Electrical Properties and Thermal Degradation of Polyaniline-Pbs Nanocomposites.

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ABSTRACT

Lead supplied (PbS) filled Polyaniline matrix nanocomposites were studied for the application in electrical properties and thermal stability. The nanocomposites were prepared using by chemical Oxidation Process with APF as oxidant. The prepared product was characterized using XRD, TGA and TEM. Transmission electron microscopy indicates the partical size and morphology of synthesize PANI and its Nanocomposite. X-ray diffraction (XRD) shows the degree of crystallites and Paricle size of Nanocomposites using Debye Scherer formula. Thermogravimetry analyzer (TGA) showed the thermal stability of Polyaniline and Its nanocomposite. The electrical conductivity of the nanocomposites was studied using Four Probe methods.

Keywords: Polyaniline, TEM, PbS, TGA, Nanocomposite, electrical conductivity.

1. INTRODUCTION:

Polymer Nanocomposites with nanoparticle are normally used for the different applications like, electrically conductivity and thermally stability, mechanical properties, thermodynamics study, aircrapt and thermal interface materials. It is glowing material which required low processing temperatures However; as compared to metal and ceramic material polymer have lower electrical conductivity, thermal stability and higher coefficient of thermal expansion. The area of nanocomposite and nanoscience is one of the innovative areas for current research and development. At nearby, easily accessibility of nanomaterials offers the guarantee of developing polymer nanocomposites material with modified in thermal, mechanical and electrical properties for a particular application. Polymer metal nanocomposite containing fillers with at least one dimension in the range of 1 nm to 100 nm. There are a number of metallic particles like, SiO₂, AI₂O₃, PbS, ZnS₂ etc [1-5]. With the addition of nanosized inorganic particles into polymer matrices the new composites material will show signs of unexpected properties, which greatly differ from that of bulk Polyaniline. Though the conservation of uniform distribution of nanosized particle in the research process of nanocomposites is very difficult, for the reason that of strong tendency for nanoparticles to agglomerate. [6-8] to prevent the formation of agglomerated nanoparticles in polymers, the combination of inorganic particles with polymers is frequently proficient by plane alteration. It is know that plane alteration of nanoparticles by graft polymers onto it is an resourceful way to get better its dispersability in polymer matrix as well, and hence restructure the polymer matrix, thus ornamental the properties of the resulting Nanocomposite. PbS as one of the multifunctional inorganic nanoparticles has haggard increasing, concentration in recent years due to its numerous significant physical and thermal stability, high catalysis activity, effective antibacterial and bactericide function, intensive ultraviolet and infrared adsorption. [9-11] Moreover, the advance of PbS nanoparticles could improve the properties of polymer matrix. However, PbS nanoparticles, like other nanoparticles, possess high temperature semicrystalline thermoplastics polymer which has high thermal stability and, it shows very good

impact on D.C electrical conductivity at different wt percentages [12-16]. In the face of its good mechanical and chemical properties, almost not any work on the based thermal stability is reported in the literature. Presently the aim of this study is to find the effect of PbS doped Polyanilne for the Electrical study and thermal stability.

2. MATERIALS AND METHODS:

2.1. Production of Polyaniline via chemical route:

Production of Polyaniline was conceded by the chemical route of aniline in the presence of sulphuric acid with APS (Ammonium per-sulphate) as oxidant. Both (0.4 mol) APS and 0.4mol H_2SO_4 is added in 100 ml distilled for 2 hours in a four-neck round bottom reaction flask. The resolution of APS in H_2SO_4 was further added drop-wise in the mixture of aniline with a magnetic stirrer for 3 hours to initiate polymerization. The product was presently agreed at room temperature for 6-7 hours. A precipitation of PANI with green color obtained. The synthesized Polyaniline were recovered from the polymerization mixture and washed with deionized water repeatedly until the washing liquid was completely colorless

Characterizations;

UV-Visible of nanocomposite was calculated in the frequency range of 400–4000 cm⁻¹. TGA of all nanocomposites were record on Perkin-Elmer Diamond TGA/DTA. TEM micrographs of synthesized sample were taken on Transmission Electron Microscope PHILIPS model-CM200 with resolution 2.4Å.

3. RESULT AND DISCUSSION;

3.1. X-Ray Diffractions Spectra

The Fig.1.show XRD of Pure PANI and its Nanocomposite. The crystalline peaks at 2θ = 22 and 28° , indicated amorphous nature of pure Polyaniline. The inclusions of the PbS nanoparticle in the PANI matrix shows more arranged of the polymer resulting in good crystallanity. The crystalline size of crystalline particle of nanocomposite calculated using Debye scherr formula. The calculated partcal size for nanopartical is 20nm.



Fig.1.XRD of Pure PANI and PANI/PbS Nanocomposite.

3.2. UV-Visible Spectra:

The Fig.2 indicated the UV-Visible spectra of Pure PANI and Its Nanocomposite. The main incorporation peak of Bulk PANI at 285 nm, which is owing to π - π^* , and peak at ~ 375 nm, analogous to n - π^* transition. The UV-spectra of nanocomposites at different wt ratio indicated main inclusion peaks at ~ 295nm. for π - π^* transition, 385nm for polaron- π^* transition and band at 785 nm assigned to polaron- π transion.





3.3. TEM MICROGRAPH

Fig.3 indicated TEM micrograph of Pure PANI and its nanocomposite.TEM of pure PANI shows capsule like structure. The nanocomposite demonstrates dark spot on the surface indicated PbS nanoparticals in the central crack of PANI. TEM micrograph of PANI/PbS nanocomposite pragmatic both the PANI and PbS nanoparticals with average diameters of 20nm.



Fig.3. TEM of pure PANI & PANI/PbS Nanocomposite.

3.4. DTA Thermograph of Nanocomposite:

Fig.4 indicated DTA thermogram of pure PANI and its nanocomposite. The DTA thermogram of all sample shows an endothermic peak at 120-300°C. These endothermic peak was due to the chain cross liking, of -N=Q=N- groups of Polyaniline [17]. Consequently on the basis of thermal profile of the nanocomposite it is clear that the oxidative reaction starts at higher temperature as compared to pure Lead sulphides materials which indicate good thermal stability of nanocomposites as compare to than bulk PbS and PANI.



Fig.4. DTA analysis of Pure PbS and PANI/PbS nanocomposite.

3.5. Tempreture Dependent D.C electrical conductivity of Nanocomposite:

Table 1.indicate D.C.electrical conductivity and Activation energy of pure PANI and its nanocomposite. The temperature dependent D.C electrical conductivity of PANI improved with increased weight % of PbS nanoparticles[18].

Sr.No.	Material	Conductivity'	Activation
		σ (S/cm)	energy, E _a (eV)
1.	Pure PANI	2.705X10 ⁻²	3.97 X10 ⁻⁴
2.	5% PANI/PbS	8.22 X10 ⁻²	2.13 X10 ⁻⁴
3.	10% PANI/ PbS	7.974 X10 ⁻²	1.2065 X10 ⁻⁴
4.	15% PANI/ PbS	2.835 X10 ⁻¹	1.226 X10 ⁻⁴
5.	20% PANI/ PbS	1.40224	0.9191 X10 ⁻⁴
6.	25% PANI/ PbS	1.96766	0.6786 X10 ⁻⁴

Table 1.D.C.Electrical conductivity of Pure PANI & PANI/PbS nanocomposoite

4. CONCLUSIONS:

Polyaniline and its nanocomposites have been produced via chemical route with different wt ratio of PbS. The XRD study exposed the measure of degree of crystallites. The UV-Vis spectra inclusion bands at 280 nm, which is due to π - π^* of C=C, and. The thermal stability for the nanocomposites has been improved as major mass losses occurred at higher decomposition temperature as compared to the pure PANI in the DTA profile. The D.C.electrical conductivity of all synthesize PANI/nanocomposite at different wt percentages (5-25%) is higher than the pure PANI.

5. REFERENCES;

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