Indian J.Sci.Res. 17(1): 30-33, 2017 ISSN: 0976-2876 (Print)
ISSN: 2250-0138(Online)

AC CONDUCTIVITY STUDIES OF POLYANILINE/CuO COMPOSITES

HAJEEBABA K INAMDAR[a], SASIKALA.M[b], CHAKRADHAR SRIDHAR B[c], BASAVARAJA SANNAKKI[d] AND M.V.N.AMBIKAPRASAD[e1]

[ade]Department of Physics, Gulbarga University, Kalaburgi, India
[b]Department of ECE, Godutai Engineering Collage for Womens, Kalabaurgi, India
[c]Department of Physics, AMC Engineering Collage, Bangalore-, India

ABSTRACT

In-situ polymerization was carried out in the presence of copper oxide, to synthesize Polyaniline CuO composites. The synthesis is reported here, characterization and ac-conductivity results of some polyaniline (PANI)based composites. These materials were synthesized through incorporation of various fractions of metal oxides.Paramagnetic metal oxide particles with appropriate surface properties have been widely used experimentally for numerous *in vivo* applications such as contrast enhancement in magnetic resonance imaging, tissue repair, immunoassay, detoxification of biological fluids, hyperthermia, and drug delivery and in cell separation *etc*. In the present investigation, polyaniline/ CuO composites with Copper oxide (50%) were synthesized by *in-situ* polymerization method. The composites were characterized by X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM). The dc conductivity of the samples were measured as a function of temperature in the range 30-190 ^{o}C and it was observed that the increasing the concentration of the Copper oxide particles increases the ac conductivity of the Polymer composites.

Keywords: Conducting Polymers, Polyaniline(PANI), Cuo, Electrical Conductivity

A material whose structure is originally conductive,such as conductive polymer,can be used to prepare antistatic materials.Owing to its excellent properties and lower price, carbon black , in past decades, has been blended into polymers materials, to provide the conductivity of materials.Owing to its unique electro-optical properties,polyaniline (PANI) has been extensively investigated in the field of conductive polymers (Salmi et al, 2013). In recent years nanocomposites have become one of the most extensively studied materials all over the world, as they have shown to posseses several technological applications *e.g.* in effective quantum electronic devices, magnetic recording materials and sensors etc.(Salmi et al ,2013.) Further, nanocomposites composed of conducting polymers and metal oxides have opened many applications *e.g.* in drug delivery, conductive paints, rechargeable batteries, toners and smart windows etc.(Soloman et al 2007), and pinter et al. The present study especially aims to investigate PANI-CuO composites in order to obtain a new noble material which can be utilized for electrical applications.

CuO is a semiconducting material that has a direct wide band gap of 2.5 eV at room temperature. Indeed CuO is a peculiar material that exhibits multiple Properties that include piezoelectric, semiconducting, piezoelectric and photo catalytic activities ambalaji et al. In the present paper, PANI/CuO composites were prepared by *in situ* polymerization of aniline monomer with different doping concentrations of CuO9-10]. All the composites have been analyzed using X-ray Diffraction (XRD) and Scanning Electron Microscopy (SEM). The dc conductivity of these composites was studied as a function of temperature at different dopant concentrations.

EXPERIMENTAL

Synthesis of Polymer

The synthesis polyaniline (PANI) was based on mixing aqueous solution of aniline hydrochloride and ammonium persulphate at room temperature, followed by the separation of PANI hydrochloride precipitate by filtration and drying. An equi-molar volume of aniline and hydrochloride acid was dissolved in distilled water in a volumetric flask to obtain 100 ml of solution. Similarly, ammonium per sulphate (0.6M) was dissolved in 100 ml water. Both solutions were kept for 1 hour at room temperature and then mixed in a beaker, stirred with A

[1]**Corresponding Author**

mechanical stirrer and allowed to polymerizing. After a day, the PANI precipitate was collected on a filter, washed with 0.3 M HCL and acetone repeatedly. The Polyaniline hydrochloride powder was then dried in air in vacuum at 60 ^{o}C for 24 hours.

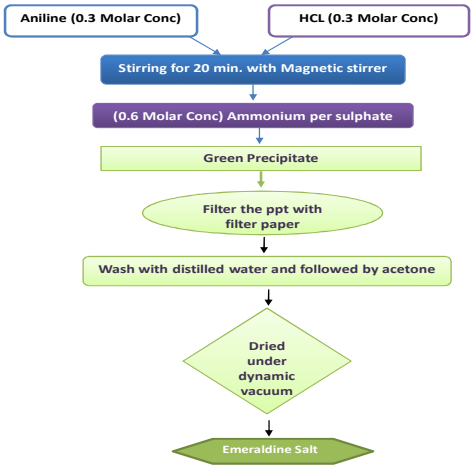

Fig2.1. (a) Flow Chart for Preparation of Polynailine/CuO Composites

2.2 Synthesis of Polyaniline/Copper oxide composites

Synthesis of Polyaniline–Copper oxide composites were carried out by *in-situ* polymerization method. Aniline (0.3 M) was mixed in 0.3 M HCl and stirred for 15 min to form aniline hydrochloride. Copper oxide powder were added in the mass fraction to the above solution with vigorous stirring in order to keep the copper oxide homogeneously suspended in the solution. To this solution, 0.6 M of ammonium per-sulphate, which acts as an oxidizer was slowly added drop-wise with continuous stirring at ice temperature for 4 hours to completely polymerize. The precipitate was filtered, washed with deionized water and acetone, and finally dried in an oven for 24 h to achieve a constant mass. The Polyaniline - copper oxide composites were thus obtained containing various weight percentage of nickel oxide (*i.e.*10, 20, 30, 40, & 50%)

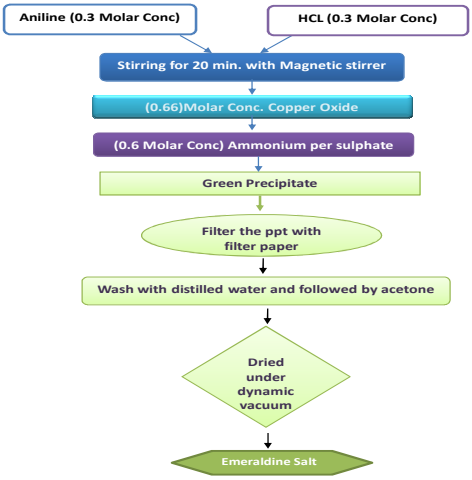

Fig2.2. (b) Flow Chart for Preparation of Polynailine/CuO Composites

PREPARATION OF PELLETS

The powders of Polyaniline, Polyaniline/CuO composites, so obtained from synthesis Method discussed in early sections were make as a fine powder with the help of agate mortar in the presence of acetone medium. The powder is then pressed to form pellets of 10 mm diameter and thickness varying up to 1.8mm by applying pressure of 80 MPa in a hydraulic pressure. temperature dependent conductivity studies, the n the pellets were coated with the silver paste on both faces of the pellet for providing electrical contacts, gadisa et al ,2006.

RESULTS AND DISCUSSIONS

Electrical conductivity

The frequency dependence of AC-electrical conductivity of Pure Polyaniline (PANI) and PANI / CuO composite is shown in figure 6. As shown in the figure, the Ac-electrical conductivity of the PANI / CuO composite is higher than that of the pure PANI. The lower conductivity of the pure PANI could be ascribed to low level of protonation of the PANI chains. The improvement of AC conductivity for PANI / CuO composite comes from the effective dispersion of CuO particles in the PANI matrix which favors better electronic transport. It shows that the ac-conductivity is frequency dependent and enhances with an increase of the frequency. This indicates that there may be charge carriers, which can be transported by hopping through the defect sites along the polymer chain. It can be seen that the conductivity of PANI / CuO composite increases as the frequency increases. The frequency dependence of the AC-conductivity is considered to be a result of interface charge polarization (or Maxwell-Wagner-Sillars effect) and intrinsic electric dipole polarization, (Yoshino, 1989).This phenomenon appears in heterogeneous systems like metal-polymer composites due to the accumulation of mobile charges at the interfaces and the formation of large dipoles on metal particles or clusters.

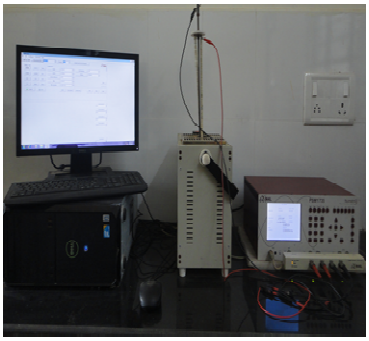

Fig: 3.1 LCR meter Newton Model PSM-1735

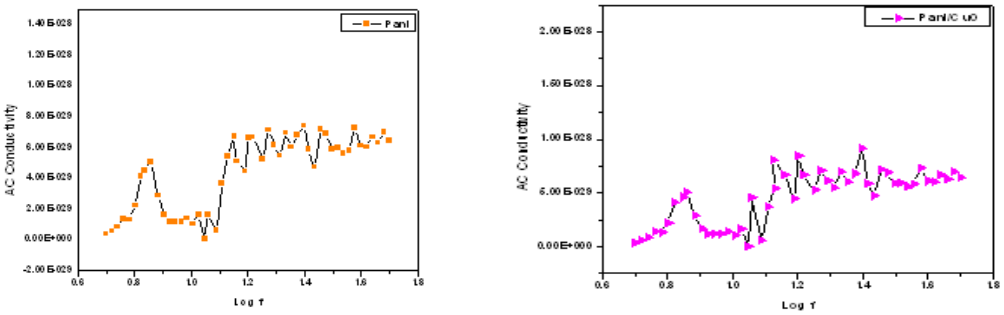

Fig:3.2 Pure Polyaniline and Polyaniline CuO Composite Sample

Dielectric Properties

The dielectric properties have been studied for the PANI/CuO composites. Dielectric loss factor variation with frequency for all the five composites is plotted in Figure 2. The Figure 2 shows that dielectric loss decreases with increase in frequency and at the higher frequency loss becomes almost constant and similar behavior was observed in ,Yoshino et al, 1985.

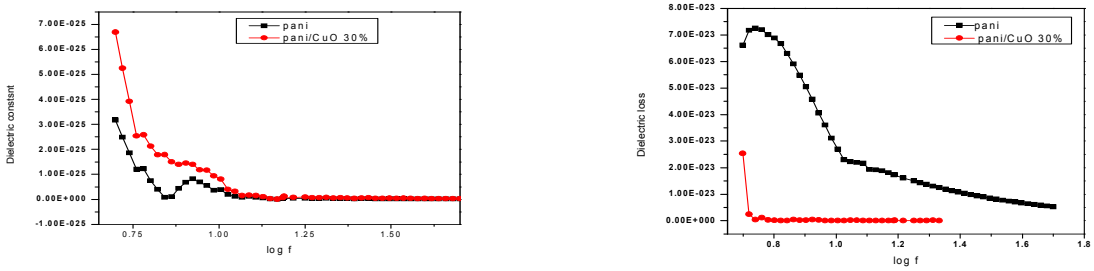

Fig:3.3 Pure Polyaniline and Polyaniline CuO Composite Sample

AC conductivity

Figure 3.2 shows the variation of ac conductivity as a function of frequency for Polyaniline –CuOcomposites for (50wt %). It is observed that σ_{ac} remains constant up to 10^4Hz. polyaniline /CuOcomposites shows high conductivity due to interfacial polarization. However, in case of pure polyaniline and other composites with Polyaniline conductivity is comparatively high. The conductivity of PANI/CuO composites increases due to the distribution of CuO particles in Pure Polyaniline.

REFERENCES

M. F. Attia, T. Azib, Z. Salmi et al., 2013 "One-step UV-induced modification of cellulose fabrics by polypyrrole/silver nanocomposite films," Journal of Colloid and Interface Science, **393:** 130–137.

S. D. Solomon, M. Bahadory, A. V. Jeyarajasingam, S. A. Rutkowsky, C. Boritz, and L. Mulfinger, 2007 "Synthesis and study of silver nanoparticles," Journal of Chemical Education,**84:** 322–325.

E. Pinter, R. Patakfalvi, T. F ´ ulei, Z. Gingl, I. D ¨ ek´ any, and C. ´ Visy, 2005 "Characterization of polypyrrole-silver nanocomposites prepared in the presence of different dopants," The Journal of Physical Chemistry B,109: 17474–17478.

W. J. Kwon, D. H. Suh, B. D. Chin, and J.-W.Yu, 2008, "Preparation of polypyrrole nanoparticles in mixed surfactants system," Journal of Applied Polymer Science, **110:**1324–1329.

F. Lopez-Garc ´ ´ıa, G. Canche-Escamilla, A. L. Ocampo-Flores, ´ P. Roquero-Tejeda, and L. C. Ordo´nez, 2013 "Controlled size nano- ˜ polypyrrole synthetized in micro-emulsions as PT support for the ethanol electro-oxidation reaction," International Journal of Electrochemical Science, 8:3794–3813.

A.Gadisa,Tvingstedt,S.Admassie,L.Lindeel,X.Cripsi n,M.R.Anderson,W.R.Salanech,**2006,**O.Inga nas, Synth .met**,** 156:1102.

K.Yoshino, 1989.Synth.Met, **28**, C669.

Hajeebaba K Inamdar1, H. Nagabhushana2, R.D. Mathad1 .2016. Materials Today: Proceedings **3** :3850–3854

Sharanabasamma M Ambalagi, Hajeebaba K Inamadar,2016. Materials Today: Proceedings 3 , 3945–3950

K.Yoshino, M.Ozaki and R.Sugimoto, 1985.Jpn.J.Appl.Phys.Lett.**24:** 373.