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Outcome of Al_2O_3 Nano Bits Dispersed in 4-Cyano 4′ Heptyloxy Biphenyl [7O.CB] Liquid Crystalline Sample -An Ocular Study

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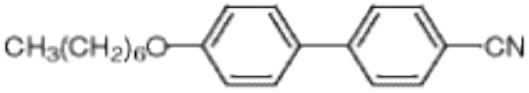
Abstact:- The Al_2O_3 nano bits are scatter in 7O.CB liquid crystalline samples in the ratio 1:100. The characterization of pure and nano scatter liquid crystalline compound is done by POM, DSC SEM and EDAX techniques. It is observed that nano particles are well established into LC compound. Modified spectrometer is used to measure the birefringence of the LC compounds. Using birefringence data the orientational order parameter is estimated. From our investigation it is noticed that, order parameter is found to be changed by 10.29% in nano dispersed compound when compared to pure sample.

Keywords:- *Liquid Crystal, Nano Particle, Dispersion, Birefringence, Order Parameter.*

I. INTRODUCTION

Mesogens are mesophases with a level of order in between that of solid and liquid showing anisotropic effects. The anisotropic effects include elasticity, dielectric viscosity, and birefringence etc., The running effects allow them to be contained in any utensil, hence these materials are viable candidates for applications. As technology advances for the mesogenic display now-a-days is await to reach lofty electro-optical performance as well as to less power depletion [1]. Alternatively synthesizing the number of lofty quality liquid crystal samples as constituents nano particles are doped to attain the goal. Thus dispersion of nano particles into liquid crystals has appeared as a fascinating area of research to the application point of view. Liquid crystal dispersion containing many types of nano bits have been developed in the present years. The nano dispersed liquid crystal paticles investigated embrace metallic nano particles [2], carbon related nano particles [3-4], and semi conducting [5-7] nano particles etc., Every type of this nano particle has its own outcome on changes of the liquid crystal material effects. It has been established that the impurity ions in the LC system strongly impact on the device exhibition such as decrease the Liquid Crystal Display (LCD) quality mainly at high temperatures. In order to take over the ion induced problems such as reduction in dielectric permittivity, increase in threshold voltage, the image flicker and slow down of the response. These studies concentrate on many essential ionic properties and intend to provide a promising solution of the ion effect issue. In recent years Al_2O_3 nano particles have bring out considerable interest owing to their capability in substances and gadget uses. Thus Al_2O_3 nano particles are dispersed into 7O.CB, the birefringence studies are carried out and hence orientational order parameter is estimated.

The molecular structure of the Liquid crystal used in this work is shown below:



II. CHARACTERIZATION

Using POM the optical textures reveal by the sterling and nano dispersed mesogenic samples are marked and related phase transition temperatures are noted. For confirmation the temperatures of transition are also measured by differential scanning calorimeter and illustrated in the table 01. The optical texture and DSC thermograms are represented in fig.1-4.

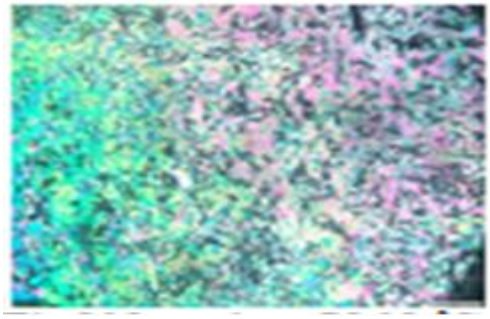


Fig 1:- Texture of pure 7O.CB Nematic at 75.12℃

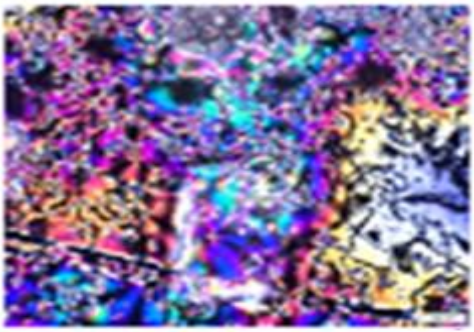


Fig 2:- Texture of 7O.CB+1%Al_2O_3 Nematic at 72.42℃

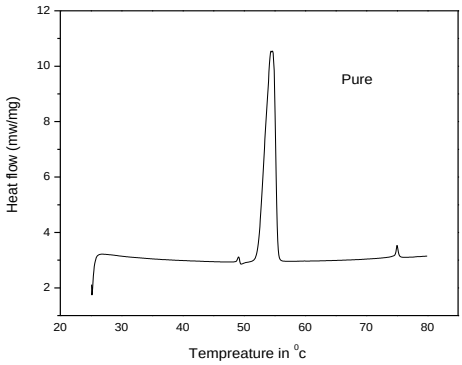


Fig 3:- DSC Thermogram of 7O.CB

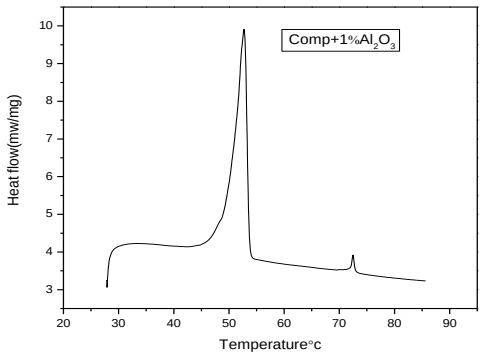


Fig 4:- DSC Thermogram of 7O.CB+1%Al_2O_3

➢ *SEM Images*

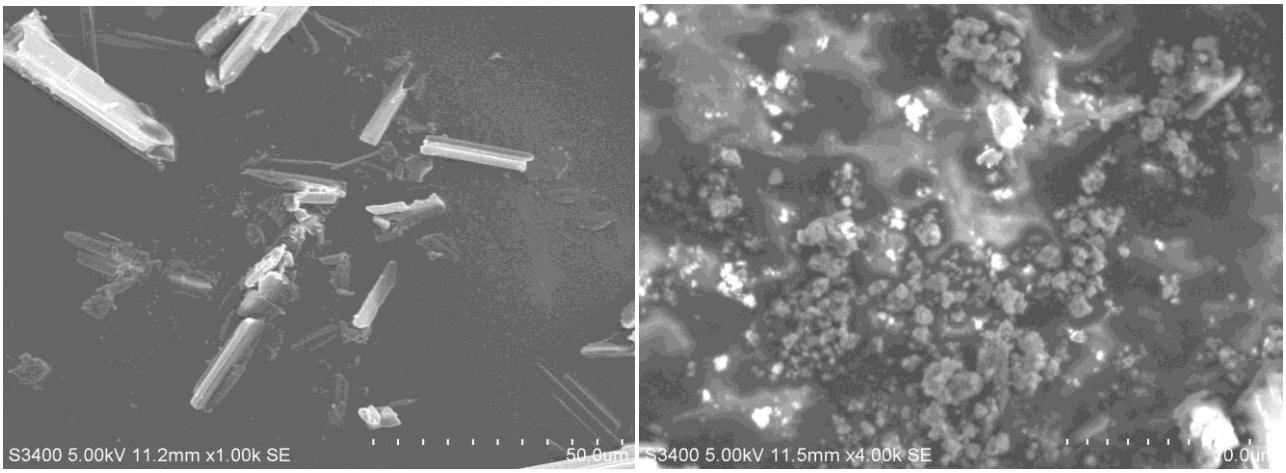
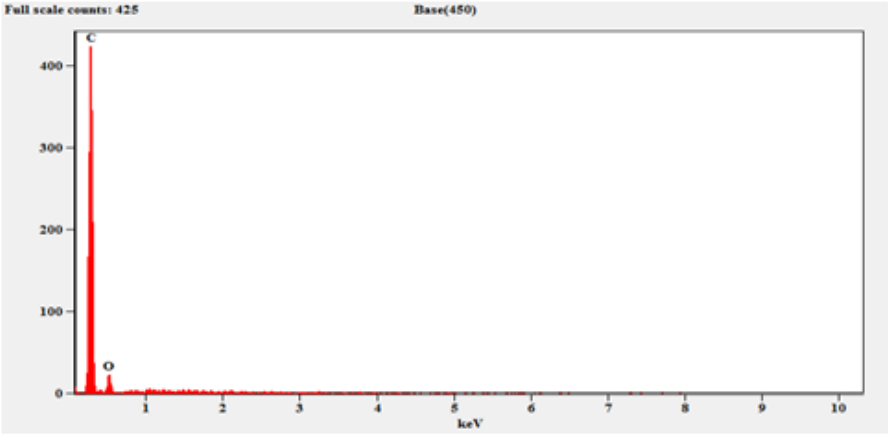


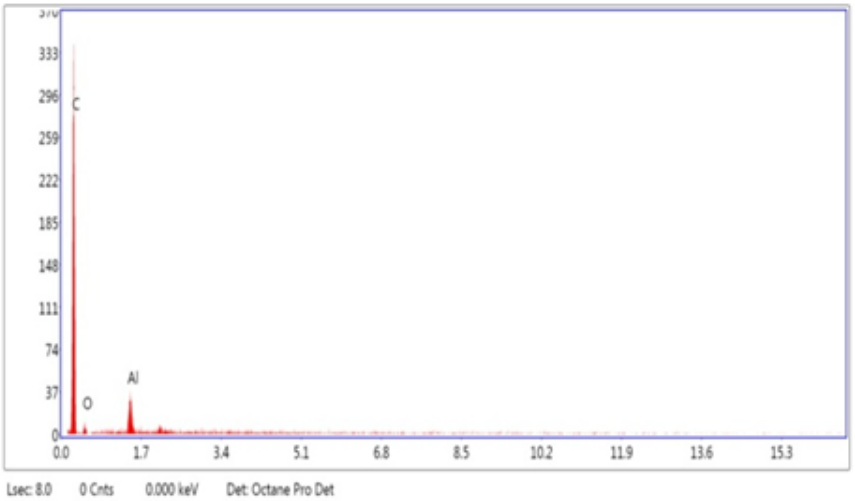
Fig 5:- Sem images of 7O.CB and 7O.CB+Al_2O_3

➢ *EDAX Data*



Element Line	Weight %	Atom %
C K	99.54	99.65
O K	0.46	0.35
Total	100.00	100.00

➢ *EDAX spectrum of 7O.CB compound*



Element line	Weight %	Atomic %
C K	89.81	92.80
O K	7.97	6.19
Al K	2.22	1.02
Total	100.00	100.00

Fig 6:- EDAX spectrum of 7O.CB+1%Al_2O_3 compound

S. No	Sample	Technique	Transition Temperature (℃)		
			Cr	N-I	Thermal range
1	4 -Cyano-4'-heptyloxybiphenyl	DSC	54.34	74.95	20.61
		POM	55.19	75.12	19.93
2	4-Cyano-4'-heptyloxybiphenyl+1% Al_2O_3	DSC	52.72	72.59	19.87
		POM	52.2	72.42	20.22

Table 1:- Transition temperatures of Pure and Nano dispersed compound

III. EXPERIMENTAL

The refractive indices of the pure and nano scatter liquid crystalline compounds are measured at wave length 589.3nm using wedge structure glass compartment similar to the one used to obtain birefringence by Haller et. al. [8]. A wedge shaped glass cell was prepared with two optical flat rectangular glass plates (50mm x 25mm) sandwiched with glass slide of 0.05mm thick which acts as a wedge spacer. The glass compartment is complete with the LC sample. The liquid crystal sample in the glass compartment exhibit as a uniaxial crystal with its line of optic axis parallel to the edge of the gap of glass dish.

➢ *Determination of Order Parameter S from Birefringence δn*

Kuczynski et. al [9] put forth a procedure for the estimation of order parameter S from the birefringence computation δn without taking the local field experienced by the molecule in a liquid crystal phase. The birefringence δn which is a function of temperature is fitted to the following equation

$$\delta n = \Delta n(1 - \frac{T}{T^*})^{\beta} \qquad (1)$$

Where T is the absolute temperature, T^* and β are persistent. T is the universal temperature T^* and β are sustained (T^*=T+x) where x varies from 0.001- 4 K and exponent β is close to 0.2. This procedure enables one to extrapolate δn to absolute zero. In practice the three adjustable parameter T^* Δn and β are obtained by fitting the experimental data for the following equation written in the logarithmic form

$$log\delta n = \log(\Delta n) + \beta log\left(T^* - {}^{T}/_{T^*}\right) \qquad (2)$$

The Order parameter S is designated

$$S=\frac{\delta n}{\Delta n} \qquad (3)$$

IV. RESULTS AND DISCUSSION

➢ Textural and Phase temperatures of transition for Liquid Crystalline nano composites are observed by Polarizing Optical microscope. The textural features are changed due to the self-assembly of nano particles in 7O.CB compounds which are illustrated in fig.1 to 4 and table. 01.

➢ The SEM and EDAX analysis is carried out. The nature of Morphological images shows that the Al2O3 nano bits are well scattered in 7O.CB mesogen samples..

- In nematic region The refractive index practically exhibits no change in isotropic stage. At the isotropic stage nematic transformation , isotropic ray is split into one two one small than isotropic value called O-ray (ordinary ray0 and another isotropic value called E-ray (extra- ordinary) these are clearly observed in the telescope of Altered spectrometer at minimum deviation angle . In nematic region the n_e Increases while no decreases with the decrease of temperature. The refractive Indices changes with temperature in isotropic and nematic stage for pure and nano Spread liquid crystalline sample is presented in the Figure. the birefringence of 7O.CB and its nano composites are measured and depicted in fig. 7. The birefringence varies from 0.1376 to 0.2285 in 7O.CB and 0.1433 to 0.2334 in Al_2O_3 composites.

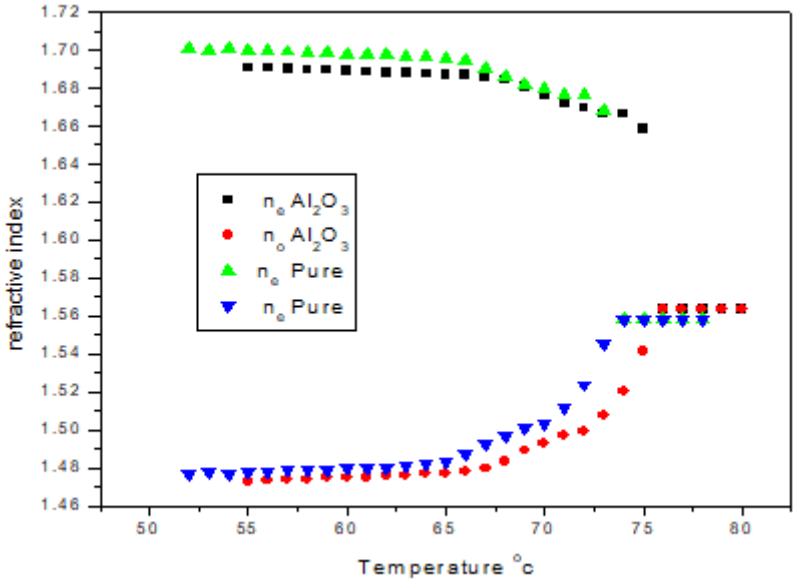


Fig 7:- Temperature changes of refractive indices in 7O.CB+1%Al_2O_3

The Order Parameter is evaluated by Kaczynski method ($S=\frac{\delta n}{\Delta n}$) in pure and nano composites of 7O.CB. The Order parameter is found to be decreases with the increase of temperature and which varies from 0.2548 to 0.42318 and 0.2810 to 0.4587 in Pure and nano composites. The order parameter evaluated is well within the literature data available on number of LC compounds (0.2 to 0.8).

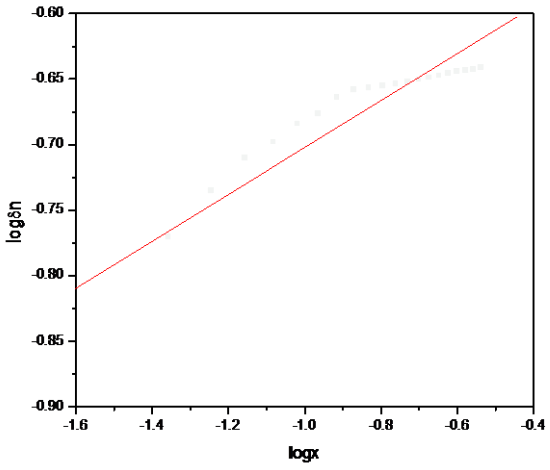


Fig 8:- Log δn -logx plot of 7O.CB

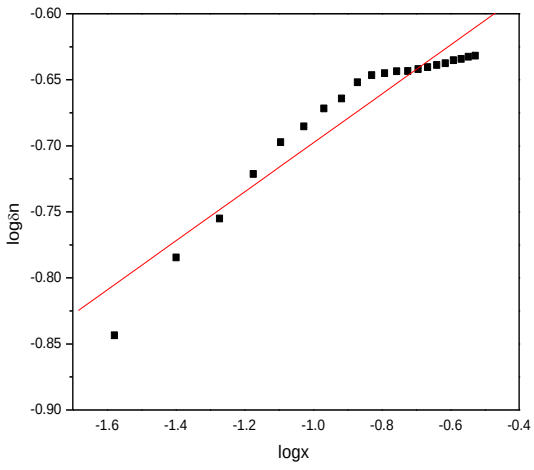


Fig 9:- Log δn –log x plot of 7O.CB+Al_2O_3

Sample	T	T^*	β	R
7O.CB	348	349	0.17927	0.91712
7O.CB+1%Al_2O_3	345	346.95	0.18546	0.95501

Table 2:- The perfect order in birefringence and material constant of compound

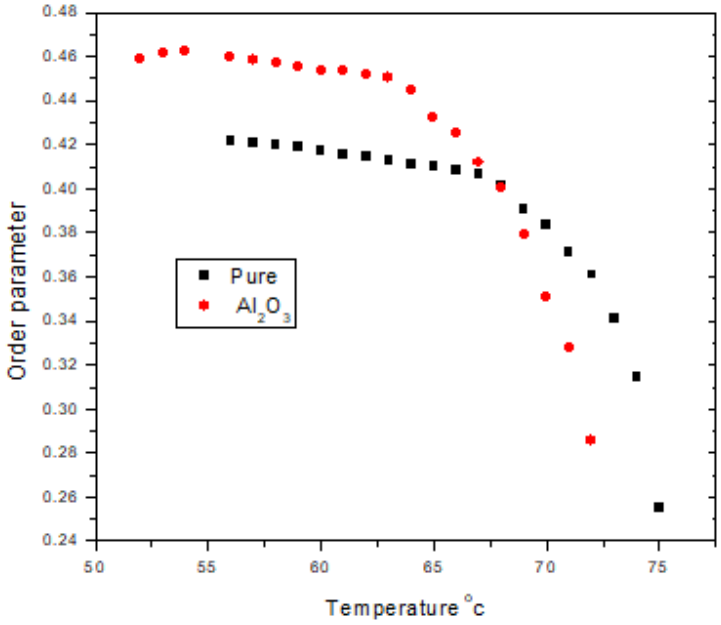


Fig 10:- Order parameter S vs. temperature of Compound 7O.CB+1%Al_2O_3

- The percentage of Order parameter increases by 10.29% due to the dispersion Al_2O_3 nano bits.

V. CONCLUSION

Mesogens act as a tunable solvents for the dispersion of nano particles. Because of the dispersion of nano bits into the LC's the birefringence anisotropy and dielectric anisotropy increases hence vision of angle increases. This is one of most advantage in LC display gadgets for the production of large panel LC display with good depth.

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