**Indium Tin Oxide (ITO) Conducting Effect on Dielectric Spectroscopy without Biasing Voltage in Liquid Crystal Mixture**

**First Author Name, Second Author Name, Third Author Name**

Department & university

First Author Email, Second Author Email, Third Author Email

**ABSTRACT:**

In dielectric study we have use Indium tin oxide (ITO)coated glass plate. The ITO layers are widely used to make electrodes in measuring cells, because these layers are transparent and investigations can be performed by using the cells. It was found during the dielectric spectroscopy measurements, performed for smectic liquid crystalline mixture, that it is not possible to detect some important dielectric relaxation modes for SmA\*and SmC\*ferroelectric liquid crystal mixture for the frequencies higher than 200 kHz. The measuring cell does not allow to measure relaxations, because its own dielectric behaviour covers the dielectric response of a liquid crystalline medium. One can observe the contribution for high frequency part of the dielectric spectrum, due to the finite resistance of ITO layers. In this paper theoretical model was introduced, which shows how to calculate relaxations related to liquid crystals from dielectric response of the empty and filled measuring cell. The proof of strong influence of cell properties on effective values of dielectric permittivities was shown.

**KEYWORDS:** liquid crystal mixture, dielectric spectroscopy, relaxation modes, dielectric strength, relaxation frequency.

**INTRODUCTION:**

The existence of ferroelectric properties in tilted smectic liquid crystals (SmC\*, SmF\*, SmI\*) is firmly established on the basis of experimental and theoretical investigations [1-2]. From structural view point, the ferroelectric SmC\* phase exhibits layered structure and appears by the formation of an incommensurate structure in which the molecular director precesses helicoidally while going from one layer to another. In order to understand the physics and material properties of ferroelectric smectic C (SmC\*) liquid crystals, theoretical and experimental investigation have been carried out by various research groups on materials having small and large spontaneous polarization, helix pitch and rotational viscosity to explore their use in electro optic displays [3-8]. Dielectric spectroscopy has been carried out to understand the static and dynamic properties of ferroelectric liquid crystals (FLCs) and their mixtures [9-12]. It also gives information about various collective and molecular process observed in the broad frequency range. Appearance of Goldstone mode "GM" and the soft mode "SM' which occur due to the phase fluctuations of azimuthal angle () and the amplitude of tilt angle have been demonstrated by several researchers [13-15] At the SmC\*-SmA, only the SM is observable due to the fact that both the amplitude and tilt angle fluctuations become indistinguishable near the SmC\*-SmA transition. Wrobel et al. explained that the large dielectric increment of the GM hinders the detailed investigations of other collective processes. The complex permittivity of the SmC\* phase is dominated by the DM [16, 18] ; however it can be suppressed by application of a bias field resulting in the unwinding of the helicoidal structure. Bersnew et al. [19-22] and Wrobel et al. [15] have reported. The director reorientation can be described in terms of the real ['(,T)] and imaginary [''(,T)] part of the complex dielectric permittivity [\*(,T)] which is given as

**RESULTS AND DISCUSSION:**

Figs. 1 shows the effect of frequency on the imaginary part of the dielectric study the dielectric loss ('') increases from 0.2 (at 15 Hz) attains a maxima of 0.8 (about 300 Hz) in lower frequency range and in case of higher frequency range 0.2 (at 500 kHz) and ~1.0 at 40 Cº for sample SCE-4 .

At higher frequencies, second loss peak have been observed. It is expected to have been formed the other relaxation mode. We believe that the other relaxation mode originates as a consequence of surface effects due to the charge accumulation phenomena between the alignment layer and the ferroelectric liquid crystal materials.

**CONCLUSIONS:**

A detailed analysis of dielectric properties of FLC mixtures has been carried out. Our results indicate that:

1. The imaginary part of dielectric data effective on lower and higher frequency side show significant contribution of conductivity effect in SmC\* phase.
2. The real and imaginary part of FLC mixture decreases with bias voltage.
3. The real part (permittivity) is decreases with increasing temperature frequency in SmC\* phase and permittivity increase with temperature in SmA and again decrease with temperature in N\* phase.

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**REFERENCES:**

1. **Meyer R.B., Liebert L., Strzelecki and Keller P. :** J.de. Phys. (Paris) **36**, L69(1975).
2. **Beresnev L.A., Blinov L.M., Osipov M.A. and Pipin S.A.** : Mol. Cryst. Liq. Cryst., **158A**, 1-150 (1988).
3. **Peter J. Collings and Michael Hird :** Introduction to Liquid Crystals, Taylor & Francies, London (1997).
4. **de Gennes P.G. :** The Physics of Liquid Crystals, Clarendon Press, Oxford (1974).
5. **Parmar D.S. and Ph. Martinot-Lagarde** : Ann. of Physics, 3, **275** (1978).
6. **Raina K.K.** : Mol. Cryst. Liq. Cryst., 151 211 (1987).
7. **Clark N.A. and Lagerwal S.T. :** Appl. Phys. Lett., 36 **899**(1980).
8. **Srivastava S.L., Agarwal V.K., Loseva M.V., Chernova N.I. and Bersenev L.A. :** Liquid Cryst. 11 **851**(1992).
9. **Majumder T.P., Roy S.S. and Roy S.K. :** Mol. Cryst. Liq. Cryst. 265-**577** (1995).
10. **Jitendra Kumar Kushwaha, V. P. Arora, K.K. Raina and V. K Agarwal Research paper entitled** “Dielectric spectroscopy of wide temperature range nematic liquid crystal mixtures”in Journal of Mol. Cryst. Liq. Cryst. Vol. 541, pp 236/474 (2011).