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Supporting Information

Large extraordinary refractive index in highly birefringent nematic liquid crystals of dinaphthyldiacetylene-based materials

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Derivation of equation (1)

Assuming that the materials are isotropic and have no absorption, the transmitted wave amplitude, E_t and intensity, I_t can be given by

$$E_t = E_0 e^{i\omega t}\left(\frac{tt'}{1-r^2e^{-i\delta}}\right) \qquad (1)'$$

$$I_t = I_i \frac{(tt')^2}{(1+r^4)-2r^2\cos\delta} \qquad (2)'$$

where I_i, E_0, r, t *and* δ refer the intensity of incident wave, the amplitude of incident wave, the reflection amplitude coefficient, the transmission amplitude coefficient and the phase difference, respectively. Furthermore, t *and* t' *are* the fraction of transmission amplitude coefficients entering into the material and the fraction transmitted when a wave leaves the material, respectively. (Here, in the derivation of equation (1)′, a common factor of $e^{-i\delta/2}$ is omitted because we are interested in the irradiance. Moreover, a phase difference of π/2 between the reflected and transmitted waves are also ignored.)

At condition of normal incidence, the reflection amplitude coefficient, r can be written as

$$r = \frac{n_1 - n_2}{n_1 + n_2} \qquad (3)'$$

where n_1 and n_2 are the refractive indices of the glass cell and LC material, respectively.

By using $\cos\delta = 1 - 2\sin^2(\delta/2)$, $tt' + r = 1$ and $\delta = 4\pi n_2 d/\lambda$, equation (2)′ can be expressed as

$$\frac{I_t}{I_i} = \frac{1}{1+\left[\frac{2r}{1-r^2}\right]^2 \sin^2\left(\frac{\delta}{2}\right)} = \frac{1}{1+\left(\frac{n_1^2 - n_2^2}{2n_1 n_2}\right)^2 \sin^2\left(\frac{\delta}{2}\right)} \cong 1 - \left(\frac{n_1^2 - n_2^2}{2n_1 n_2}\right)^2 \sin^2\left(\frac{2\pi}{\lambda} n_2 d\right) \quad (4)'$$

where d and λ refer thickness of LC media and wavelength of incident light, respectively.