The dielectric properties of (PVA-PVP-CdS) Nanocomposites for gamma shielding Application

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Abstract: Nanocomposites Method prepared by casting with various Preventatives of cadmium sulfide (0, 1, 2, 3, and 4) wt%. Dielectric constant increases with increasing frequency and filler concentration. Dielectric loss decreases as frequency increases, whereas it increases as Cadmium Sulfide concentration increases. The electrical A.C conductance of (PVA- PVP- CdS) Nanocomposites as the filler and TheFrequency are increased. Electron Scanning microscopy shows morphological the surface of (PVA-PVP- CdS) Numerous composites films or pieces allocated random distribution of particles on the top surface, homogeneous and coherent. (PVA-PVP) blend and with different wt.% of Cadmium sulfide films have good linear attenuation coefficients for gamma-ray radiation.

Keywords: cadmium sulfide nanoparticles, dielectric properties, gamma shielding.

Introduction

Prepare polymer mixing is very simple with various techniques, includes solution blending technology. Because of its outstanding efficient thermal capacity The resistance of chemicals, Strong strength of mechanics, the solubility of water, Moderate, and moderate and pant Electricity Dependent efficiency, PVA That may be the on side A strong metal host material [1]. Additives are constituents Added to polymers to have unique properties for them and to strengthen basic properties. In a granular form or as small particles, these constituents are added. nanocompositesCould be characterized As a compound material in which dimensions in the nanometer range are shown by At Minimum one phase (The filler mostly) as filler Reaches level of the Nanometer, the interactions at the interfaces become significantly Wide about the inclusion size and therefore the final characteristics Show important changes [2]. Nanocomposites There are two parts of nanocomposites, the Filler, and matrix, a conventional a
mixture usually Uses likethe filler of Fibers like carbon or fiberglass. the properties of nanocomposites are highly dependent on: filler properties (geometry, scale, a form of filler), host matrix (crystalline chemistry, polymer chemistry, thermoplastic nature or thermosetting), surface treatment, interfacial properties, Fill grade, dispersion, and agglomeration degree, relative arrangements and subsequent synergies between components and methods of synthesis[3] PVP is a hydrophilic, biocompatible polymer that is used Enhance the hydrophilic character of polymer mixed materials in a variety of Biomedical applications and processes of separation [4], due to its waterSoluble and non-toxic [5]. Polyvinyl alcohol (PVA) is one of the earliest and most sold polymers, and is currently widely used in semiconductor applications in a range of Applications [6].

**Experimental Work**

The nanocomposites were produced by dissolution polyvinyl alcohol (70 wt%), and polyvinyl Pyrrolidone (30 wt%) in distilled. The Cadmium Sulfide Nanoparticles Added to the polymer blend Concentration solution 1, 2, 3, 4 wt%. The films have been prepared to use the conventional Technique of casting By dissolving Distilled powders oH2O. The Powders have been dissolved using a magnetic mixing stirrer (30 Minutes) and then placed each one of these ratios in a 5×5 cm²Glass Bain left to drier the room temperature combination for (5days).Dielectric characteristics (PVA-PVP- CdS) The use of The composites was Measured an LCR Frequency range meters (100Hz to 5 MHz) the temperature of the room. the Capacitance as Measured (C ) The dielectric constant (ε ) was calculated using the equation[7]

$$\varepsilon = \frac{cd}{\varepsilon_o A}$$

Where (d) is in thickness of the sample and (A) is the Surface, (εo) is the free space permissiveness. Dielectric loss (ε″)can be calculate using the equation [7].

$$\varepsilon'' = \tan \delta \times \varepsilon$$

Where: tan δ is The factor of dissipation.

Calculate the conductance of A.C (σac) Could be Computed By the Equation [8].

$$\sigma_{ac} = \omega \varepsilon_o \varepsilon''$$

where: ω is angular frequency (ω = 2π).

The measurements of gamma-ray protection (PVA–PVP–CdS) Nanocompositethe Gamma-ray attenuation properties for various samples. concentrations of CdSNanoparticles were investigated. the source of Gamma rays (IRS - 192 -5mci) he was placed (3cm) away from the detector; the Film of (PVA–PVA–CdS) The Nanocomposites he was placed at a Distance of 3 cm From The source of gamma rays. Gamma-ray streams transmitted passing The Geiger counter is measured by the samples estimate of coefficients of linear attenuation [9].

$$N = N_0 e^{-\mu d}$$

Where N0 is the number of radiation part counts m over a period of time without an absorbent, μ is the gamma-radiation Coefficient of attenuation, where N denotes the counted number with asample of d thickness during that period.
Results and discussion

“Figure 1” Electron Scanning Microscopy (SEM) Pictures of the (PVA-PVP-CdS) Nanocomposites Various concentration films of Cadmium Sulfide nanoparticles content. found to be softer, homogenous, and coherent. One can be noticed from the figures that the addition of Cadmium Sulfide nanoparticles in (PVA-PVP-CdS) nanocomposites leads to changes in Morphology of the surface. You can see it from the images the grain adds up with an increase Cadmium Sulfide NanoparticleRatio. Morphology of The surface of (PVA-PVP-CdS) the nanocomposites Films Displays Many randomly distributed Top surface aggregates or chunks [10]. The results Show an increase in surface dot numbers with an increasing cadmium supplied Nanoparticleconcentration. An electron microscope (SEM) is an electron microscope that depicts the surface of the sample by scanning it with a high-energy beam of electrons, as it features users to create a high-resolution image of up to (1nm) At the University of Tehran.

**Figure (1)**: SEM Pictures of the (PVA-PVP-CdS) Nanocomposites (A) For (PVA- PVP) blend, (B) For 1wt.% CdS, (C) For 2wt.% CdS, (D) For 3wt.% CdS, (E) For 4wt.% CdS.

“Figure2” show Dielectric constant variation Of (PVA-PVP-CdS) Nanocomposites with Frequency. The figure Displays, with the increasing frequency the Dielectric constant Decrease of values, The increase in frequencies leads to a decrease in the polarization of space charge towards Complete polarization.
Polarization of the space charge at low frequencies is the main type of polarization. This is similar to the researchers' findings [11].

**Figure (2): Dielectric constant variation with Frequency for (PVA-PVP-CdS) nanocomposites.**

“Figure 3” shows dielectric steady increasing with increased cadmium sulfide weight percentages. The cause of this increase in dielectric constant values represents an increase in charge carriers as well as the continuous network. The formation of CdS ions within the composite [12].

**Figure (3): Dielectric constant versus Cadmium sulfide concentration (PVA-PVP-CdS) a composite.**

“Figure 4” The connection and between dielectric loss and frequency of (PVA-PVP-CdS) Nanocomposites. The obvious from the Dielectric loss values are high at a low frequency but decrease at an increasing Frequency. This is because the contribution of the polarization of the space charge is
reduced when the frequency is increased [13]. “Figure 5” show dielectric loss increases as the cadmium sulfide weight percentages increase. As a result of the increased charge on the dipole [14].

**Figure (4):** Dielectric loss versus frequency for nanocomposites (PVA-PVP-CdS).

**Figure (5):** Dielectric loss versus nanocomposites concentration for cadmium sulfides (PVA-PVP-CdS).

“Figure 6” show The Variable the Electric conductivity A.C for (PVA-PVP-CdS) Nanocomposites frequency. The figure shows an increase in A.C conductivity significantly frequency augmentation, This is attributed to the polarization of space loads Low- frequency And Process hopping The motion of the
load transporting. High frequency, the increase in conductivity is small because of through the hopping process, the electronic polarization and carriers. This is consistent with the researchers' findings [15].

**Figure (6):** The A.C Conductivity of electricity versus Frequency of (PVA- PVP- CdS) nanocomposites.

“Figure 7” Displays the A.C conductivity variation of (PVA-PVP-CdS) Nanocomposites, with Cadmium Sulfide concentration At 100Hz. Conductivity Continues to Increasing increase With Cadmium Sulfide Concentration of nanoparticles. This the augmentation is because of the effect in the space Charges and building a continuous network from Cadmium Sulfide Nanoparticles in the inside nanocomposites. This is analogous to the results which are reported by Rao et al [16].

**Figure (7):** A.C electrical conductivity compared to the concentration of nanocomposites in cadmium sulfide (PVA- PVP- CdS).

“Figure 8” show (N/N0) variation (PVA-PVP) mixture of different (CdS) Nanoparticles concentrations. Transmission radiation is reduced by the increase in concentrations of CdS nanoparticles due to increasing attenuation radiation [17].
Figure (8): (N/N0) Variation for (PVA - PVP) blends containing various concentrations of (CdS) nanoparticles.

“Figure 9” indicates in variety of Radiation gamma attenuation coefficients for (PVA - PVP) mix as a function of (CdS) particles nanoscale. [18] The efficacy of attenuation rise with increased levels of nanoparticles; This is due to gamma radiation being absorbed or reflected by nanocomposites materials used for shielding. [19].

Figure (9): Gamma radiation Attenuation Coefficient Variation for (PVA-PVP) Blending as a Function of the Concentration of CdS nanoparticles.

Conclusions
1- The dielectric constant, dielectric loss, and electrical conductivity in alternating (A.C) for (PVA-PVP-CdS) nanocomposites are increasing with the rising CdS nanoparticles concentration. And the increase in the applied electric field frequency decreases.

2- Surface morphology of the (PVA-PVP-CdS) nanocomposites films is revealed by scanning electron microscopy (SEM), which reveals several chunks or aggregates randomly spread over the top surface are uniform and consistent.

3- With an increase in the concentration of CdS nanoparticles, increased attenuation coefficients for gamma radiation.

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