PREFACE

Liquid crystal (LC) is a nature's delicate phase of matter, which has remarkable combination of properties that of crystalline solids and isotropic liquids. The LCs are anisotropic optical materials like crystalline solids and at the same time, they can flow like isotropic liquids. Since the discovery of LC, there has been tremendous development in this field due to the realization of its applications and its unique properties during phase transition. Ferroelectric liquid crystals (FLCs) are some special kinds of LCs enriched with important property, *i.e.*, ferroelectricity. The devices based on FLCs have been found to possess interesting display parameters such as high response speed (in microseconds), good optical contrast and low threshold voltage.

The present thesis mainly deals with extensive and systematic investigations based on dielectric and electro-optical studies of some FLC materials to explore their basic and applied aspects. Some part of the thesis deals with the dielectric and electro-optical properties of pure FLC materials while rest of the thesis mainly emphasis on the effect of different types of nanomaterials on these properties. The brief description of the research work presented in this thesis is given below:

Chapter I presents the introduction of LC materials starting from its mysterious discovery to its classification and various applications. A detailed description and literature survey of FLCs, has been presented and classified on the basis of chemical, geometrical shape, and molecular arrangement with a brief review of the present status of the field.

Chapter II deals with the experimental techniques used for the fabrication of sample cells and the instruments involved in the characterization of these samples. The different stages in the preparation of a LC sample cell have been discussed in detail here and the different methods for studying the physical, electro-optical and dielectric properties of LC materials have also been described in this chapter.

Chapter III describes the possibility of obtaining enhanced memory effect by the coating of conducting polymer, poly-3 hexyl thiophene (P3HT) rather then the coating of non-conducting polymer (nylon 6/6) on the surfaces of FLC samples. The observed memory effect has been investigated by textural, electro-optical, and dielectric spectroscopic methods and it depends mainly on the concentration of P3HT. The doping of ~ 0.2% wt./vol. of P3HT in chloroform solution appeared to be the most suitable amount for achieving good memory. The observed memory effect has been attributed to minimization of depolarization field and ionic charges and the devices based on underlying phenomenon would be much promising due to their excellent price to performance ratio.

Chapter IV demonstrates the effect of silane and graphene oxide (GO) nanomaterial on the alignment and dielectric properties of FLC material. We found that silane possess the capability of inducing a uniform homeotropic (HMT) alignment in FLC by surface treatment while by the addition of GO in to FLC material, one can achieve a perfect HMT alignment without any surface treatment of the substrates. By applying a dc field, a field-induced transition from HMT to homogeneous (HMG) configuration, in both Sm C^* and Sm A* phases has been observed which can be confirmed by textural, dielectric and electro-optical studies.

Chapter V describes the effect of copper oxide (CuO) decorated multi walled carbon nanotubes (MWCNTs) on the response time and ionic impurities of FLC material. The doping of CuO decorated MWCNTs into FLC medium, can improve the optical contrast and physical parameters of the host material also. The fastening of the response in CuO decorated MWCNTs doped FLC has been attributed to the decrease in rotational viscosity whereas the suppression of ionic impurities of the host FLC medium has been attributed to the adsorbance/trapping of ions by the guest CuO decorated MWCNTs.

Chapter VI describes the effect of zinc oxide nanoparticles (ZnO NPs) on the phase transition temperature and dielectric relaxation behavior of electroclinic liquid crystal (ELC) materials. Addition of ZnO NPs in ELCs show a remarkable shift in Sm C* to

Sm A* phase transition and the collective dielectric relaxation behavior of doped ELC shows the existence of a low frequency peak along with the Goldstone mode in the Sm C* phase. The frequency separation of both peaks increases with temperature and the low frequency peak vanishes near transition temperature. The same dielectric behavior was observed by doping some other nanomaterial (*e.g*. GO) into ELCs.

Chapter VII summarizes the findings of all the studies presented in different chapters of the thesis and the future scope of the work presented.