PERSISTENT POLARIZATION AND DIELECTRIC RELAXATION PHENOMENA IN POLYMERS

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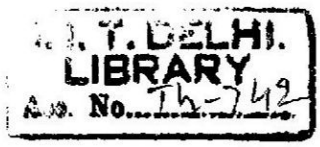

CERTIFICATE

I am satisfied that the thesis entitled ' Persistent Polarization and Dielectric Relaxation Phenomena in Polymers' by Rashmi is worthy of consideration for the award of the degree of Doctor of Philosophy and is a record of the original bonafide research work carried out by her under my guidance and supervision and that the results contained in it have not been submitted in part or full to any other University or Institute for award of any degree/diploma.

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ABSTRACT

The study of persistent polarization and relaxation phenomena in dielectric materials has,of late, assumed special significance from the academic as well as application point of view. The research work presented in this thesis deals with an investigation of these phenomena in a group of structurally related polymeric dielectrics. The polymers which have been studied are - polystyrene, polystyrene-chloranil donor-acceptor complex, poly (styrene-chloranil) copolymer , and poly(styrene-allyl alcohol) copolymer. Different dielectric techniques have been employed and the results have been correlated to get an overall view of various aspects of polarization and relaxation phenomena in these polymer systems.

Persistent polarization in the electret state of these materials has been investigated by thermally stimulated discharge (TSD) technique. The molecular origin of polarization has been probed. The relaxation modes have been identified and the relaxation kinetics parameters evaluated. Effects of complex formation, copolymerization, presence of impurities like absorbed water molecules, and thermal history on the relaxation processes have been discussed.

The absorption currents which arise in dielectrics on the application/removal of step function field have been analyzed.

It has been found that these currents originate from same polarization mechanisms as determined by TSD studies. The charge carrier injection, trapping, and transport phenomena have also been studied. Relaxation bands have been obtained from isothermal discharge transients, and low frequency dielectric loss(obtained by Fourier transformation of absorption currents). Activation energy of the relaxation processes have been calculated from the shift of the relaxation bands with time/frequency.

Polarization and relaxation phenomena have been investigated by the conventional AC dielectric bridge experiments also. Useful information has been obtained on dipolar and space charge polarizations, their temperature and frequency dependence, and effects of structural variations on the dielectric parameters.

Surface charge decay studies on corona charged polymer samples have been carried out from application point of view. The results of these studies have been used to test the feasibility of utilization of these dielectrics in electrothermography. The experimental results have proved poly(styrene-allyl alcohol) copolymer to be a suitable material for these applications.

ABBRÈVIATIONS

PS : Polystyrene

CA : Chloranil

PS-CA : Polystyrene-Chloranil donor-acceptor complex

PSCA : Poly(styrene-chloranil) copolymer

PSA : Poly(styrene-allyl alcohol) copolymer

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