline. The results of ac conductivity show a strong dependence on the weight percent of $NiCoFe_2O_3$ in polyaniline.

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