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Comparison of Ac Conductivity of PVC-PS Blend and PANI Doped PVC-PS Blend

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ABSTRACT

The polyblend of polyvinyl chloride (PVC) and polystyrene (PS), in the weight ratio 5: I were prepared by using 1.25 gm of PVC and 0.25 gm of PS. Polyaniline (PANI) has been used as dopant with 2.5 % of the total weight of the two polymers. The ac conductivity of polyaniline doped PVC-PS thin films have been investigated in the temperature range 313 K -353 K and in the frequency range 0.5 KHz - 200 KHz. Plot between log σ_{ac} and 1000/T is used to calculate activation energy.

Keywords: Polyblend, PVC, PS, PANI, ac conduction.

I. INTRODUCTION

In recent years, conducting polymer composites and blends have attracted the attention of material researchers, with increase in interest in obtaining properties that are intermediate between those of homopolymers[[1,2] Generally polyvinyl chloride (PVC) is being used for the consumer products like cables, pipes, window frames, packaging bottles, Hit cards and audio recording. It is also used in car interiors and in hospital as medical disposables. The presense of chlorine in the PVC structure is the reason of its better properties like fine resistance and durability. Dielectric properties and surface morphology of proton irradiated ferric oxalate dispersed PVC films has been studied [3]. Poly vinyl chloride (PVC) can act as a mechanical stiffener in the electrolyte due to its immiscibility with the plasticizer. A novel composite film of PANI doped with azobenzene sulfonic acid (ABSA) blended with PS was obtained by a simple and inexpensive electrospinning method [4].The ac electrical conductivity of the blend of polypyrrole doped with iron (III) chloride in PVA matrix at different temperatures has been studied [5]. In the past two decades different polymer hosts such as PMMA [6], PANI [7],PVC [8], PVdf[9] had been studied as the gel forming polymer electrolytes, this plasticized or gelled polymer electrolytes possess higher room temperature ionic conductivity could be useful for lithium and lithium ion battery application. The effect of ZrO_2 on conductivity of PVC - PMMA - $LIBF_4$ DBP polymer elecctrolytes has been investigated. [10]

II. METHODS AND MATERIAL

Experimental

The polyvinyl chloride (PVO) and polysterene (PS) of standard grade product supplied by Polychem Industries, Mumbai were used for the study The conducting polymer (polyaniline)was prepared by chemical oxidation using ferric chloride by conventional procedure. Polyaniline was used as a dopant

Sample Preparation

For the preparation of PVC-PS polyblend, the two polymers PVC (1.25g) and PS (0.25g) were taken in the ratio 5:1 by weight. 1.25 g of PVC in 15 ml tetrahydrofuran (THF) and 0.5g of PS in 10 ml of THF dissolved seperately and subsequently mixed together.
For the preparation of Polyaniline doped thin films the two polymers PVC (1.25g) and PS (0.25g) were taken in the ratio 5:1 by weight. 1.25 g of PVC in 15 ml tetrahydrofuran (THF) and 0.5g of PS in 10 ml of THF dissolved seperately and subsequently mixed together. Polyaniline was taken in 25 wt % and was dissolved in 5 ml of THE to produce Polyaniline solution . After allowing them to dissolve completely. the three solutions were mixed together The solution was heated at 60° c for two hours to allow polymers to dissolve completely to yield a clear solution . A glass plate thoroughly cleaned with hot water and then with acetone was used as a substrate, To achieve perfect levelling and uniformity in the thickness of the film, a pool of mercury was used in a plastic tray in which the glass plate was freely suspended .The solution was poured on the glass plate and allowed to spread uniformly in all directions on the substrate. The whole assembly was placed in a dust free chamber maintained at a constant temperature (40°C). In this way, the film was prepared by isothermal evaporation technique [11.12]. The film was subjected to 12 hours heating at constant temperature of 50°C and for another 12 hours at room temperature to remove traces of solvent .Finally, the film was removed from the glass plate, it was cut into small pieces of suitable size which were washed with ethyl alcohol to remove the surface impurities

Thickness measurement

For measuring the thickness, micrometer screw guage [12] with least count 0.001cm (10 μ m) was used. But for greater accuracy and resolution, a compound microscope in conjunction with an acculometer which gives least count 1.3 μ m and 3.3 μ m, at the magnification of 1:10 and 1 100 respectively was used. A small section of the sample was taken mounted vertically to get a clear section of view of the thickness. The film used for the present study was of the thickness 70 μ m

Electrode coating

The electrode coating on the film of measured thickness was done by quick drying and highly conducting silver paste [12] supplied by Eltecks Corporation, Bangalore. A mask of a circular aperture of 25 cm diameter was used while coating to ensure uniformity in size of coated silver electrode

Structural characterization

The X-ray powder diffractogram of polyaniline doped PVC-PS blend have been recorded from a Phillips automated diffractometer (RS IC, Nagpur) and as shown in fig1 and fig2 .The X-ray diffractograms of all the samples were obtained for ensuring the nature of the file (amorphous or crystalline)

AC conductivity measurement

The film coated with silver electrodes was sandwiched between the electrodes of (2.5 cm diameter each) the sample holder forming Metal Insulator Metal(MIM) system was connected to precise LCR meter having temperature range of 313K-353K,and frequency range of 0.5KHz-200KHz. Using precise LCR meter, TH 281613, Tonghul values of Z and θ was measured,

III. RESULTS AND DISCUSSION

XRD Analyisis

Fig. 1 shows the diffraction pattern of polyaniline doped PVC-PS blend. of peak in X-ray spectra of polyaniline doped PVC-PS blend confirmed the amorphous nature of the polymer sample [13]

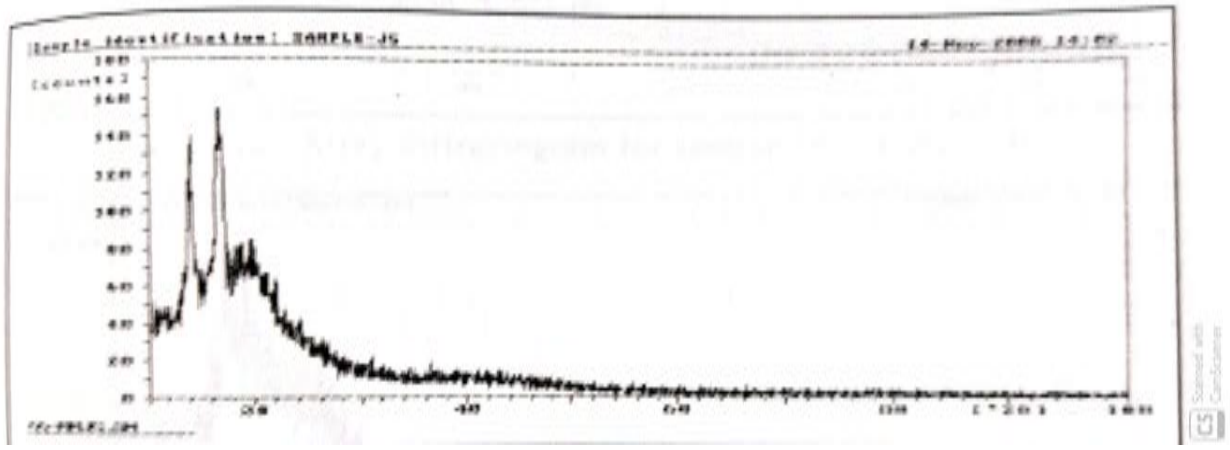


Figure 1. X-ray diffractogram of sample, PVC-PS polymer blend

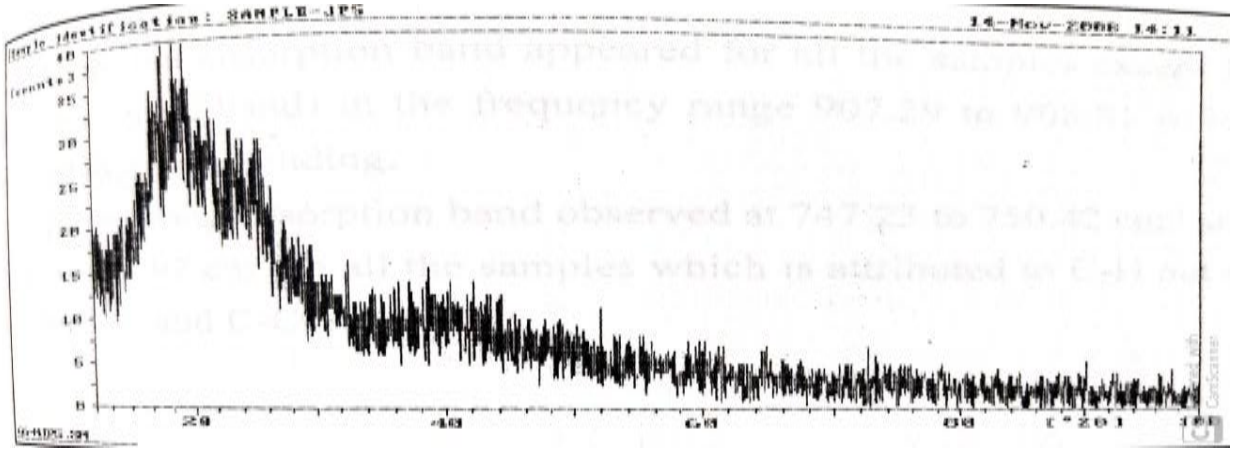
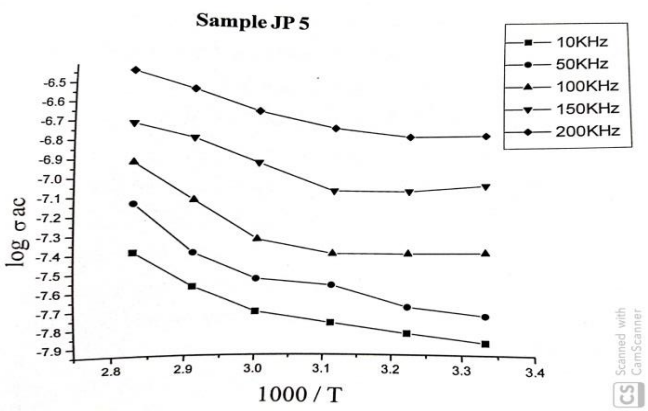


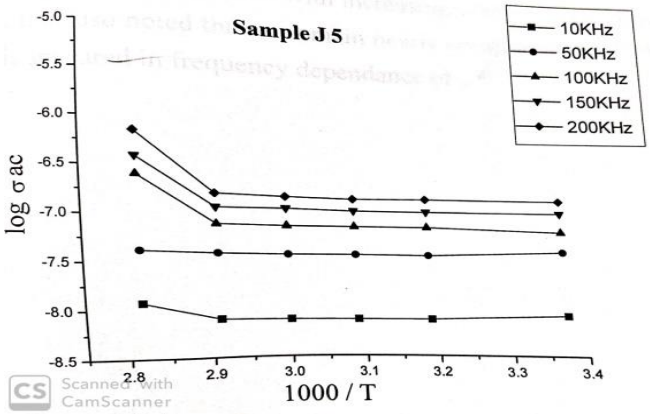
Figure 2. X-ray diffractogram of sample, polyaniline doped PVC-PS polymer blend

AC Conductivity

Fig 3 and 4 shows variations of AC conductivity σ_{ac} with different temperature at frequencies 10KHz to 200KHz .With increase in temperature conductivity increases



J5 pvc –ps Polymer blend



JP5 – Polyaniline doped pvc –ps Polymer blend

Table 1 Values of activation energy at two different frequencies for J5 and JP5

Sample	Activation energy in eV	
	100KHz	200KHz
J5	0.0128	0.0177
JP5	0.1539	0.0521

The values of activation energy Ea the following trends

1. Activation energy of PVC-PS polymer blend increases with increase in frequency and Activation energy of Polyanilline doped PVC- PS blend decreases with increase in frequency.
2. At constant frequency activation increases when dopant is added.

IV. CONCLUSION

At low temperature ac conductivity is frequency dependent and at high temperature ac conductivity is weakly dependent on frequency. Such dependence has been observed in disordered amorphous matrial(14,15)

V. ACKNOWLEDGEMENT

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