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Research Article

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Preparation and Study of A.C. Electrical Properties of (PVA-PVP-CdS) films

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Abstract Casting method have been prepared films from composites of Polyvinyl alcohol and polyvinyl pyrrolidone(PVA-PVP) doped with different weight percentages of Cadmium sulfide (CdS).By using LCR meter in the frequency range (100 Hz to 5 MHz) at room temperature to study the A.C electrical measurement of the films. The effectsof A.C electrical possessionsof PVA-PVP-CdS films appearance that the dielectric constant, dielectric loss, and A.C electrical conductivity are increased with the increasing of content of cadmium sulfide. As well as, the dielectric properties and A.C electrical conductivity are variations with increasing of the frequency of practical electrical field.

Keywords Composite, Cadmium sulfide, Dielectric properties, Electrical properties

Introduction

Many techniques to prepare polymer blends and among them resolution blending is very fast and simple since it needs simple apparatus such as glass dishes only and not intricate any complicated process. Polymer blends are physical combination of two or more structurally different copolymers and they interact through secondary forces with no covalent bonding [1]. The compounds prepared of polymer with a leading filler level allow the mishmash of the mechanical possessions of polymers and its easiness of treating with electrical uses needful important conductivity and it's have numerous improvements over their pure metal, which include cost, flexibility, reduced weight, ability to absorb mechanical shock, corrosion resistance, aptitude to form composite parts [2]. There are many necessary properties of Poly vinyl alcohol similar adhesive environment, water solubility, film creation aptitude and uses in biomedical rings [3]. PVP is a vinyl polymer having planar and extremely polar lateral collections due to the peptide bond in the lactam circle [4]. Chosen PVA and PVA polymers for the current work because it has excellent physical possessions such as mechanical power, electrochemical immovability, non-toxicity, good film-forming ability, and biocompatibility [5]. The results for this composite are discussed to find the effect of Cadmium Sulfide additive on the A.C electrical properties.

Experimental part

The solution was prepared by melting PVA (80 wt. %) and PVP (20 wt. %) in 30 ml of distilled water, and byvia magnetic stirrer for the mixing process to obtain more homogeneous solution with temperature of 65 ^{o}C, then adding the weight percentages of additives (2%and 4%) of Cadmium Sulfide, then it waited for 25 minutes to get mixture more homogenous, and prepared the films by using casting technique through combination and casting these

solution in Petri dish (with diameter 5cm) and then left it to dry at room temperature to get films at thickness 1.5μm.Using LCR meter in the frequency range (100 Hz to 5 MHz) at room temperature to study the *A.C* electrical properties for the PVA-PVP-CdSfilms.The dielectric constant(ε') was calculated by using the following expression[6]:

$$C_p = \frac{\varepsilon' \varepsilon_o A}{d} \quad \text{.....(1)}$$

where: C_p is capacitance, ε_o is permittivity of free space, A is surface area of the sample, and d is samplethickness, whereas for dielectric loss ε'' can be calculated using expression[6]:

$$\tan\delta = \frac{Ip}{Iq} = \frac{\varepsilon''}{\varepsilon'} \quad \text{.....(2)}$$

where: tanδ is dissipation factor. The *A.C* conductivity (σ_{ac}) can be calculated by the following expression [6]:

$$\sigma_{a.c} = \omega \varepsilon_o \varepsilon'' \quad \text{.....(3)}$$

where $\sigma_{a.c}$ represents the *A.C* conductivity of the polymer sample which arises from the motion of charge carriers through the polymer .

Results and Discussion

Figure (1) shows the variation of dielectric constant (έ) vs. of frequency for (PVA-PVP-CdS) films. The figure show that the (έ) is declines with increasing of frequencies. The increase of frequencies results in decreasing of space charge polarization to the total polarization. Also, it can notice that (έ) decrease with increase in frequency, verifying the fact that for polar materials, the initial value of (έ) is high and the frequency of the A.C field is raised, the value of (έ) begins to drop [7]. Figure (2) shows the effect of adding the Cadmium Sulfide on the dielectric constant for (PVA-PEG- Sb_2O_3) films, we can noted the dielectric constant (έ) is approximately constant at low concentrations, and it increases with the increase of the concentration of Cadmium Sulfide in the range of 2 - 4wt.% which due to formation of a continuous network of (CdS) ions inside the films. At low concentrations, the (CdS) ions take the form of separated groups or clusters, hence, the (έ) becomes approximately constant. When the concentration is approximately 2wt.% or higher, CdS ions forms a continuous network inside the film. Hence, the value of dielectric constant increases as illustrates in figure (2). This result is similar to the result reached by the researcher [8].

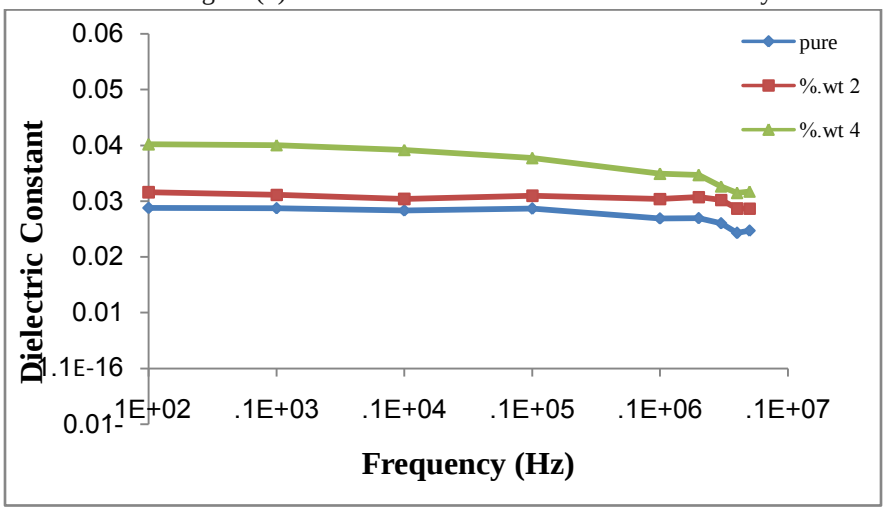

Figure 1: The variation of the dielectric constant for (PVA-PVP-CdS) films with the frequency

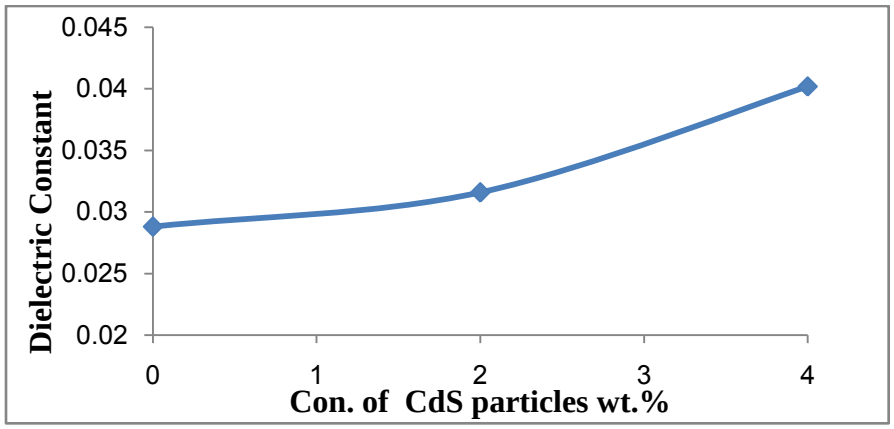

Figure 2: The variation of the dielectric constant for (PVA-PVP-CdS) films with various concentrations of Cadmium Sulfide

Figure (3) show that the relation between the frequency and the dielectric loss for (PVA-PVP-CdS) composites for different concentration Cadmium Sulfide. With increasing in frequency, the dielectric loss is decreased. This result because decrease the dipoles in composites [9]. Figure (4) display the effect of weight percentages for Cadmium Sulfide on the dielectric loss. It is clear that the dielectric loss increase with the increase of the concentration of Cadmium Sulfide due to increase the number of electrons in composites which is increase the electrical conductivity of polymer composite [10].

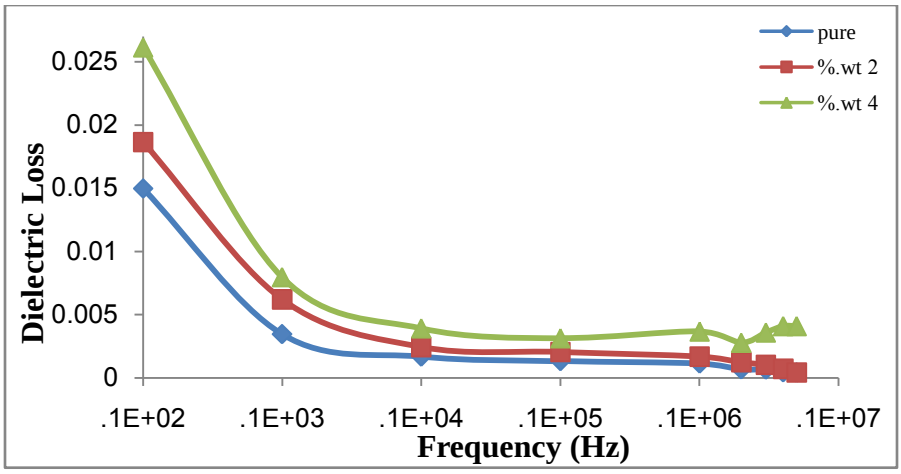

Figure 3: The variation of the dielectric loss of (PVA-PVP-CdS) films with the frequency

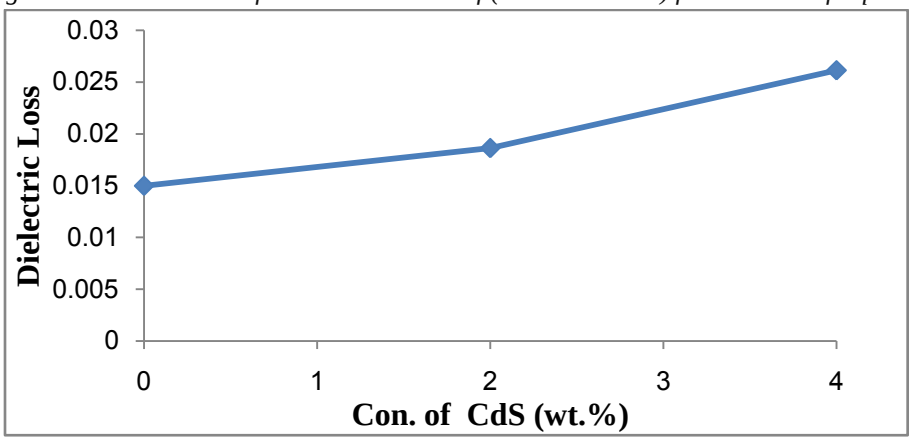

Figure 4: The variation of the dielectric loss of (PVA-PVP-CdS) films with various concentrations of Cadmium Sulfide

Figure (5) represents the A.C conductivity plot with frequency for (PVA-PVP-CdS) films. It shows that the conductivities increases with increasing of the frequency due to the electronic polarization and the motion of charge carriers by hopping process [11]. The Figure (6) represents A.C conductivity plot with various Cadmium Sulfideconcentrations.The A.C conductivity increased with increasing of the Cadmium Sulfide concentration. This behavior attributed to the Cadmium Sulfide particles forms a continuous network inside the composite[12].

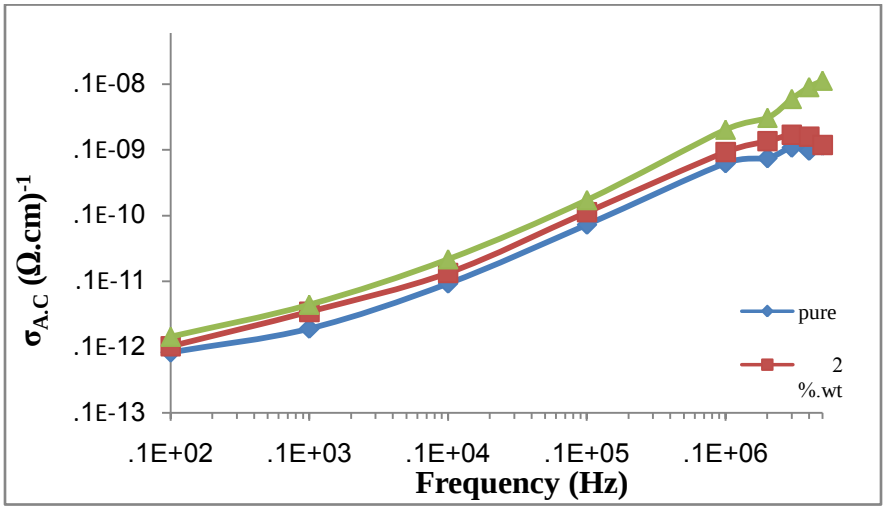

Figure 5: The variation of the electrical conductivity for (PVA-PVP-CdS) films with the frequency

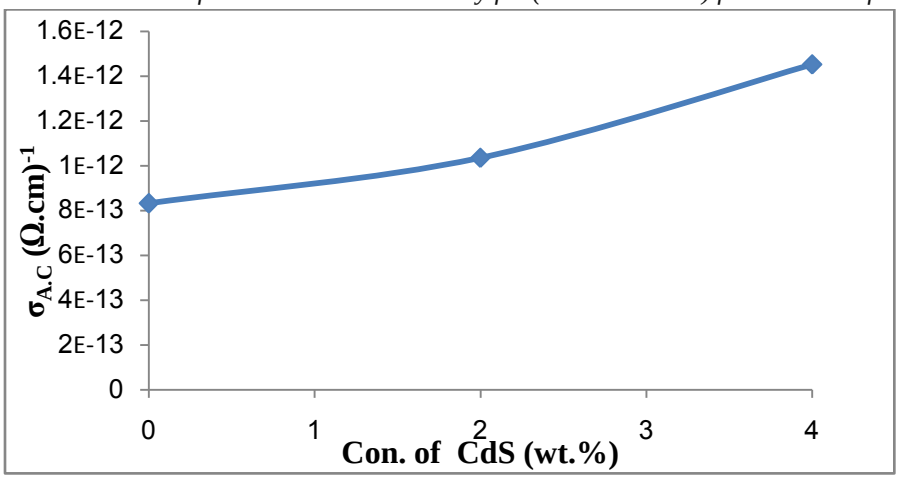

Figure 6: The variation of A.C electrical conductivity for (PVA-PVP-CdS) films with various concentration of Cadmium Sulfide

Conclusions

PVA-PEG-CdS films are prepared by casting method from mixing together PVA and PEG with various ratios of CdS. The dielectric constant and dielectric loss values are decreasing with the increase of frequency of the practical electric field for the PVA-PVP- CdS films. The dielectric loss, A.C electrical conductivity and dielectric constant values are increasing with the increasing of Cadmium Sulfide content. The A.C electrical conductivity for all concentrations are improved with the increases of the frequency of the practical electrical field.

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