ABSTRACT

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Optical Activity and Dynamic Light Scattering In Chiral Nematic Liquid Crystals

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The work reported in this thesis deals with an electro-optical study of chiral nematic liquid crystals, S-(+)-4-(2-methybutyl)phenyl 4-decyloxybenzoate (CE6) and Cholesteryl Nonanoate (CN), a cholesteric polymer, C4745, and a 90%CE6-10% C4745 mixture through the use of optical activity and light scattering techniques.

An expression for the optical activity in chiral nematic liquid crystals has been derived for zero field. This derivation represents an extension of the present theory of optical activity in chiral nematics. However, the expression does not adequately describe the optical activity data obtained from the cholesteric polymer studied. An explanation is offered for this behaviour.

A rotating analyzer system was used to measure the optical activity of the samples used. This method is very sensitive and accurate in measuring optical activity and from these data, the second order transition mode temperatures, were determined.

Dynamic light scattering studies were performed on various concentrations of CE6-CE6R. From these results, phase diagrams were constructed for the CE6-CE6R mixtures. The transition to the blue phases becomes more continuous with increasing chirality. However, the isotropic – BPIII transition is discontinuous in CE6. The light scattering data can be fitted to a single exponential over a wide temperature range. The linewidth decreases with

decreasing temperature in the isotropic phase and increases with decreasing temperature in the blue phases. Also, the linewidth increases with increasing applied field and increases slightly with increasing chirality. The scattered intensity increases with increasing chirality and with increasing electric field.

The isotropic transition becomes more discontinuous as the electric field increases. The electric field destroys the contribution from the $m = 2$ modes while enhancing the contributions from the $m = 0$ mode.

Some of the work described in this thesis has been published in four refereed articles. They are presented in appendices I – IV.

Keywords: Optical activity; Light scattering; Chiral nematic liquid crystals; phase transitions; Side-chain polymer; Phase diagrams; Electro-optical effects