Optical Characterization of New Chiral Nematic Liquid Crystal

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The chiral nematic liquid crystal compound analyzed in this work was obtained mixing a chiral dopant (CB15) with a nematic liquid cystal (E180) at a concentration E180/CB15 of 65/35 [1]. The material shows notable variation in its texture with a small variation of temperature, between 20 to 35ºC. The observed color in the sample changes with the sample temperature, and the observation angle. Thus, besides optical characterization by UV-Vis absorption technique, for a more extensive characterization, reflection spectra were carried out. Moreover, we could be observed that the light reflected by the sample is polarized, where the reflected light is analyzed by a achromatic waveplate and polarizer (analyzer). The polarization was identified and quantified by ellipsometry technique [2]. The reflected light can be determined by analyzing the Stokes parameters; which are obtained adjusting the experimental data with the following equation:

$$I(\theta) = \frac{1}{2}[A + B.sin(2\theta) + C.\cos(4\theta) + D.\sin(4\theta)]$$

where I is the intensity of the electric field, θ is the angle between the axes of the quarter waveplate and the axes of the polarizer, $A = S_0 + \frac{S_1}{2}$, $B = S_3$, $C = \frac{S_1}{2}$ e $D = \frac{S_2}{2}$, S_0, S_1, S_2 and S_3 being the Stokes parameters. The Stokes parameters are associated with the polarization degree (P) of the light by:

$$P = \frac{(S_1^2 + S_2^2 + S_3^2)^{\frac{1}{2}}}{S_0}.$$

The reflected light presents a high degree of polarization (~85%), where ~80% is circular polarization[3]. In UV-Vis characterization, the spectra blue shift approximately 30 nm where the temperature increase in the range from 20 to 35º C. It was also obtained, by circular polarized light absorption that this chiral nematic liquid crystal presents circular dichroism. The results indicate strong dependence on temperature and reflection angle with the size of the molecules helix and the anisotropy of the system, respectively. Finally, as a result, this liquid crystal can be used to temperature sensor as well as color display that change its color in function of observation angle. The authors are very grateful to FAPEMIG, CNPq, CAPES, NanoBio/MCT, for the financial support of this research.
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