STUDY OF PERSISTENT INTERNAL POLARISATION IN DIELECTRICS

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Symbols used

Anode	Δ
Cathode	O

PREFACE

The study of electrization in an insulator is in some respect more important than of magnetization on account of its greater utility. The discovery of the electret effect has provided a new ingeneous tool to investigate the electrical properties in the solid dielectrics. Electret effect in dielectrics has been the subject of extensive studies during the past few decades but still is the subject of much interest due to its technological importance. Much of our knowledge about the electric properties of the dielectrics has been gained by studying the mechanism of polarisation and absorption of charges in different states of dielectrics. Therefore the study of the electret effect in dielectrics is important from scientific as well as from technological point of view.

Extensive studies of electret effect have been done in wax materials and their theories are well known. This effect in resins has also been studied extensively. However, only a very few papers have appeared on electret effect in the field of high polymers. In recent years increasing attention has been given to the studies of charge storage phenomena in plastic materials. The present information of the electret effect in these materials is far from complete due to lack of detailed investigations. Therefore it has been decided to investigate the electret effect

experimentally in PVC(SR_{11}) and shellac wax. These two materials differ substantially from each other in their physical properties and their study is expected to reveal several interesting features of dielectrics.

The thesis is divided into five chapters. A survey of earlier literature relevant to the present work has been reported in Chapter I. Details of different experimental techniques used for the fabrication and measurement of surface charge of thermoelectrets are given in Chapter II. The experimental results of surface charge decay characteristics of shellac wax and PVC(SR_{11}) thermoelectrets which were polarised and stored under different conditions are presented in Chapter III. In Chapter IV, the quantitative study of the electret effect in these materials was carried out by the analysis of the glow peaks, obtained from the "Thermally Stimulated Discharge current" (TSD) technique. The application of these studies with particular reference to the development of a xerographic developer and toner has been discussed in Chapter V of this thesis.

Some of the important results reported in this thesis are as follows:

A double reversal phenomena has been obtained at higher fields in case of PVC(SR_{11}) and at lower fields in case of shellac wax. The decrease in the final surface

charge density and increase in the time of charge reversal has been found with the decrease in the cooling rate during the polarisation. Higher magnitude of the final surface charges is observed in foil electrets in evacuated condition compared to the thicker electrets, studied in the open atmosphere. In case of shellac wax, a linear relationship has been found between the initial surface charge density and electrode work function. The shellac wax electrets are much more sensitive to the humidity as compared to PVC(SR_{11}) electrets.

Thermal current spectrum of shellac wax electret shows only one glow peak near the softening temperature whereas one more peak at lower temperature has been observed in case of PVC(SR_{11}) electrets. No peak shift is observed with the variation in polarising field, temperature and time of the electrets which are prepared and preserved under controlled conditions of humidity. But samples preserved under very high relative humidity show some shift in the peak position towards the lower temperature side. Moreover the low temperature peak of PVC(SR_{11}) electrets has disappeared completely due to exposure to humidity. The relaxation time τ also decreases with increase of the exposure time to humidity.

Part of the work reported in this thesis has resulted

in the following research publications in international journals.

1. Studies of Electret Effect in Shellac Wax, Phys. Stat. Sol. (a) 4, K20 (1971).
2. Charge Decay Characteristics of PVC(SR_{11}) Thermoelectret, IL Nuovo Cimento (B) 3, 225 (1971).
3. Effect of Electrode Material on the Electret Behaviour of Shellac Wax Thermoelectret, Phys. Letters (A) 36, 401 (1971).
4. Effect of Different Cooling Rate on Thermoelectrets, Phys. Stat. Sol. (a) 6, K121 (1971).
5. Studies of Electret Effect in Shellac Wax Magnetoelectret, J. Electrochem. Soc. 118, 1675 (1971).
6. Studies of Electret Effect in Shellac Wax, Ind. J. Pure Appl. Phys. (To be published in Feb. 1972).
7. Thermal Current Measurements in PVC(SR_{11}) Electrets, Phys. Letters (A) 39, 216 (1972).
8. Effect of Water Vapour on Thermoelectret Behaviour, IL Nuovo Cimento (B) (Accepted for publication).
9. Thermally Stimulated Discharge Current Studies in Shellac Wax, Phys. Stat. Sol. (a) (Accepted for publication).
10. Review on Thermoelectrets and its Applications, Phys. Stat. Sol.(a) (Accepted for publication).
11. Studies of Electret Effect in Polyvinyl Chloride Foil Electret in Vacuum, J. Electrochem. Soc. (Accepted for publication).

The work reported in the paper entitled "Studies of Electret Effect in Shellac Wax Magnetoelectret" has not been included in the thesis.

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