CHAPTER 6

SUMMARY AND FUTURE SCOPE
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6.1 Summary

The measurement of dielectric properties in a wide frequency range gives the information on the conduction mechanism, interfacial polarization and molecular dynamics. Dielectric constant is a characteristic property of the material and it has contributions from the orientational polarization, space charge polarization, dipolar polarization, ionic polarization and electronic polarizability which are functions of frequency and temperature. The dielectric studies are very useful as they provide important information regarding molecular structure, and type of molecular interaction in the sample and hence the probable phases that can be shown by the molecules of the sample.

Textural and phase transition temperature measurements, Low frequency Dielectric Investigations carried out on two homologous series of 2-(4- n alkanoyloxy benzylidenamino) benzothiazoles (for n=12 and 16), 6-methoxy-2-(4- n- alkanoyloxybenzylidenamino) benzothiazoles mesogens (for n=14 and 16), Fe$_3$O$_4$ nano doped p-n-alkyloxybenzoic acid mesogens and (S)-(−)-2-Methylbutyl4’-(4”-n- alkanoyloxybenzoyloxy) biphenyl-4-carboxylates (S-MB-nB-BC) where n=16 and18 are discussed in Chapters 3A, 3B, 4, and 5 respectively in this dissertation. This chapter summarizes the results of the work carried out and presents the important finding along with future scope of the work.

Let us have a clear and elaborative summary of the findings done in this research work.

The textural observation 2-(4- n alkanoyloxybenzylidenamino) benzothiazoles (where n= 12 and 16) mesogens shows enantiotropic Smectic A phase. Benzothiazole heterocyclic fused ring system, exhibits good hole-transporting properties with a low ionization potential making it of potential interest as hole-transporting materials in organic light-emitting devices (OLEDs) so that the benzothiazole ring is chosen as the mesogenic core in this study. Due to the high orientation of liquid crystal molecules in isotropic phase shows high value of $\varepsilon'$ when compared with other phases. The decrease in permittivity with frequency can be explained on the basis of Koop’s theory, which considers the dielectric structure as an inhomogeneous medium of two layers of the
Maxwell–Wagner type. In this model, the dielectric structure is assumed to be consisting of well conducting grains which are separated by poorly conducting grain boundaries.

Data of Dielectric loss clearly shows that low frequency data are affected due to ionic conductance, where as high frequency data are affected due to ITO resistance. As usual relaxation frequencies are seen to shift towards lower side with decrease in temperature. In second case of the conductivity is increased with increasing temperature in both samples. This is due to the restriction of charge carrier at low temperatures, as the temperature increased the mobility of charge carriers are increased so that the conductivity increases up to isotropic phase in both samples. The relatively higher value of the activation energy is suggested to the higher potential barrier witnessed by the molecular dipole moment to orient to the field. At high frequencies the activation energy decreases so that it will have a relatively high dielectric strength. Cole-Cole plots show Debye relaxation. The observed relaxation times from the Cole-Cole plots and relaxation curves are in good agreement.

As a third case of study, The presence of nanoparticles in the interstices of NnOBA is confirmed through UV – Visible spectra, in which NnOBA samples show characteristic peaks of Fe\(^{+3}\) ion, which were not observed by nOBA. The strong interaction between the Fe\(_3\)O\(_4\) nanoparticles and the liquid crystal anisotropic matrix has brought obvious effects on thermal transition behavior and dielectric properties of LCs. Observed nanodoped liquid crystals exhibit threaded nematic and Sm C for n=6,7,9&12 and astonishingly exhibit cholesteric phase in nano doped 8OBA and Sm A and Sm B phases in nanodoped 10OBA. Therefore, when the nanoparticles are dispersed in the anisotropic liquid crystalline medium, the particle resonance, depending on the angle of the director and the surface reactivity, is identifiable. The presence of nano not only effects the molecular ordering but also influences the dielectric nature of pure samples which is shown in all measured dielectric parameters like \(\varepsilon'\), \(\varepsilon''\), \(\tau\) and activation energy. These changes can be attributed to the dipole moment contribution of magnetite nano particles to the liquid crystal molecules. The magnetite nanoparticles make the LC molecule to reside in the applied AC field direction for a longer time even after the removal of applied field. This is an exciting feature of our findings which is applicable to memory devices, a most wanting property of storage devices.
The non-symmetric response of loss $\varepsilon''$ (or $\tan\Delta$ about its maximum value) with the increasing frequency in turn suggests for an off-centered dielectric dispersion in the all phases of Ferro electric liquid crystals samples. By observing the dielectric loss spectrum there is cross over frequency is observed in both the compounds. Dipolar relaxation SmecticC* and Smectic A, phases is found to follow Arrhinius shift through their activation energies.

6.2 Future Scope of Work

1. From X-ray Diffraction studies crystallization nature and structure can be studied.
2. Dielectric anisotropy measured from parallel and perpendicular components of $\varepsilon$.
3. Visco elastic properties can be determined from Rheology studies.
4. Optical tilt angle measurement of FLC samples.
5. Molecular dynamic studies by applying bias voltage.