

INFRARED STUDIES ON LIQUID CRYSTALS

A THESIS SUBMITTED TO THE  
UNIVERSITY OF MYSORE  
FOR THE DEGREE OF  
DOCTOR OF PHILOSOPHY

BY

JACOB RICHARD FERNANDES

LIQUID CRYSTALS LABORATORY  
RAMAN RESEARCH INSTITUTE  
BANGALORE 560 006, INDIA

February 1978

DECLARATION

I hereby declare that this thesis was composed by me independently and that it has not formed the basis for the award of any Degree, Diploma, Associateship, Fellowship or any other similar title.

*J. R. Fernandes*

Jacob Richard Fernandes

'CERTIFIED'

*S. Chandrasekhar*

CERTIFICATE

I certify that this thesis has been composed by Mr. **Jacob Richard Fernandes** based on investigations carried out by him at the **Liquid Crystals Laboratory, Raman Research Institute, Bangalore** under my supervision. The subject matter of this thesis has not previously formed the basis of the award of any degree, diploma, associateship, fellowship or other similar title.



**Professor S. Chandrasekhar**  
Liquid Crystals Laboratory  
Raman Research Institute  
BANGALORE 560004

## ACKNOWLEDGEMENTS

The work reported in *this* thesis was carried out in Raman Research Institute, Bangalore under the guidance of Professor S. Chandrasekhar.

I am deeply indebted to him for *his* stimulating guidance and keen interest and also to Dr. S. Venugopalan for his valuable suggestions and constant help.

I am also grateful to all my colleagues in the laboratory for their help and cooperation at various stages of the investigations. In particular my thanks are due to Professor C.L.Khetrapal, Dr.N.V.Madhusudana, Dr. G.S.Ranganath, Dr. A.C.Kunwar, Dr. R.Shashidhar, Dr. V. Surendranath, Mr. B.K. Sadashiva, Mr. U.D. Kini, Mr. P.P. Karst, Mr. K.T. Balakrishnan, Mr. J. Padmanabhan, Mrs. Vani Narayan, Mr. M.R. Subrahmanyam, Mr. K. Subramanya, Mr. S. Raghavachar and Mr. K. Vasudevan.

I would also like to thank the National Council of Educational Research and Training for the award of a Fellowship.

Lastly I would like to thank my parents and my brothers for their encouragement and Yasmin for her wide assortment of help.

## CONTENTS

	Page No.	
Chapter 1	Introduction	1
Chapter 2	Experimental Apparatus and Procedure	23
Chapter 3	Far-Infrared and Raman Spectra of the Solid Phases of CBOOA	44
Chapter 4	Infrared Spectroscopic Study of Phase Transformations in Liquid Crystalline CBOOA	70
Chapter 5	Pas-Infrared Absorption in the Highly Ordered Smectic Phases of TBBA	92
Chapter 6	Determination of the Absolute Orientational Order Parameter Using Infrared Dichroism: Application to CBOOA	110
Chapter 7	Orientational Order and Tricritical Behaviour in Some Homologues of the n-OMCPC Series of Liquid Crystals	128
Chapter 8	A New Differential. Technique for the Study of Dichroic Spectra Using Unpolarized Radiation	145
Appendix A	Group-Theoretical Derivation of the Number and Irreducible Representations of the External Zone-Center Phonons of Crystalline CBOOA and TBBA	155

	Page No.	
<b>Appendix B</b>	<b>Derivation of the Resultant Lineshape when Two Lorentzian Spectra are Convolved</b>	162
<b>Appendix C</b>	<b>Relationship Between the Order Parameter and the 'Dichroic' Ratio for a Homeotropically Aligned Sample</b>	165
<b>Appendix D</b>	<b>An Estimate of the Required Correction. to the Order Parameter when a Homeotropically Aligned Sample is Used</b>	168