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Composites : Poly Aniline–Polyvinyl Alcohol- Cuprous Chlorides Applied Different Temperature for Gas Detector

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ABSTRACT

In our present study, we have developed Polyaniline –Polyvinyl alcohol -Cuprous chloride doped thin films polymeric composites. These films were synthesized by chemical oxidative polymerization in aqueous medium. These polymeric composites were characterized by U. V. -visible, FTIR, surface morphology by Scanning electron microscope (SEM). Their electrical conductivity was measured by four probe techniques. The ohmic behaviour observed by I-V characteristics. Gas monitoring properties of the sensor was checked against hazardous gases like Ammonia. The sensor shows almost stable and repeatable response for minimum 5 ppm and maxmum 500 ppm for at varies at 25-40 degree temperate.

Keywords: Polymer, Polyanailine, Cuprous Chloride, Conducting Polymer, Ammonia Gas Sensor.

I. INTRODUCTION

Materials have been vital in the historical background of human undertakings and their study. One of the most significant group of materials in our lives today is composite material. The man made composite material, is a three-dimensional blend of at least two artificially unmissable materials, with a particular interface isolating the segments, made to acquire properties that can't be accomplished by any of the segments acting alone(1) . Nanocomposites are composites in which at any rate one of the stages shows measurements in the nanometer range. These materials have been arisen as reasonable choices to conquer impediments of miniature composites and solid (2). The polymers having poly-formed structures and have poor electrical conductivity however the oxidized polymers show apparent electrical conductivity. Among synthesis polymers Polyaniline (PANI) is novel among the directing and the most investigated, natural occurring polymer which is nothing but difficult to incorporate, having reasonable great synthetic dependability and generally read for electronic and optical applications(3). Various metal constantly oxide particles have been epitomized into the conductive polymer to structure nano-composites. Over the most recent 20 years, there has been a strong emphasis on the turn of development of the PANI-based nanocomposites. These composite of nanomaterials are required to show a few synergistic properties between the polymer and the metal nanoparticles, making them expected contender for application in a few fields, for example, catalysis, sensors, memory

devices(4). Cu nanoparticles have been applied in numerous fields since it has size impacts as well as high conductivity. Conductivity of Cu is in a similar request of magnitude as honorable metals like Au and Ag. Cu is a lot less expensive than the honorable metals; it can diminish the expense of items in useful applications. Then again, Cu nanoparticles can go about as impetus during polymerization to increment creation yield and change in the nanoparticles content may bring about various different changes like, thermal,mechanical, and electrical properties of the nanocomposites(5). These nanocomposites display the electrolytic and gas detecting properties.

The investigation deals with a study of the influence ofCuprous chloride dopant on synthesis of Polyaniline –Polyvinyl alcohol doped thin films. These synthesized films were characterized by U. V. -visible, Fourier transform Infrared spectroscopy (FTIR), surface morphology by Scanning Electron Microscopy (SEM),electrical conductivity and I-V characteristics. The gas sensing behavior for monitoring of ammonia gas vapors at repeatable response for minimum 5 ppm and maxmum 500 ppm concentrationfor at varies at 25-40 degree temperate .

II. METHODS AND MATERIAL

2. 1. Materials-

Analytical-reagent-grade aniline,Cuprous chloride and polyvinyl alcohol granular form (AR-grade) were obtained and used in the present study. Aniline monomer was purified by distillation under reduced pressure and stored in dark at 10^{o} C. oxidising agents are used again AR grade ammonium persulfate $(NH_4)_2S_2O_8$, Each process was done with double distilled conductivity water. (qualigen fine–chem. India) were used.

2. 2. Synthesis Polyaniline–Polyvinyl alcohol-Cuprous chlorideof Composites-.

For chemical polarization of aniline, ammonium persulfate $(NH_4)_2S_2O_8$ was used as an oxidant5 mL of aniline having 1N solution was dissolved in 20 mL of Aqueous ammonium persulfate $(NH_4)_2S_2O_8$ solution with doped with 5 ml of Cuprous chloride in ethanol and stirred for 25 min was added drop wise to the solution of aniline. Cuprous chloride was varied in, 0. 5N,1N,1. 5N and 2N,3N added to the aniline solution. This reaction mixture was stirred for 3 hr with magnetic stirrer in order to disperse Cuprous chloridein the polymer solution and inserted glass plate to obtained coated uniform thin films. The obtained product was filtered and washed thoroughly with distilled water in order to remove the unreacted aniline and excess ammonium persulfate the thin film are kept to observe the uniform effect of therefore it kept in ultarsonicate to control the thickness and smoothness of thin film fornation . Thethin film samples were kept vacuum-dried for 1 hr at 60–70^{O}c with unreacted to humid environment to remove the humidity also.

III. RESULTS AND DISCUSSION

1) UV-Visible spectra -

UV-visible spectroscopy is a very sensitive tool for the study of Cuprous chloridedoped Polyaniline – Polyvinyl alcohol thin films protonation and more precisely for the elucidations of the dopant Cuprous chlorideinto the thin films. UV-visible study selected those films, which have uniform, and good sensor response time. These sample films were dissolved in (DMSO) solvent, and then the UV-visible spectra recorded in the range 200-700 nm. The sample yields sharp peaks within 360-380nm and a broad band at 465-580nm wavelength ranges. In DMSO the sample, however exhibits broad peak around 680 nm indicating formation of emerladine base. Fig-. 1.

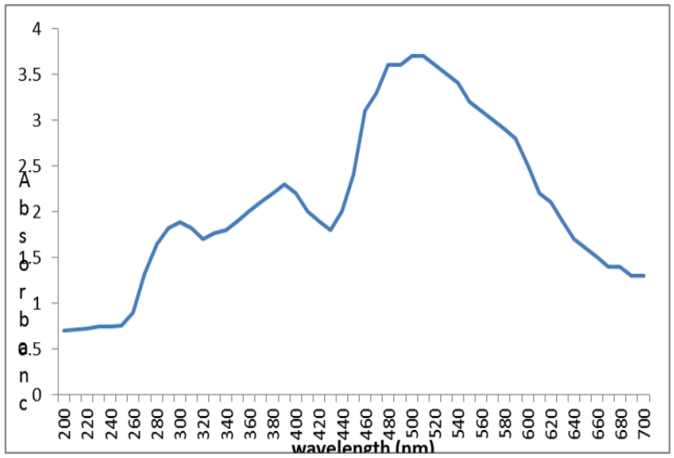

Fig-1. Polyaniline–Polyvinyl alcohol-Cuprous chloride –

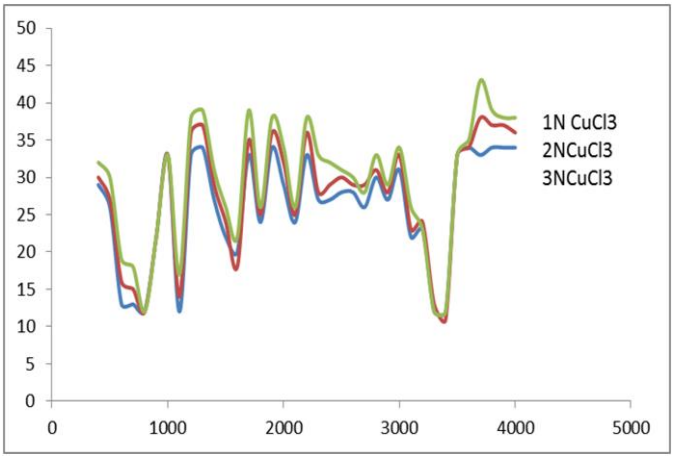

Fig 2. The FTIR spectra of Polyaniline–Polyvinyl alcohol-Cuprous chloride

2) FTIR-spectra

The FTIR- spectra of doped Cuprous chloridedoped Polyaniline –Polyvinyl alcohol thin composites thin films were recorded in the range of 4000-400 cm^{-1} usingDMSO as solvent The principal characteristics band occurrence indicates the type of functional group present in the polymer. The medium strong band observed at 3350 cm^{-1} suggests the presence of N-H stretch. The spectra shows the peak at 1620 cm^{-1}, which is due the presence of C=C group of aromatic benzonids ring. The observed medium intensity band in the region 1410-1244 cm^{-1} suggests the presence of C-N stretch). Cuprous chloride in Polyaniline –Polyvinyl alcoholmaterial (doublet) splits into triplets and shifts towards lower frequency at 1213 cm^{-1}. leading to exposure of the hidden C-N^{+} group as (NH, $^{+}NH_2$, ^{+}NH=, C=N^{+}) in Cuprous chloridedoped Polyaniline –Polyvinyl alcohol on the nature and percentage of doping which may effect the population of charge defect center (polaron and bipolaron) and ultimately the electrical conductivity. The C-O stretching vibrations in plane and out of plane, the bending vibration were observed at 1065cm^{-1} and 704 cm^{-1}.

The entire characteristics of band confirm the presence of doped conducting Cuprous chloridedoped Polyaniline –Polyvinyl alcohol thin films in Fig-2.

3) SEM study

A typical SEM image of 2NCuprous chloride dopedPolyaniline –Polyvinyl alcohol films having uniform and good stability. This film is shown in fig-3. Therefore SEM images give first hand information about a molecular level combination of the components and possibility for application as gas sensors. This thin films surface morphology study indicates that the films have porous surface and uniform in nature, which is one of the essential conditions for gas sensors.

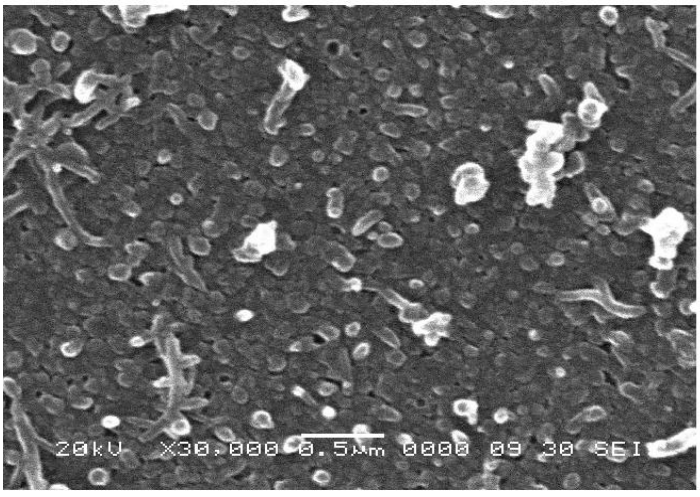

Fig -3. SEM image of 2NCuprous chloride dopedPolyaniline –Polyvinyl alcohol

3. 4) I-V characteristics-

The electrical conductivity of the synthesized Cuprous chloride having 1N,2N,3N dopedPolyaniline – Polyvinyl alcohol films studied at room temperature by four probe indigenous developed computer controlled (I-V) system. It is observed that, with the increasing concentration level, the electrical conductivity of thin films gradually increases.

The current-voltage (I-V) characteristics of synthesized films were studied to ensure an Ohmic behavior of all thin films samples but 2N,Cuprous chloride is more accurate linear relationship of I-V curve is shown in fig-4.

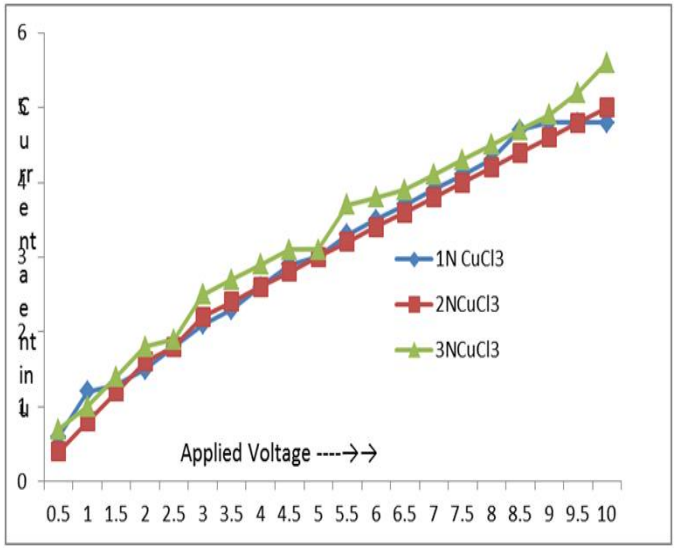

Fig-3. . I-V curve

3. 6) Ammonia Gas sensing behaviors-

The synthesized Cuprous chloride dopedPolyaniline – Polyvinyl alcohol thin films were studied for ammonia gas at different temperature by using indigenous developed computer controlled gas sensing system. Initially the films were allowed to saturate for 5minutes to expose to ammonia gas then after 7 minutes recovery time for minimum5ppm to maximum 500 ppm at 25,30,35,40,45 Degree temperature.

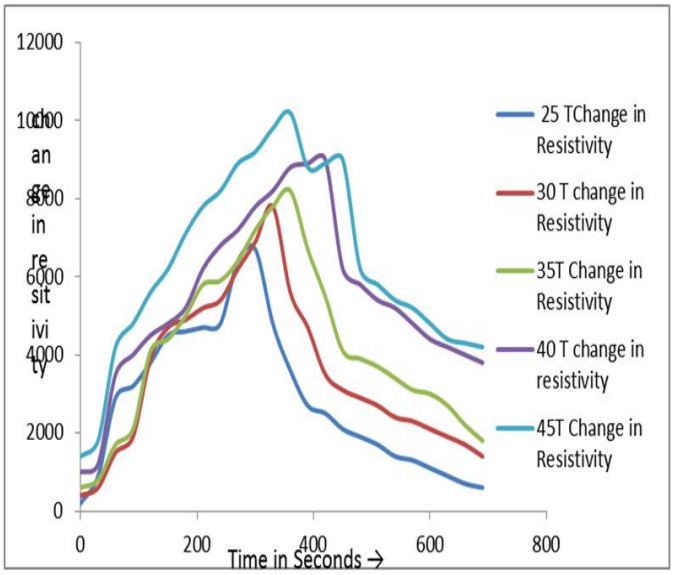

Fig-3. 6: TMA and ammonia Gas Monitoring Minimum 5ppm &Maximum-500ppm

IV. CONCLUSION

The present investigation concluded that, the synthesis of Cuprous chloride dopedPolyaniline – Polyvinyl alcoholcomposite films using chemical bath deposition method and successful fabrication of chemiresistive ammine sensors based onCuprous chloride dopedi composite films for ammine leakage detection at 25,30 and 35 degree Temperature good reposes and recovery time but whenever it increase the temperature the 2NCuprous chloride doped Composites not good response and recovery time . The I-V characterization study clear that the 2N Cuprous chloride dopedPolyaniline –Polyvinyl alcoholcomposite have liner ohmic behavior than that of 1N, 3N other synthesis films. Thus the usefulness of this study Cuprous chloride dopedPolyaniline – Polyvinyl alcoholcomposite films having good ohmic behavior as well as very nice ammonia sensor for minimum 5ppm level at indigenous developed sensor.

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