THERMO- AND PHOTO- ELECTRET STUDIES IN ORGANIC SOLIDS

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PREFACE

Ample understanding of solid state concepts has been developed in the field of inorganic solids, while the research in organic solids has so far been carried out mainly at the basic level and it has already created much interest in the field of solid state physics. Research on organic solids represents a meeting place of physical methods, organic chemicals and biological systems.

The present work has been undertaken for obtaining a better understanding of the polarization mechanisms, in organic dielectrics viz. molecular solids, and conjugated polymers, and the relation of such mechanisms to the physico-chemical structures of these solids. To achieve this, 'ELECTRETS' of organic dielectrics were prepared and studied for their depolarization characteristics by electrical and optical techniques.

Electret effect was discovered in 1919, when M. Eguchi observed a persistent internal polarization in a mixture of waxes which had undergone an electrical and thermal treatment. Such thermoelectrets have attracted a great deal of attention in practical life because of their miniature size and economic handling. In 1937, Nadzakov discovered a similar kind of polarization in photo-conducting materials, which was named as photoelectret. Photo-electrets too have been found to be quite potential in the field of electrophotography and data storage systems.

Although, thermoelectret and photoelectret states are produced in the materials under different experimental treatments, they have several features in common. A study of thermoelectret and photoelectret states in molecular solids and conjugated polymers broaden their scope for practical utilization and is expected to give a better understanding of the conduction mechanism in these weakly bonded organic solids.

The interesting feature of electrets made of organic molecular solids is the retention of their polarization for a longer time, due to weak bonding forces present in them, as compared to electrets of inorganic solids.

Chapter I gives brief introduction of the subject and its present status highlighting the theoretical and experimental developments in this field.

Chapter II contains experimental details about the preparation and measurement techniques of electrets.

Chapter III covers thermoelectret studies carried out on organic polymers of industrial importance.

Chapter IV deals with photoelectret studies of organic molecular solids and a polymer of biological importance. In this connection, aromatic hydrocarbons, with an increasing order in the number of benzene rings have been investigated for

photoelectret and thermophotoelectret states.

In Chapter V, a practical device has been developed, in the light of its many uses suggested by several scientists, after thorough investigation and intensive experimentation.

Chapter VI contains summary of the investigations carried out, conclusions drawn from them, and indicates a direction of future developments in the field of organic electrets.

A part of the present work has resulted in the following publications:-

1. "Depolarization Current Characteristics of Naphthalene Photoelectrets" - P.K.C. Pillai and Malti Goel, J. Electrochem. Soc. 118, 359-64 (1971).

2. "Effect of Alternating Field on Polarization in Anthracene Photoelectrets" - P.K.C. Pillai and Malti Goel, I.J. Pure Appl. Phys. 9, 444-449 (1971).

3. "Photoelectrets and their Applications" - P.K.C. Pillai and Malti Goel, Phys. Stat. Sol. (a) 6, 9-27 (1971).

4. "Investigations of Photopolarization in Pyrene" - P.K.C. Pillai and Malti Goel, Electrochem. Acta 17, (1972).

5. "Photoelectret formation in β-Carotene" - P.K.C. Pillai and Malti Goel, Ind. J. Pure Appl. Phys. (accepted for publication).

6. "Surface Charge and Infrared Absorption Characteristics of Polyethylene Terephthalate Electrets" - P.K.C. Pillai and Malti Goel, J. Appl. Phys. (USA) (accepted for publication).

7. "Charge Storage in Epoxy Resin Thermoelectrets" - P.K.C. Pillai and Malti Goel, J. Electrochem. Soc. (accepted for publication).

8. "Effect of Temperature on Photoelectret Characteristics of Organic Materials" P.K.C. Pillai and Malti Goel, Phys. Lett. A. (accepted for publication).

9. "Electret Formation in Polytetrafluoroethylene" - P.K.C. Pillai and Malti Goel (communicated).

10. "Thermophotoelectret Investigation in Aromatic Hydrocarbons" - Int. Conf. on Electrets, Miami Beach, Florida (1972).

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