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Angular Dependence of Selective Reflection from the Chiral Smectic C Phase

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ANGULAR DEPENDENCE OF SELECTIVE REFLECTION FROM THE CHIRAL SMECTIC C PHASE

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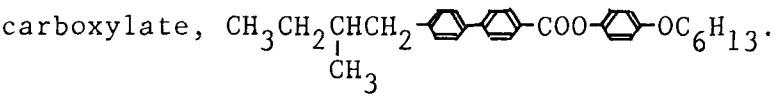
Abstract

Transmission spectra were measured with obliquely incident light for a chiral smectic C phase of (+)-4-n-hexyloxyphenyl 4-(2"-methylbutyl)biphenyl 4'-carboxylate. Extra reflection bands were observed at about twice the wavelengths of the "normal" Bragg reflection bands, which had been previously predicted by the computor calculation by Berreman.

Introduction

It is well known that a chiral smectic C phase exhibits similar optical behabior as that of cholesteric phase in the case of normal incidence. Different behavior was, however, predicted to appear in the case of oblique incidence by the computor calculation.[1] In order to verify such behavior, optical properties were studied for a substance with a chiral smectic C phase with selective reflection in the wavelength range of visible light,[2] (+)-4-n-hexyloxyphenyl 4-(2"-methylbutyl)biphenyl

4'-carboxylate,  .

Experimental

(+)-4-(2'-Methylbutyl)biphenyl, which was synthesized as previously described,[2] was reacted with oxalyl chloride to yield acid chloride.[3] Esterification and purification were done as previously described.[2] Transition points were as follows, Cryst-Sm C*, 69.0 °C, Sm C* -Chol, 80.0 °C, and Chol-isotropic liq., 164.5 °C (lit,[2] 68.8 °C, 80.2 °C, and 163.5 °C, respectively).

Transmission spectra were measured on a Hitachi 340 spectrophotometer. Samples about 30 μm thick were sandwiched between two flat plates of quartz.

Results and Discussion

Figure 1 shows transmission spectra of the chiral smectic C phase.

At normal incidence, a decrease of transmittance was observed in the wavelength region of the visible light ("normal" Bragg reflection). About 50% transmittance is a direct result of the near 100% circular dichroism (transmission of one circularly polarized component and reflection of the other). Theoretically, a band at about twice the wavelength of the "normal" reflection (full pitch band) should not appear at normal incidence. A small band was, however, observed. This is probably due to the incompleteness in the orientation of the helical axes.

At oblique incidence, full pitch band became dominant. Angular dependence of the transmittance of each band is shown in Fig. 2. This includes

the losses due to surface reflectin, which is considered to become dominant, as the angle θ increases. Neverthless, it is clear that the full pitch band becomes large more drastically than the "normal" Bragg reflection band. In the cholesteric phase, no band was observed in the longer wavelength range than the "normal" Bragg reflection. This result corresponds to the prediction[1] derived from the fact that the basic period is always half the pitch for cholesteric phases, while the basic period is full

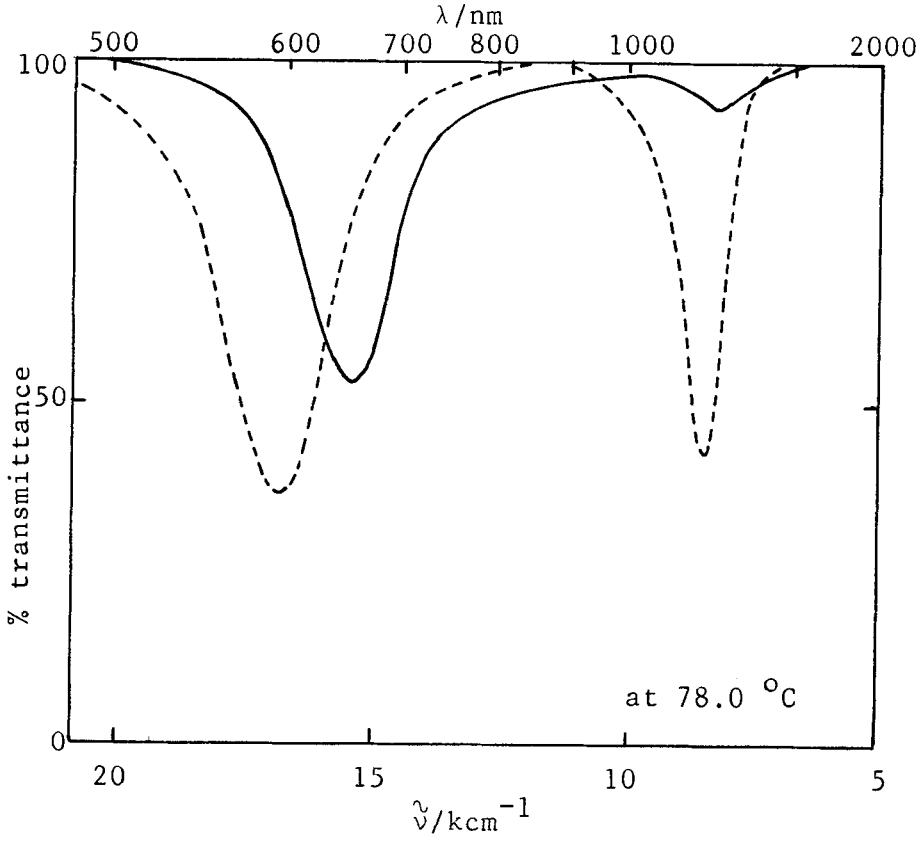


Fig. 1. Transmission spectra of the chiral smectic C phase. ———, normal incidence (θ=0°), ------, oblique incidence (θ=40°).

pitch because of the molecular tilt in the layers for chiral smectic C phases. The wavelength of minimum transmittance was shifted to the shorter wavelength range, as was ascribed to the Bragg reflection rule.[4] At more oblique incidence, deviation from the relation of the Bragg reflection became appreciable.

Detailed analysis with polarized lights is now in preparation.

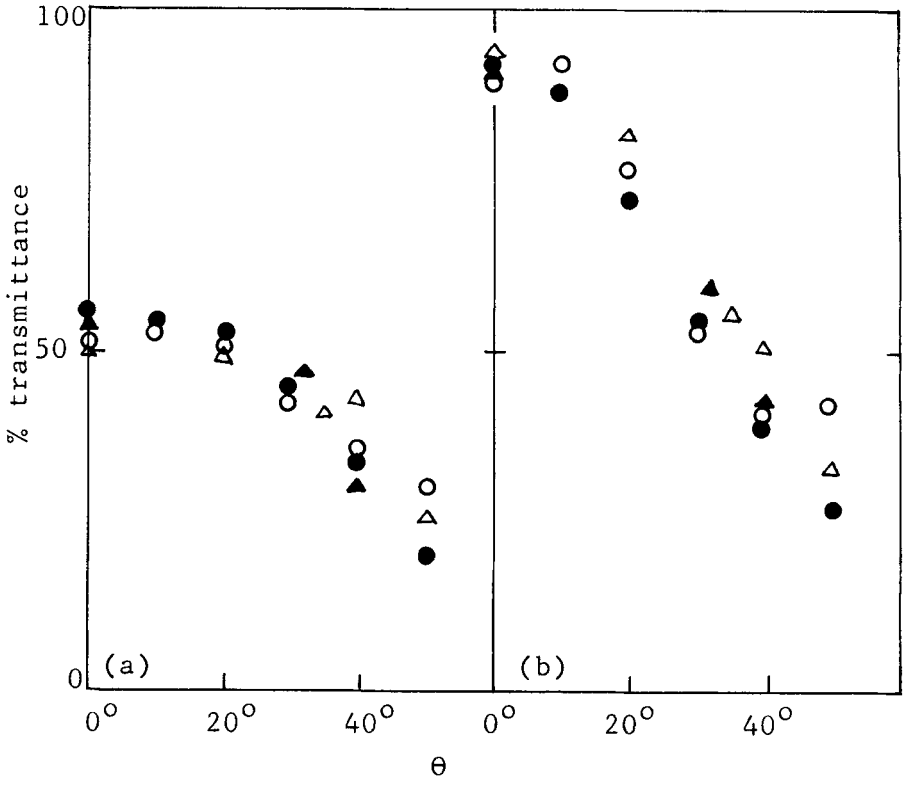


Fig. 2. Angular dependence of transmittance of (a) "normal" Bragg reflection band and (b) full pitch band for the chiral smectic C phase.

References

1. D. W. Berreman, Mol. Cryst. Liq. Cryst., 22, 175 (1973).
2. G. W. Gray and D. G. McDonnell, Mol. Cryst. Liq. Cryst., 37, 189 (1976).
3. C. S. Oh, Liquid Crystals and Ordered Fluids (ed., J. F. Johnson and R. S. Porter, Plenum Press, New York, 1974) Vol. 3, p. 53.
4. J. L. Fergason, Mol. Cryst., 1, 293 (1966).