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A.C. CONDUCTIVITY STUDY IN POLYMER COMPOSITE FILMS (PVC-PVAc) DOPED WITH CONDUCTING POLYMER POLYANILINE (PANI)

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Dielectric properties and a.c. electrical conductivity of polyvinyl chloride (PVC)-polyvinyl acetate (PVAc) composite film doped with polyaniline at low temperatures in frequency range from 50 Hz to 1×10^3 KHz have been studied. The Decrease in dielectric constant and increase in a.c. conductivity with increase in frequency in higher frequency range have been explained. The increase in a.c. conductivity due to doping of PANI has been explained on the basis of protonic doping of PAIN. The composite films have been characterized by employing X-ray diffraction.

KEYWORDS : Polyaniline, a.c. conductivity, PVC-PVAc film.

INTRODUCTION

In the recent year conducting composite and blends have attracted the attention of material researchers with increasing interest in obtaining properties that are intermediate between those of homopolymer Kim *et. al.* [1]. Investigation of electrical properties of these materials are desirable not only to predicts the electrical properties but also to predicts indirectly the dynamical behavior Migahed *et. al*. [2].

The study of conductivity relaxation behavior in conducting polymer composite has become an interesting area of active research because of their potential application in solid state devise Bhattachary *et. al.* [3]. Aim of the present work is to prepare and study composite material containing PAIN with nonconducting PVC-PVAc copolymer film. The frequency dependent dielectric constant and a.c. conductivity of conducting composites have been studied in frequency range 50 Hz to 10^3 KHz.

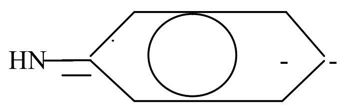
EPERIMENTAL DETAILS

PVC supplied by polychem industries, Mumbai and PVAc supplied by Wilson laboratories, Mumbai were used for the study. The conducting polymer (polyaniline) was prepared by chemical oxidation using ferric chloride by conventional procedure. For preparation of polyaniline doped thin film, PVC (1.5 gm.) and PVAC (0.5 gm) were taken in the ratio 3 : 1 by weight. These two polymers were dissolved separately in 15 ml of tetrahydrofuran (THF) solvent. 0.2 gm. of PANI was dissolved in 5 ml. of THF separately.

Then the solutions were mixed together. The solution was heated at 60°C for two hours to allow polymer to dissolve completely to yield a clear solution. A glass was cleaned with hot water and then with acetone. To achieve perfect leveling and uniformity in the thickness of the film, a pool of mercury was used in plastic tray in which the glass plate was freely suspended. The solution was poured on glass plate and allowed to spread uniformly in all direction on the substrate. The whole assembly was placed in a chamber maintained at constant temperature (40°C). In this way four films were prepared by keeping concentration of PVC-PVAc constant and by changing concentration of PANI from 0.2 weight %, 0.4 wt. %, 0.6 wt% and 0.8 wt. %. These four systems (films) were taken for investigation. Films were prepared by isothermal evaporation technique.

SYSTEMS: I PVC + PVAc + PANI (0.2%) II PVC + PVAc + PAIN (0.4%)

III PVC + PVAc + PANI (0.6%) IV PVC + PVAC + PAIN (0.8%)



Polyaniline

Measurements

The films were placed between two electrodes of the sample holder. The dielectric and a.c. conductivity were calculated by measuring equivalent parallel capacitance and equivalent resistance for four systems (samples) over the frequency range 50 Hz to 1000 KHz using impedance analyser at 313 K. Values of dielectric constant and conductivity are plotted against frequency four systems. The variations in dielectric (ε') and a.c. conductivity are explained.

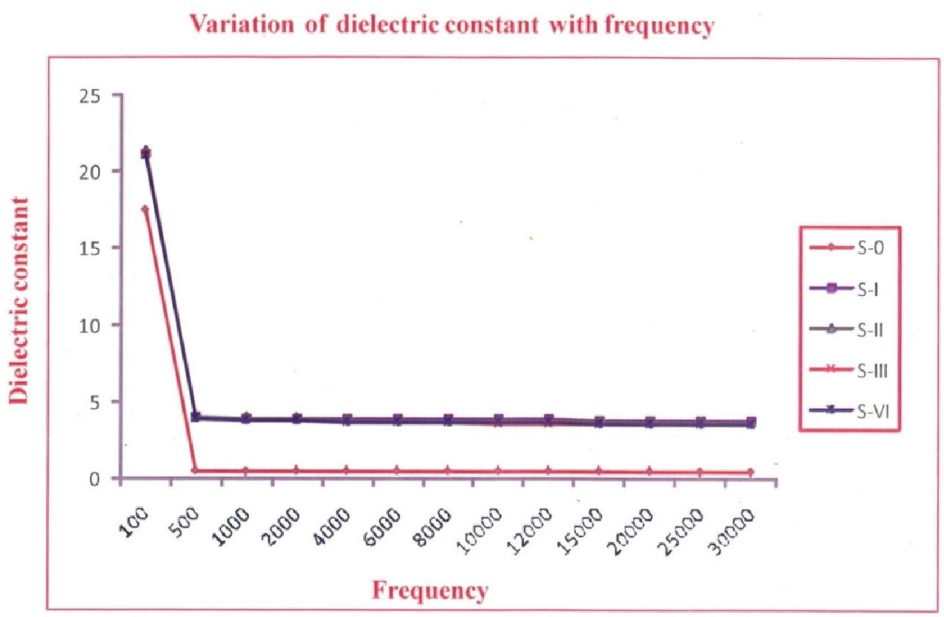


Fig. No. 1

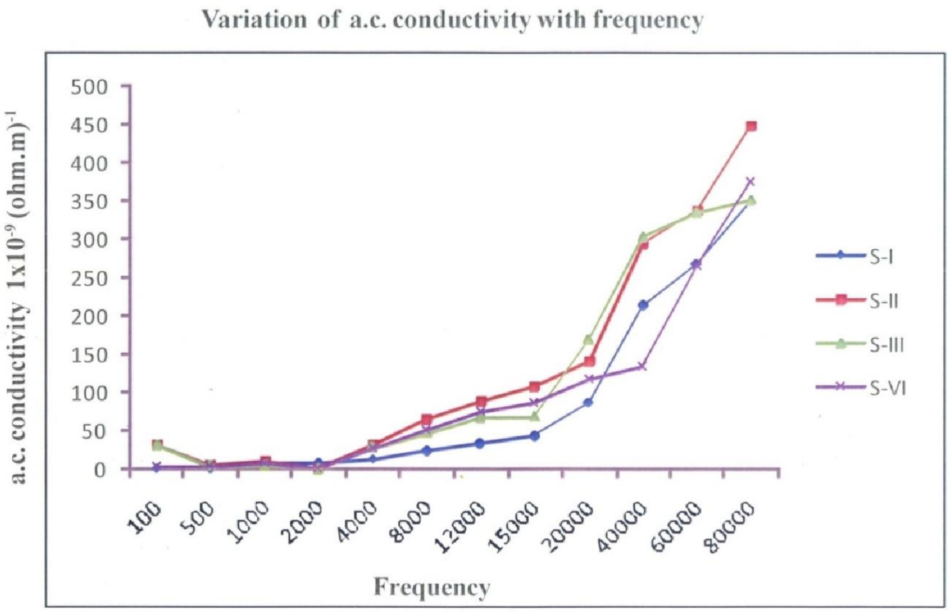


Fig. No. 2

RESULT AND DISSCUSION

From the graph (1) of (ε') dielectric constant against frequency, it is observed that in lower frequency range, dielectric constant is high. This result is in agreement with Kyrisis *et al*. [4], according to which permittivity can be very high at low frequency in the system with conductive component .While in higher frequency range, above 100 Hz, the dielectric constant was found to decrease with increase in frequency. This may be due to characteristic of the ordered material and due to the fact that ions are able to oppose the effect of the field and ions are not tightly pinned to polymer chain. This result is in agreement with Migahed *et. al*. [5], according to which at higher frequency, decrease in dielectric constant is the characteristic of ordered material.

From the graph (2) of a.c. conductivity against frequency, it is observed that a.c. conductivity increases in high frequency range. This indicates that there is motion of charges in amorphous region. This also support the presence of isolated excess charge carrier (polaron) in this region. This observation is in agreement with result obtained by Shatala, D. Patil *et. al*. [6].

The protonic exchange between NH = group of aniline help to increase the conductivity in PVC-PVAc blend. The good conductivity in polymer blend might be due to protonic doping of polyaniline. Such type of increase in conductivity in polymer blend due to doping of polyaniline in salt was reported by Joel *et. al.* [7].

Rajandran *et. al*. (8) reported the conductivity to be equal 0.0045×10^{-4} S/cm at 100 KHz for polymer composite(PVC-PEO-LiF3SO3) and increase in conductivity is attributed to cation-dipole interaction. In the present work, conductivity of PVC-PVAc-Aniline is found to be equal to 0.005×10^{-4} S/cm.

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