Dynamic Light Scattering Measurement for the Twist Distortion Elasticity under the Reflection Scattering Geometry
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Cholesteric liquid crystal and cholesteric blue phases attract attention from the viewpoint of the application for new types of fast displays, lasers and nonlinear optics. In these phases, the twist elastic constant is an important factor to characterize them in relation to their spontaneous helical structures. Dynamic light scattering(DLS) technique is effective to measure elastic constants. In order to measure the twist elastic constant in these phases, the scattering vector must be parallel to their helical axes. Since the helical axis always becomes perpendicular to glass substrates in the planar alignment, the twist elastic constant cannot be measured because the scattering overlaps the direct reflection from the surface of the glass substrates. So we have designed the cylindrical glass cell to separate the direct reflection, and tested to measure the twist elastic constant in the nematic phase.

A schematic drawing of the improved sample cell is shown in Fig.1. We adopted a half-cylinder as one of substrates for separating the direct reflection light from the surface of the cylinder and the scattered light. Furthermore, the scattered light and the direct reflection at the interface between a glass plate and air are separated spatially using a 5mm-thick glass plate and making cell thickness with 100μm. First of all, we measured the director fluctuation by DLS at scattering angle θ = 50~100° from the nematic phase of 5CB in the planar alignment to evaluate only twist distortion. Normalized autocorrelation function plots and fitting curves obtained from the function

\[ f(x) = \exp(-t/\tau) \]

are shown in Fig.2. Values of β is distributed around 0.8~0.9 due to imperfectness of the director orientation in the cell. Dispersion relation of the director fluctuation of the twist mode is shown in Fig.3. Obtained result is quite consistent with the dispersion relation of the diffusive hydrodynamic mode, \( \tau \propto 1/q^2 \), which is predicted by the hydrodynamic calculation for the nematic liquid crystal[1]. In conclusion, we have successfully measured the fluctuation related to the twist distortion of the director under the reflection scattering geometry.

References:

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