IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Synthesis and characterization of PVA Based Solid Polymer Electrolyte System

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Abstract

The polyvinyl alcohol (PVA) thin film added with different concentrations of Cupric Oxide (CuO) 5, 10, &15 weight% prepared by solution cast method has been investigated for Structural & Optical Properties. The structural investigation was done by using Fourier Transform Infrared Spectroscopy (FTIR). When PVA doped with CuO we found that (C= C) and (C–O) stretch the bond which shows that there is structural change that increases with dopant salt concentration. The absorbance and transmittance spectra have been recorded in the wavelength range of (320-620) nm in order to study the Optical Properties with UV-Vis which revels that as salt concentration increases (Cuo, CuO) absorbance also increases

*Keywords:*PVA , FTIR,UV-VIS Thin film, Polymer complex

Introduction

In recent years polymers have been a subject of considerable interest because of their physical and chemical properties. Polymers are widely used insulation, electrical industries as well as in micro electronics. Different polymers films i.e pure and doped with different additives is used in various medical, biological and technological applications.Polyvinyl alcohol (PVA) is a cheap polymer with a high density of functional –OH groups, it also shows potential for chemical cross-linking [1,2].Polyvinyl alcohol has excellent film forming, emulsifying and adhesive properties. It has high tensile strength and flexibility; it is odorless and nontoxic. PVA is an exceptional polymer with high dielectric strength, good charge storage capacity and dopant dependent optical and electric properties [3]. PVA is a semi crystalline material with fully degradable and dissolve in water which goes towards green chemistry. According to literature, several combinations of PVA with acid and saltshave been studied to improve structural and optical properties.Tawansi et al [4,5] studied the (PVA) films filled with various mass fractions of CuOand prepared by using a casting method. The filling level (FL) dependence of certain IR absorption peaks was correlated with the obtained physical parameter characterizing the other properties. AlaburManjunathetet all,F. A. Mustafa [6,7] studied made an attempt to disperse CuO nanoparticles in the polyvinyl alcohol (PVA) and to understand the change in structural, optical and electrical properties of the polymer film.

In this study,PVA thin films are prepared with addition of Cupric Oxide(CuO)With different concentrations to study structural and optical properties. The Optical Properties have been recorded in the wavelength range of (320-620) nm.

Experimental

PVA, Cupric Oxide (CuO) were the starting material. Polymer electrolyte membrane complex with CuO (PVA: 5,10,15wt%) were prepared by solution cast method. First of all, PVA was dissolved in Deionized water to which CuO was added in different wt% along with continue stirring (4 hours) to obtain homogeneous viscous solution. These homogenous viscous solutions were casted in a glass Petri dish and left to dry for a week to remove any residual solvent. These polymer films were cut into circular pieces for characterization .To investigates the structure of the polymer by using FTIR type (SHIMADZU Japan) and the absorbance and transmittance measurement were carried out by using (UV-visible 1800 spectrophotometer) in the wavelength range ((320-620)nm.

Results and Discussion

A) Structural Investigation By FTIR

Generally, the infrared spectroscopy includes the region of electromagnetic spectrum of approximately from 0.78 to 1000 μm. The most useful segment of the infrared region of the spectrum is from 2 to 16 μm. The absorption bands, which occur in this region, are due to the fundamental molecular vibrations. Consequently, they lend themselves for identification, qualitative analysis and band assignment. In fact, the matter absorbs infrared radiations selectively with respect to the wavelength.

The presence of broad absorption peaks in FTIR spectra for all the samples is evident. The broadening of absorption peaks in each spectrum is attributed to semicrystalline/partial amorphousness of complexes. The broadening of absorption peaks increases with increase in increase in dopant concentration. Obviously such broadening of absorption peak(s) indicates increased amorphous nature owing to doping.

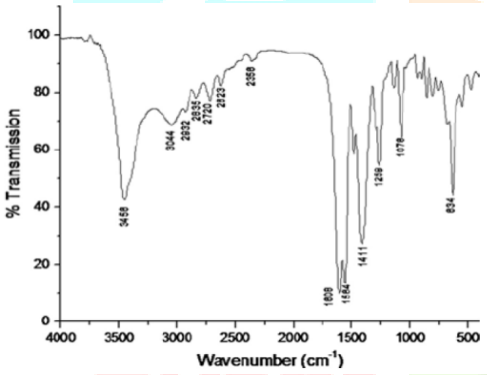


Fig. 1.1 FTIR Study of Pure PVA

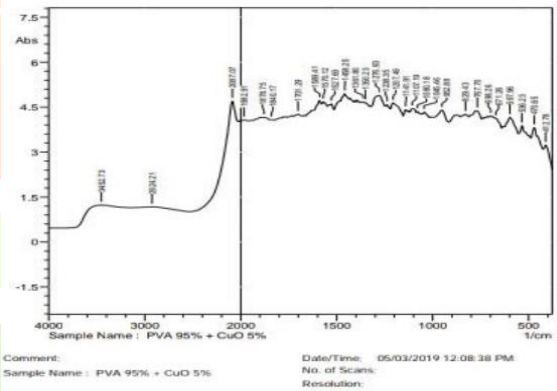
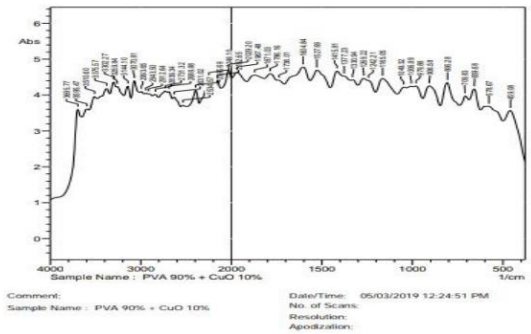


Fig. 1.2 FTIR Study of (PVA95-Cuo5)%



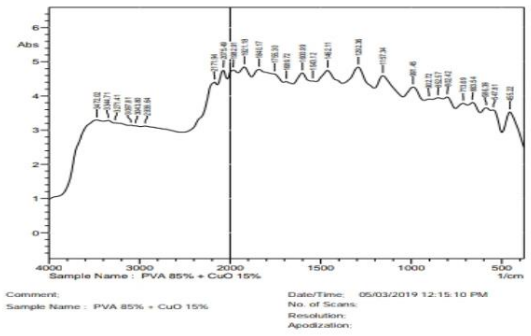


Fig. 1.3 FTIR Study of (PVA95-CuO10) %Fig. 1.4 FTIR Study of (PVA95-CuO15)%

Figure 1.1-1.4 represents IR spectrum of Polyvinyl Alcohol complexedwith Cupric Oxide. The peak was recorded at 1543.12 $cm{-}1$ indicates the presence of C = C stretch bond , C - Cl stretch was recorded at 1292.36 $cm{-}1$ and C – H stretch was recorded at 991.45 $cm{-}1$, at 2939.64$cm{-}1$ indicates the presence of CuO.

B) Optical Properties by UV-Vis Spectroscopy

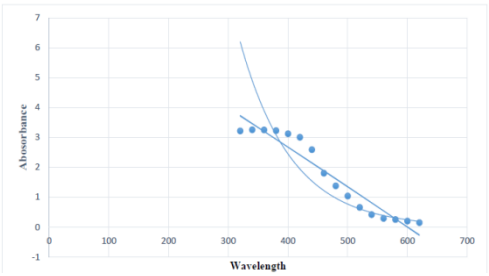


Fig. 2.1 **UV–Vis of** Pure PVA

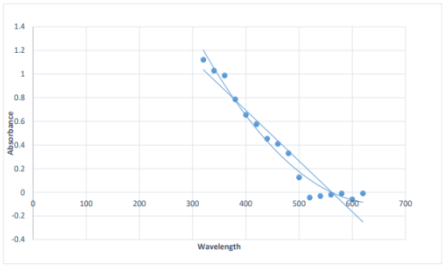


Fig. 2.2**UV–Vis of** Pure (PVA 95 - CuO 5)%

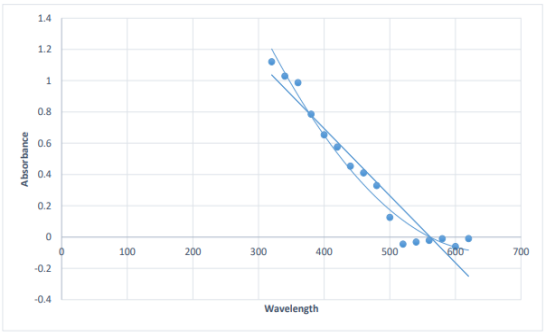


Fig. 2.3**UV–Vis of** Pure (PVA 95 - CuO10)%

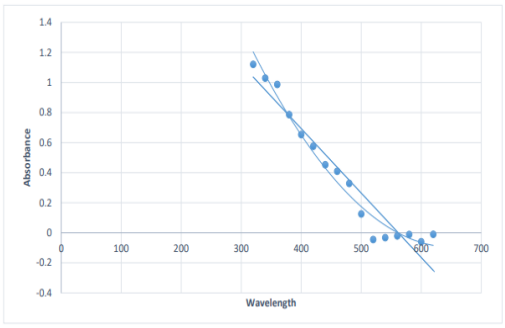


Fig. 2.4**UV–Vis of** Pure (PVA 95 - CuO 15)%

Fig. (2) shows the relation between absorbance and transmittance with the wavelength, we found that the behavior of all curves is same. The rapid increases of the a absorption in the low energy and sudden decrease in special energy and the absorbance increases with increasing the concentration CuO that is related to change in films structure, transmittance increases with the wavelength and decreases with increasing the concentration of CuO.

We can determine the absorption coefficient () by using the following equation

$$\alpha = 2.303\ A/t$$

Where A is the absorbance. The optical absorption coefficient (α) is important to determine the kind of electronic transition. If ($\alpha > 10^4$) the transition is direct and if ($\alpha \leq 10^4$) the transition is indirect [15,16]. It shows the dependence of the absorption coefficient on the photon energy for samples before and after doping.

Conclusion

In this study the polymer thin films of pure PVA and doped with CuO are synthesized using Solution Casting technique. From FTIR study it has been found that, the concentrations of CuO(15%) increases the structural disorder. PVA before doping acts as an insulator and after doping it became semiconductor. From UV-VIS study it is clear that the optical constants of polyvinyl alcohol are changing with the increasing concentrations of CuO.

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