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A.C. CONDUCTIVITY STUDY IN POLYMER COMPOSITE FILM DOPED WITH CONDUCTING POLYMER POLYANILINE (PANI)

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Dielectric properties and a. c. electrical conductivity of polyaniline doped polyvinyl chloride (PVC)-polymethyl methacrylate (PMMA) composite film at low temperature in frequency range at 50 Hz to 1×10^{3} KHz have been studied. The decrease in the 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-PMMA 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 behaviour 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 Bhattacharyy *et al*[3]. Aim of the present work is to prepare and study composite material containing PAIN with nonconducting PVC-PMMA copolymer film. The frequency dependent dielectric constant and a. c. conductivity of conducting composites have been studied.

PREPARATION OF SAMPLE

PVC supplied by polychem industries, Mumbai and PMMA supplied by Dental Product of India Ltd., 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 PMMA (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 a constant temperature (40°C). In this way four films were prepared by keeping concentration of PVC-PMMA 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 studied. Films were prepared by isothermal evaporation technique.

Polyaniline

Measurements

Dielectric and a. c. conductivity were measured for four samples over the frequency range 100 Hz to 10^3 KHz using impedance analyser at 313 K. Values of dielectric & conductivity were plotted against freq.

Variation of dielectric constant with frequency

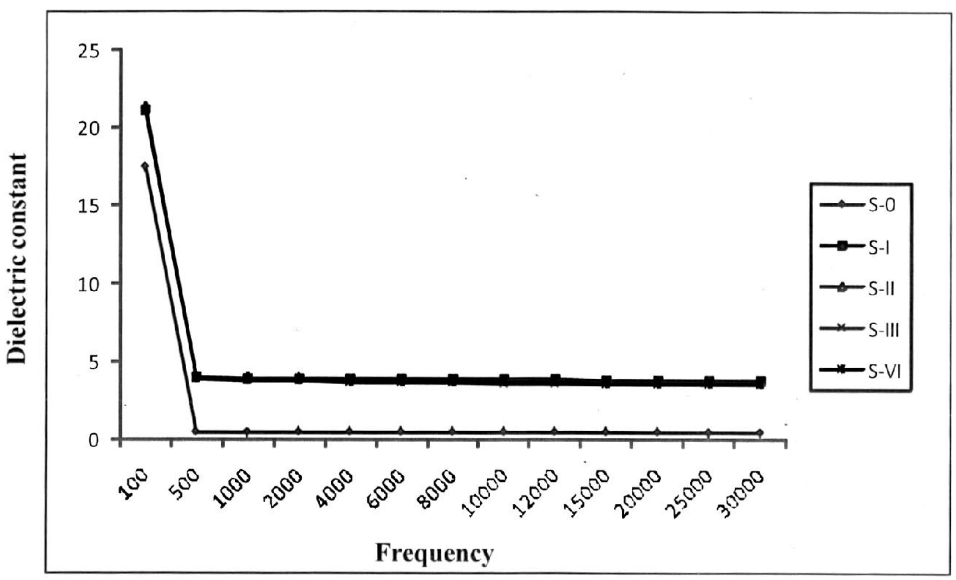

Fig. No. 1

Variation of a.c. conductivity with frequency

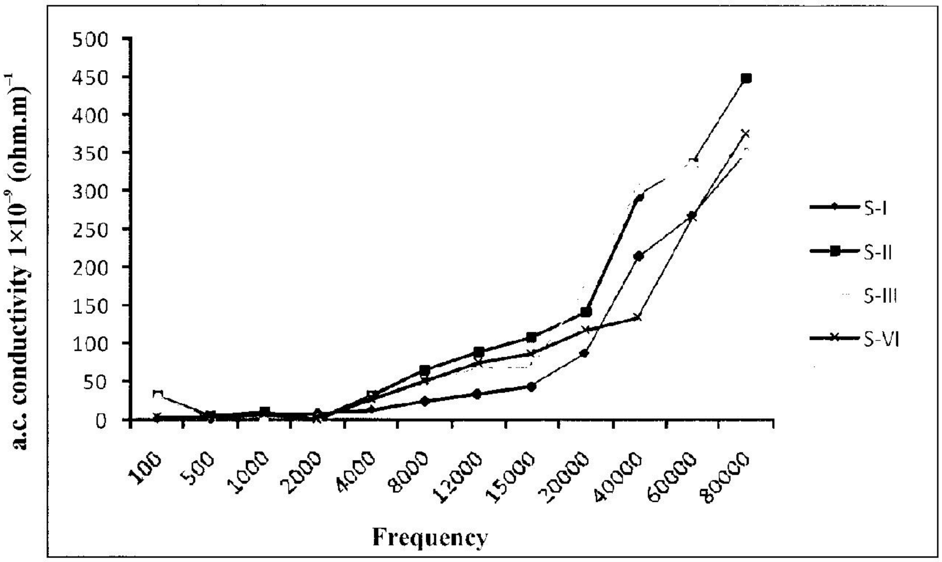

Fig. No. 2

Result and discussion

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 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-PMMA 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 0.005×10^{-4} S cm^{-1} at 100 KHz for Polymer composite (PVC-PEO-LiF_3SO_3) and increase in conductivity is attributed to cation-dipole interaction. In the present work, conductivity of PVC-PMMA-Aniline is found to be equal 0.005×10^{-4} S cm^{-1} at 100 KHz.

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