Fluorescence and Texture Studies of Ferroelectric Liquid Crystal and Its Fluorescent Dye Doped System

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Abstract. **- In this paper, we report textures and fluorescence study for pure ferroelectric liquid crystal (FLC) and its 1% doping of fluorescent dye in pure FLC. Excitation wavelength, emission wavelength and quantum yield has been determined for both mixtures from fluorescence study. Quantum yield shows the probability of excited state being deactivated by fluorescence rather than non radiative mechanism. The values of these parameters are strongly changed by the concentration of fluorescent dye. In addition to this, we also observed UV absorption indicating that there is higher value of UV absorption for fluorescent dye doped system in comparison to the pure system.**

Keywords: Fluorescence, UV Absorption, Ferroelectric Liquid Crystal

INTRODUCTION

Ferroelectric liquid crystals (FLCs) are the material exhibiting most fascinating phases among all the thermotropic liquid crystals. These materials are technologically important due to their considerable characteristics such as high optical contrast, good switching response. The incorporation of different types of guest materials into the host material (FLC) is very practical method for manipulating the properties of host material. Recently it was shown that the dispersion of quantum dots, nanotubes in the FLC matrix does enhance the material properties of the pure system [1-9]. The fluorescent dye doped FLC are not only of fundamental importance but it is also useful in different devices applications such as development of less energy consuming mobile communication displays [10]. In the present investigation, excitation wavelength, emission wavelength and quantum yield are obtained from fluorescent study while optical textures has been observed from optical polarizing microscopy.

EXPERIMENTAL DETAILS

The FLC material used for present study is Felix 16/100 and the phase sequence of the sample is Cr- SmC* -SmA - N*- Iso at -20^{0}C, 72^{0}C, 82^{0}C and 94^{0}C. The fluorescent dye used for doping is Poly (3,3′,4,4′-benzophenonetetrac arboxylic dianhydride-alt-3,6-diaminoacridine hemisulfate) has been used as guest material purchased from Sigma Aldrich India. The one concentration of fluorescent dye has been prepared by doping of fluorescent dye 1% wt./wt. FLC in pure FLC and we call this as mixture 1 throughout discussion. The UV visible absorption study has been performed UV-VIS spectrophotometer (Elico SL210) for a wavelength interval 300-600 nm. The fluorescent measurement has been performed fluorescent spectrophotometer (Elico SL-174) in wavelength interval 200-600 nm. The optical response of FLC was performed by square wave method by using a 5mW He-Ne laser of wavelength 633 nm. The optical response was recorded by photo detector Instec PD02-L1 [4].

RESULTS AND DISCUSSION

The electrical switching behavior of all the mixtures have been confirmed by optical polarizing microscopic study at 10X magnification through crossed polarizer interfaced with camera. The photographs has been taken for all the mixtures in SmC* phase at room temperature. When there is no field the textures are shown in figure 1(a) as field is increased from 0V the helical axis of molecule or director get disturbed and get oriented more or less parallel along the electrode as shown in figure 1(b).

The UV visible absorption study has been carried out to observe absorbance of white light by pure FLC and mixture 1. We have made solution of pure FLC, mixture 1 toluene and we kept normality 1N for absorption and fluorescence study. The absorbance in arbitrary unit on the wavelength scale in nanometer for the pure and fluorescent dye doped has been plotted in figure 2. From figure 2 we see that absorbance is higher for fluorescent dye doped FLC mixtures in comparison to the pure FLC. In fluorescent dye doped FLC mixtures we see that absorbance is higher for mixture 1 in comparison to

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pure due to reason that dye molecules support FLC molecules to increase absorption.

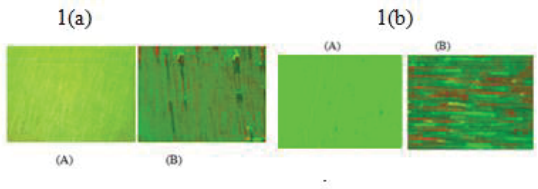


Figure 1.(a) Optical Photographs in SmC* Phase at room temperature with no field while figure 1(b) represents field of 5V. In both figures (A) Pure FLC (B) Mixture 1

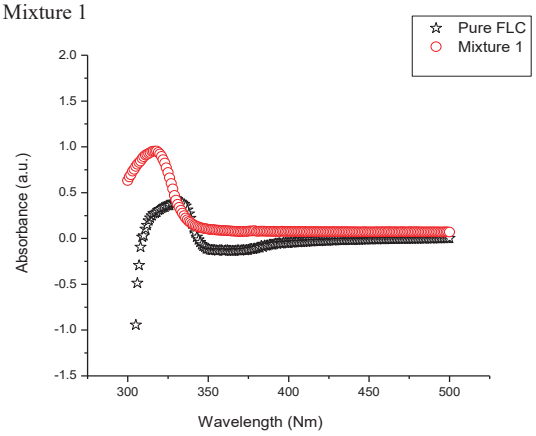
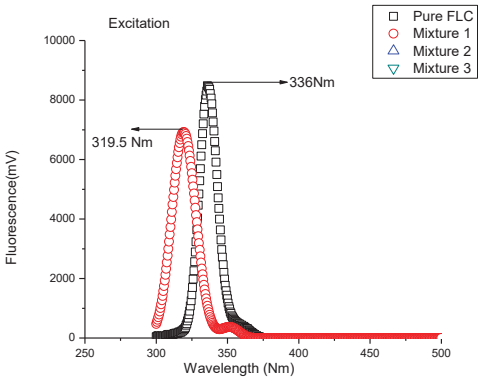
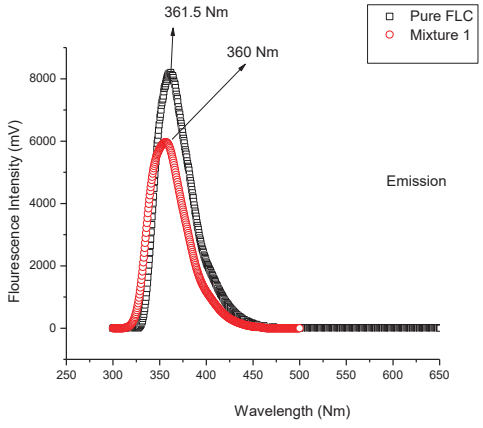


Figure 2. Wavelength variation of absorbance for pure and mixture 1.



(a)



(b)

Figure 3.Wavelength variation of fluorescence for pure and mixture 1 (a) Excitation spectra (b) Emission spectra.

The wavelength variation of fluorescent intensity has been plotted for excitation and emission spectra for all the mixtures and shown in figure 3(a) and figure 3 (b). From this figure we see that there is non-linear behavior of fluorescent intensity. The excitation wavelength for pure FLC is 336 nm, fluorescent dye is 266 nm while it decreases for mixture 1 i.e. 319.5 nm,. The figure of emission spectra for all the mixtures shows the same trend as for excitation spectra. We have also evaluated quantum yield with the help of Elico software using excitation and emission data for all the mixtures. Quantum yield gives the probability of excited state being deactivated by fluorescence rather than by another non radiative mechanism. An energetically excited state is formed when a fluorophore absorbs a photon of light. The fate of this species is varied, depending upon the exact nature of the fluorophore and its surroundings and end result is deactivation and return to the ground state by fluorescence, internal conversion and vibrational relaxation. The value of quantum yield is 2.588281, 2.972469 for pure FLC and mixture 1 respectively.

CONCLUSION

We have explored pure FLC and fluorescent dye doped system using UV absorption and fluorescence study. In this study we found that UV absorption is higher for fluorescent dye doped system in compared to the pure system. The excitation and emission wavelengths along with quantum yield have been evaluated for both mixtures from fluorescence study. The excitation wavelength of fluorescent dye doped system has been shifted towards higher side in compared to the excitation wavelength of fluorescent dye i.e. 260 nm.

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