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PRETRANSITIONAL EFFECTS IN NEMATIC MIXTURES EXHIBITING INDUCED SMECTIC PHASE

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ABSTRACT: Induced smectic phase was obtained in mixture of two nematic liquid crystals: 5CB and p-hexyloxyphenyl p'-pentyloxybenzoate. Pretransitional effects above nematic-smectic phase transition were illustrated by measurement of the conductivity anisotropy ratio $\sigma_{\parallel}/\sigma_{\perp}$ in function of concentration and temperature. Its value reached minimum for equimolar composition of mixture.

The phenomenon of inducing of smectic or nematic phases in mixtures of nematic liquid crystals is intensively investigated, but not well explained yet. It is related to the forming of molecular complexes, but the conditions required for this process are not well understood[1,2]. This paper presents the experiment carried out on mixtures of two nematic liquid crystals: p-hexyloxyphenyl p -pentyloxybenzoate (6050, nematic range 59 - 87°C), and p-n-pentyl p'-cyanobiphenyl (5CB, 22 - 35°C). Both the substances were synthesized and purified in Institute of Organic Chemistry at Technical University of Łódź. The smectic A phase was obtained in mixtures, in which

5CB concentration was in the range 23 - 73 mole %. The phase diagram is shown in Figure 1. The smectic-nematic transition temperature was the highest at about 40 mole % of 5CB. The nematic-isotropic transition curve was slightly convex upwards.

The electrical conductivity of the mixtures was measured by use of automatic C bridge E315A Meratronik at frequency 1kHz in directions parallel and perpendicular to the magnetic field assuring uniform orientation of the sample. The conductivity anisotropy ratio $\sigma_{\parallel}/\sigma_{\perp}$ was determined throughout nematic range in mixtures of various composition. The mixtures were doped with 0.5 weight % of tetrabutylammonium bromide in order to enhance the conductivity and to make it nonsensitive to accidental impurities. This stabilized and, on the other hand, increased slightly the $\sigma_{\parallel}/\sigma_{\perp}$ ratio. The absolute error of its value was smaller than 0.01.

For a given composition $\sigma_{\parallel}/\sigma_{\perp}$ increased at first during cooling from isotropic phase, but then it decreased again, when nematic-smectic transition was approached. This decreasing is well known[3], and was taken for pretransitional behaviour due to existing of cybotactic smectic groups in nematic phase. Similar effect was present also in mixtures, which did not form smectic phase. The magnitude of $\sigma_{\parallel}/\sigma_{\perp}$ ratio depended on the composition of the mixture. Figure 2 shows this dependence at the nematic-smectic transition temperature. It reached minimum for the equimolar composition.

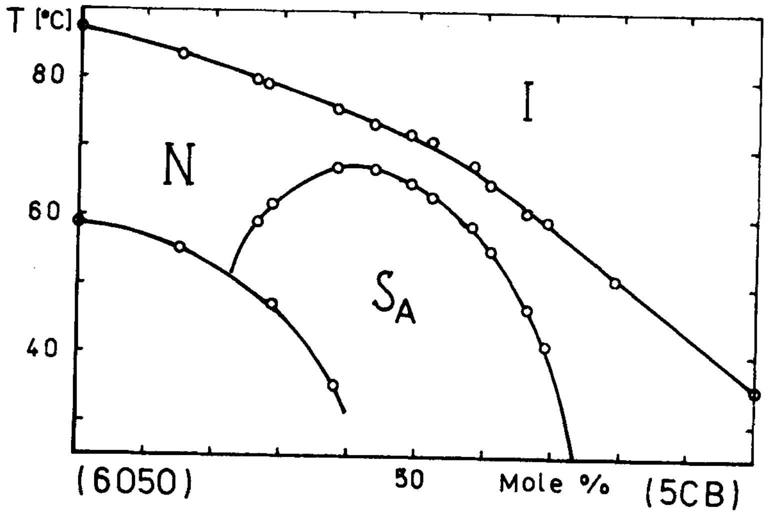

FIGURE 1 Phase diagram of the system 5CB/6050

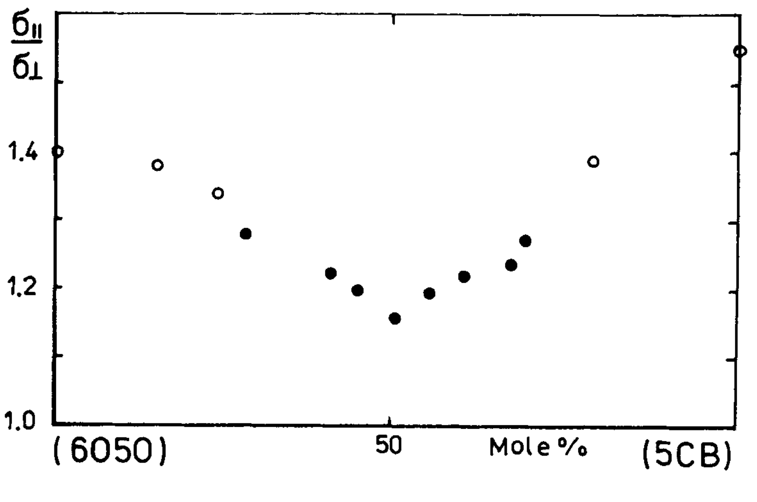

FIGURE 2 Conductivity anisotropy ratio at nematic-smectic (shaded circles) and nematic-solid (opened circles) transition versus mixture composition.

This illustrates the fact, that the role of cybotactic groups was the most significant for this composition. This result supports the common opinion about existing of the molecular complexes with stoichiometric composition 1:1. It offers also the method of determination of the composition of such complexes in liquid crystal mixtures forming induced smectic phase.

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