

INVESTIGATIONS ON THE MICROSTRUCTURE OF POLYMERS USING POSITRON AS A MICROPROBE

THESIS

SUBMITTED TO THE UNIVERSITY OF MYSORE
FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY
IN PHYSICS

By

R. RAMANI

Guide: Dr. C. Ranganathaiah



DEPARTMENT OF STUDIES IN PHYSICS
UNIVERSITY OF MYSORE
ANASAGANGOTRI, MYSORE - 570 006
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DEDICATED TO
MY

PARENTS AND TEACHERS

DECLARATION

I hereby state that this thesis entitled "INVESTIGATIONS ON THE MICROSTRUCTURE OF POLYMERS USING POSITRON AS A MICROPROBE" has been composed by myself and comprises the results of my investigations carried out in the Department of Studies in Physics, University of Mysore, Manasagangotri, Mysore under the supervision of Dr. C. Ranganathaiah, Reader in Physics.

I also state that this thesis or any part of it has not been previously formed the basis for the award of any Degree, Diploma or other similar title.

Mysore
17 September, 1996.

R. Ramani —
(R. RAMANI)

CERTIFICATE

I certify that this thesis comprises of the research work done by Mr. R. Ramani independently under my guidance and supervision.

Mysore
September, 1996.



.. 17/09/96

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PREFACE

The basic understanding of the material properties of polymers is of great importance due to their wide range of applications in several fields. Ever since the existence of free volume was postulated, this has become an interesting topic in polymer research. Over the past few decades, there have been several developments both theoretically and experimentally to understand polymer properties in terms of free volume. Since the dimensions of the free volume holes are of submicroscopic level, only few techniques are available to characterize them. One among them is Positron annihilation lifetime technique which has proved to be a novel technique to characterize the defects in condensed media. This is because of the fact that positrons and positronium preferentially scan the defects/open volumes like free volumes. Since the annihilation characteristics can be measured accurately, the information on defects/free volumes can be derived from positron annihilation parameters.

This thesis comprises the investigations of the author to understand the microstructural changes in terms of free volume holes of three technologically important polymers viz., Acrylonitrile-Butadiene-Styrene, Poly (ethyleneterephthalate) and Polycarbonate using positron annihilation lifetime

technique. To effect a change in free volume, the author has used three different methods viz., iodine sorption, UV irradiation and isochronal annealing. The results are presented in chapters IV, V and VI of this thesis.

Mysore
September, 1996.

R. Ramani 17/09/96.
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