INVESTIGATIONS OF ELECTRET EFFECT IN SOLID DIELETRICS WITH SPECIAL REFERENCE TO THE APPLICATIONS IN ELECTROPHOTOGRAPHY AND ELECTRONICS

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PREFACE

Electret studies opened up a new way of understanding the mechanism of polarization and absorption of charges in amorphous and crystalline dielectrics. Practical applications of electrets depend on their surface charge characteristics. Various properties of electrets prepared from several dielectrics have been investigated extensively by using different methods. But so far no satisfactory explanation has been given to explain the complete mechanism of electrets. This may be due to lack of thorough investigations of its properties. The properties of electrets depend upon the material used and on the polarizing conditions. In this thesis thermoelectret and photoelectret states in certain dielectrics are investigated. Although the mechanism of thermoelectret and photoelectret formation in dielectrics is different, they have several features in common. Systematic studies of the two states will, in time, shed further light on the conduction processes in dielectrics and semiconductors and on other general problems in solid state physics.

This thesis comprises of six chapters, deals with the electret effect in a number of natural and synthetic resins and a few photoconducting materials. The chemical and physical properties of most of these resins are not known completely. The first chapter contains a brief review of the earlier work and also a survey of the various explanations suggested for electret effect. The second chapter deals with a brief survey of various experimental techniques used for fabrication of electrets along

with various methods of measurements of discharge current and surface charge. The details of various experimental set up and measuring techniques used by the author for the work in this thesis are also given in this chapter.

Chapter III consists of electret studies in resins and the physical criteria to choose a binder for photosensitive coating used in direct electrophotographic systems. This chapter is divided into three sections. The first section deals with thermoelectret studies of the resins, VI, BG, Bn, CO, ST and SW. Thermoelectrets were prepared under different conditions of polarization, by changing the polarizing field, time and temperature to find out suitable polarizing conditions.

In the second section of Chapter III, photoelectret studies in these resins and their mixtures with ZnO are presented. The total charge stored by the ZnO-resin combination was found out to see the charge acceptance and charge retention characteristics. The decay of surface charge was measured by depolarizing the photopolarized samples in dark and in light.

The third section of Chapter III describes the electrophotographic techniques and a criterion to select a binder for the photosensitive coatings, by observing the physical properties.

Chapter IV is divided into two parts. The first part consists of the study of the lifetime of the photoelectrets. Two experimental techniques have been developed to increase the lifetime of the photoelectrets. In the second part, the V-I characteristics of the photoelectrets are given. It is found that photoelectrets possess rectifying property. Such an

effect was observed for the first time. A tentative explanation of the phenomena is also given.

In Chapter V, an expression is derived to explain the decay characteristics of photoelectret state with particular reference to CdS single crystals. It explains the variation of the electret effect with intensity of illumination and predicts two electron trapping levels in the CdS sample. It also gives the appropriate intensities of light to be used in a direct and photoelectret electrophotographic systems.

The sixth chapter gives the summary and salient conclusions of the whole work. The references are listed at the end of the thesis in alphabetic order.

Part of the work presented in the thesis has resulted in the following publications:

1. "The photoelectret studies in Boswellia Glabra", J. Appl. Phys., 42, 525 (1971).
2. "Study on the lifetime of the photoelectrets of ZnS", Nuclear Physics and Solid State Physics Symposium Proceedings, 3, 193 (1970).
3. "Study of the lifetime of CdS photoelectrets under different conditions of polarization", Ind. J. Pure and Appl. Phys., 9, 745 (1971).
4. "Photoelectret properties of ZnS:Cu", Ind. J. Pure and Appl. Phys., 9, 803 (1971).
5. "A study of the electret properties of Vateria Indica", J. Phys. D. Appl. Phys., 5, 1027 (1972).
6. "Investigations of the charge formation characteristics of Bn, a synthetic resin", J. Phys. D. Appl. Phys., 5 (1972).

7. "Studies on the thermo and photoelectret properties of Boswellia Glabra and ZnO-Boswellia Glabra mixtures", J. Appl. Phy.(Sept. 1973).

8. "Photoelectret characteristics of ZnO-resin mixtures and their utility in direct electrophotography", communicated.

9. "Rectifying properties of photoelectrets", communicated.

10. "Analysis of photoelectret state applied to CdS type photoconductors", communicated. Accepted for publication in Ind. J. pure and appl. Phys.

11. "Variation of persistent internal polarization with the intensity of illumination in CdS single crystals", communicated.

CONTENTS