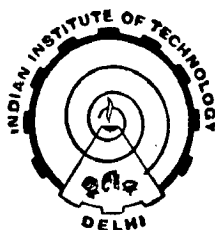


INVESTIGATIONS ON THE ELECTRICAL AND ELECTROTHERMOGRAPHIC CHARACTERISTICS OF PURE AND SENSITIZED POLYMERIC MATERIALS

By
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Thesis submitted
in fulfilment of
the requirements of the degree of
DOCTOR OF PHILOSOPHY
in PHYSICS



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INDIA

November, 1985

CERTIFICATE

I am satisfied that the thesis entitled
'Investigations on the Electrical and Electrothermographic
Characteristics of Pure and Sensitized Polymeric Materials,'
submitted by ASHOK KUMAR GUPTA is worthy of consideration
for the award of the degree of DOCTOR OF PHILOSOPHY and is
a record of the original bona-fide research work carried
out by him 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
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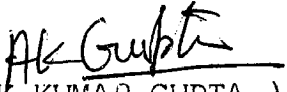
Mr. K. Giri deserves special thanks for the neat

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PREFACE

The research work presented in this thesis concerns with the characterization of various polymeric layers, pure as well as sensitized with thermosensitizer LMG, for their application in electrothermography. The polymers which have been investigated are: Polystyrene, Polymethylmethacrylate, Polyacrylonitrile butadiene styrene and Ethyl cellulose.

Effect of sensitization with LMG on glass transition temperature of PS, PMMA, and ABS thermoelectrets has been investigated by thermally stimulated discharge (TSD) technique. These polymers have been sensitized with different weight percentages of LMG to estimate the effectiveness of LMG in controlling the glass transition temperature.

The time and temperature dependence of charging currents has been analyzed. It has been shown by the studies on effect of thermal treatment on temperature dependence of resistivity of PS, PMMA, and ABS that true conductivity can be observed only when the films of these polymers are thermally treated at a temperature close to their glass transition temperature for a few hours. It has been concluded on the basis of studies on effect of sensitization with LMG on temperature dependence of conductivity that desirable conductivity can be obtained in PS, PMMA and ABS for electrothermographic applications by controlling the amount of LMG in them. Two values of activation energy

have been calculated from the slope of conductivity vs. increase of absolute temperature graphs in low and high temperature region.

Surface potential decay studies with and without exposure to infrared rays have been carried out on pure and sensitized corona charged PS, PMMA, ABS and Ethyl cellulose layers. It has been observed that the total decay of surface potential of corona charged polymeric layers under infrared exposure occurs at their T_g . ^{It} is also the transition temperature in dc conductivity measurements. Thus it has been concluded that increased conductivity and thermosensitivity of sensitized polymeric films is a direct consequence of lowering in their T_g on sensitization. On the basis of important electrothermographic characteristics such as charge acceptance, retentivity, contrast potential, residual potential and thermal sensitivity range it has been concluded that PMMA sensitized with more than 10% by wt. of LMG and ABS and EC sensitized with 25% by wt. of LMG can be used advantageously in electrothermographic applications.

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ABBREVIATIONS

LMG : Leuco malachite green

PS : Polystyrene

PMMA : Polymethyl methacrylate

ABS : Polyacrylonitrile butadiene styrene

EC : Ethyl cellulose

T_g : Glass transition temperature

T_p : Polarising temperature

E_p : Polarising field

t_p : Polarising time