APPENDIX A

Birefringence of Liquid Crystals

The NLC materials we use, 5CB and BDH-18523, were operated at wavelength of 815 nm. But the refractive indexes of the LC materials were measured neither in the literatures nor in the datasheet of manufacturers in this wavelength. The refractive indexes or the birefringences at wavelength of 815 nm are derived by fitting previously published data and calculating by inter- or extrapolating methods. The data used for fitting of 5CB is published by S. –T. Wu *et al*. [75]. And the data of BDH-18523 is from the manufacturer (Merck) and the paper published by R. –P. Pan *et al*. [117]. We use *MATHEMATICA* for fitting the data.

A-1 Liquid crystal 5CB

According to the data published by S. –T. Wu *et al*., the refractive indexes of 5CB were measured at different wavelengths from 400 nm to 700 nm at different temperatures. We fitted the data begin at the wavelength of ~600 nm.

(1) T=25.1 °C

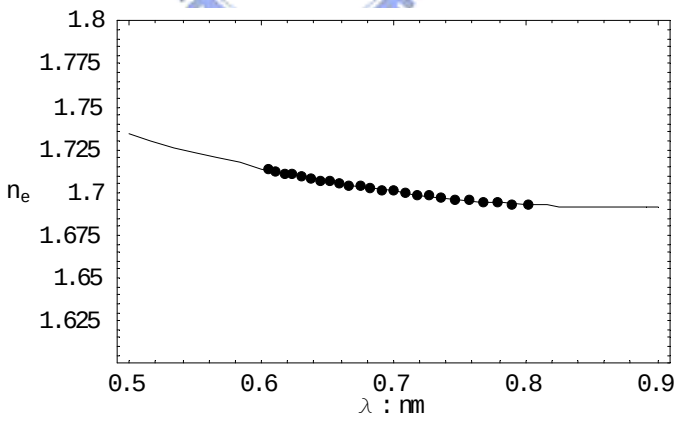

Fig. A-1.1 (a)

The equation of the fitted curve is given as

$$n_e = 1.92208 - 0.526468\lambda + 0.300009\lambda^2 \qquad \text{(A-1.1a)}$$

$n_e = 1.69228$ @λ=0.815 μm

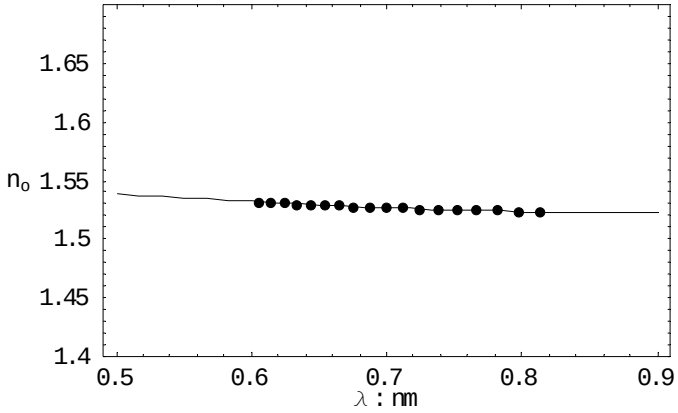

Fig. A-1.1 (b)

The equation of the fitted curve is given as

$$n_o = 1.60659 - 0.186233\lambda + 0.103087\lambda^2 \qquad \text{(A-1.1b)}$$

$n_o = 1.52328$ @λ=0.815 μm

$\Delta n = n_e - n_o = 0.1691$

(2) T=27.2 °C

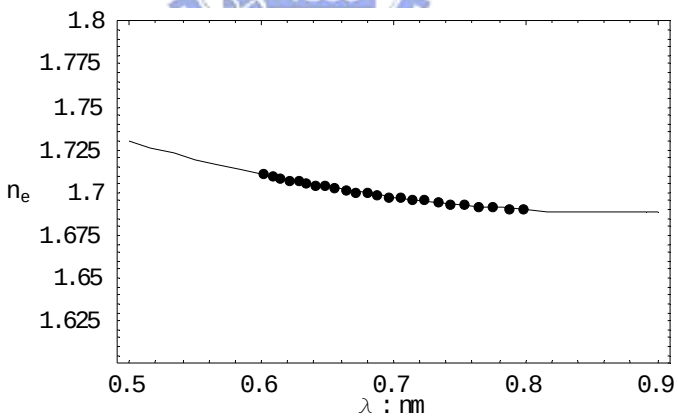

Fig. A-1.2 (a)

The equation of the fitted curve is given as

$$n_e = 1.91357 - 0.513513\lambda + 0.292481\lambda^2 \qquad \text{(A-1.2a)}$$

$n_e = 1.68933$ @λ=0.815 μm

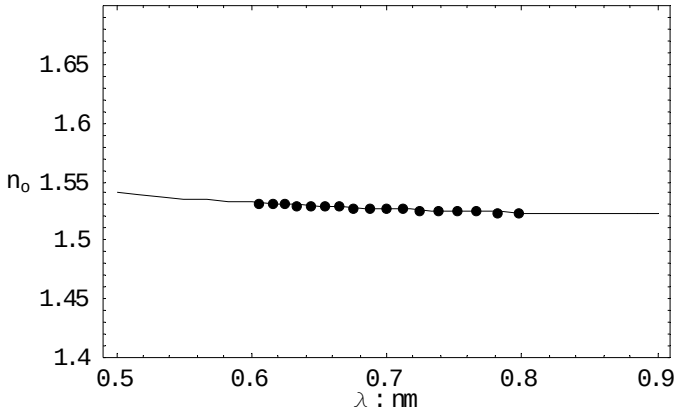

Fig. A-1.2 (b)

The equation of the fitted curve is given as

$$n_o = 1.61681 - 0.215579\lambda + 0.124061\lambda^2 \qquad \text{(A-1.2b)}$$

$n_o = 1.52352$ @λ=0.815 μm

$\Delta n = n_e - n_o = 0.1658$

(3) T=29.9 °C

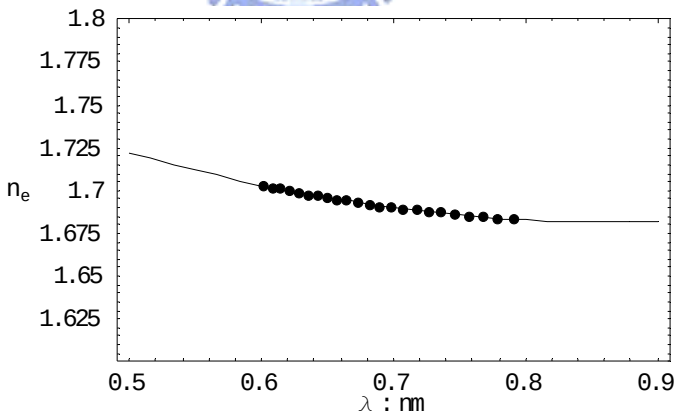

Fig. A-1.3 (a)

The equation of the fitted curve is given as

$$n_e = 1.91067 - 0.529812\lambda + 0.306559\lambda^2 \qquad \text{(A-1.3a)}$$

$n_e = 1.68250$ @λ=0.815 μm

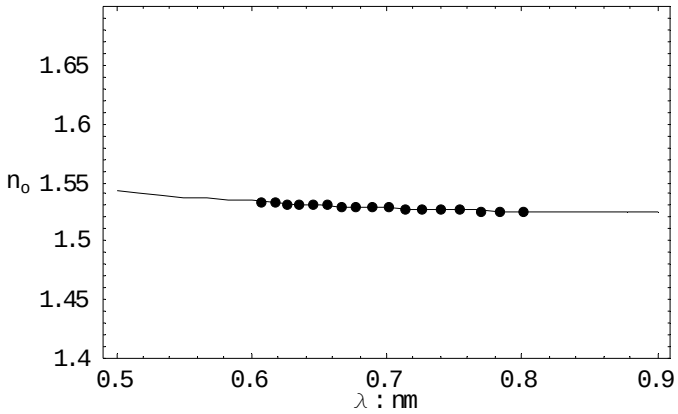

Fig. A-1.3 (b)

The equation of the fitted curve is given as

$$n_o = 1.62438 - 0.231349\lambda + 0.134308\lambda^2 \qquad \text{(A-1.3b)}$$

$n_o = 1.52504$ @λ=0.815 μm

$\Delta n = n_e - n_o = 0.1575$

The birefringence Δn varied by the change of the temperature T is calculated to be

$$\frac{\Delta n}{\Delta T} = \frac{(0.1575 - 0.1691)}{29.9 - 25.1} \sim -2.42 \times 10^{-3} / ^{\circ}C$$

A-2 Liquid crystal BDH-18523

The birefringence data at T=25 °C and the fitted curve are plotted in Fig. A-2.1.

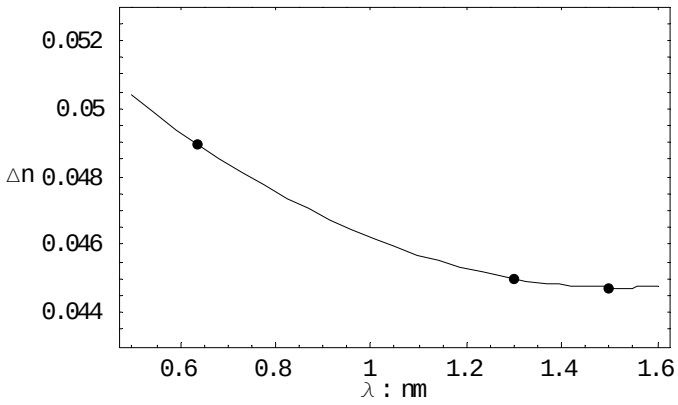

Fig. A-2.1

The equation of the fitted curve is given as

$$\Delta n = 0.0572051 - 0.0164632\lambda + 0.00541541\lambda^2 \quad \text{(A-2.1)}$$

$\Delta n = 0.04738$ @λ=0.815 μm