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Phase Transition from the Smectic G Into the G' Phase in a Binary System

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*PHASE TRANSITION FROM THE SMECTIC G INTO THE G' PHASE IN A BINARY SYSTEM**

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The structures of the smectic H and G phases have been described by a monoclinic *C*-centred lattice in which the ratio of the lattice vectors a and b is found to be $a/b > 1$.[1-3]

Recently, new smectic structures, G' and H', were found with a ratio $a/b < 1$.[4] These structures were observed in substances with a sequence of phase types, H' G' I, on the temperature scale, whereas the structures H and G seem to be preferred in sequences H G F. It is important to note that F and I phases can be distinguished also by the ratio a/b ($a/b > 1$ for the F phases, $a/b < 1$ for the I phases).[4]

There are substances with a sequence F I, whereas substances with a sequence G G' or H H' are unknown so far.**

In order to observe a direct transition G G', a chance should be given with binary systems, the components of which exhibit

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* Paper No 27 in the series: *"Relation of Isomorphism Between Liquid Crystalline Phases"*

** It has been pointed out by the referee of this paper that an article in press in *Mol Cryst Liq Cryst* by Gane, Leadbetter, Wrighton, Goodby, Gray and Tajbakhsh does describe the probable occurrence of a G'-G transition in a binary mixture of TBBA and HEPTOPD by texture observation.

a G F and a G' I polymorphism, respectively.

We re-investigated a system consisting of terephthalylidene-bis-[4-n-nonylaniline] (TBNA) and n-pentyl[4- 4-n-dodecyloxy-benzylideneamino]cinnamate (AABC 12.5)[5] (Figure 1) exhibiting the polymorphism G F I C A (TBNA) and (G) I C A (AABC 12.5), respectively. Especially the concentrations $x_{AABC\ 12.5}$ = 0.25, 0.3, 0.4, 0.5 0.6 were submitted to detailed study by texture observations.

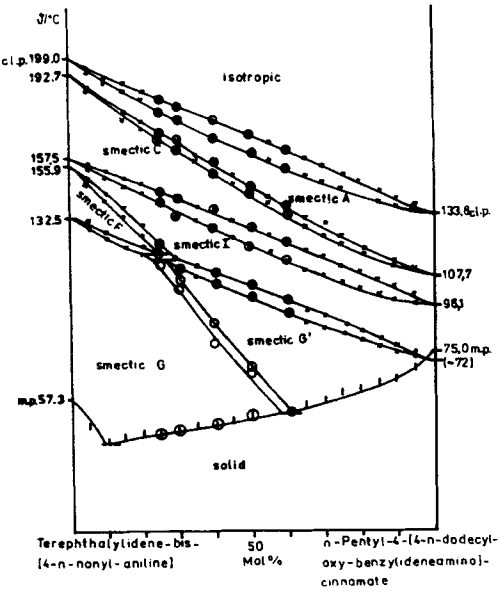
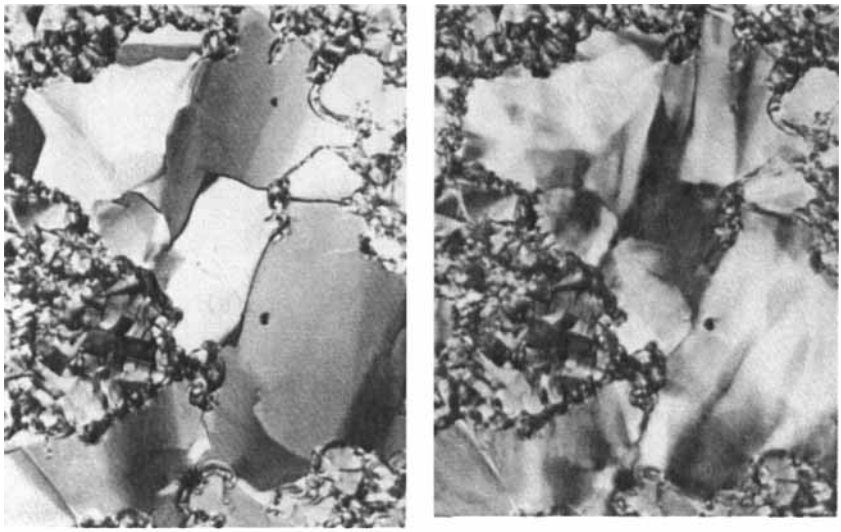


FIGURE 1 Phase diagram.[5] *The open circles represent the re-investigated points*

For a mixture with x_{AABC} = 0.4, for example, a homeotropic A phase is obtained. On cooling down the sample, a C phase arises with a *schlieren* texture; the I phase also exhibits a *schlieren* texture, together with a partly mosaic-like texture. By further cooling, a phase with a mosaic-like texture can be seen (Figure 2(a)), but this is changed a little at a temperature of about 80°C. Now the mosaic texture contains small diffuse domains (Figure 2(b)).



(a) (b)

FIGURE 2 Textures of the mixture with x = 0.4.
(a) T = 95°C, G' phase
(b) T = 65°C, G phase

In earlier investigations, these small changes in texture were not detected or they were not considered as significant alterations.

DSC measurements do not show a transition heat in this region, whereas the transition heats for the changes into the I phase were clearly observed.

For TBNA, X-ray investigations of oriented (Figure 3(a)-(c)) and non-oriented samples were made. The evaluation of the Guinier patterns in the G phase yielded the lattice parameters a = 10.21Å; b = 5.08Å; c = 45.5Å; β = 119.5°.

The structure of the I phase of AABC = 12.5, with $a/b < 1$ is described in [6].

For the mixture $x_{AABC\ 12.5}$ = 0.4, the X-ray patterns of oriented samples are significantly altered between T = 60°C and T = 80°C (Figure 4). In the wide angle region, the scattering shows maxima the positions of which are

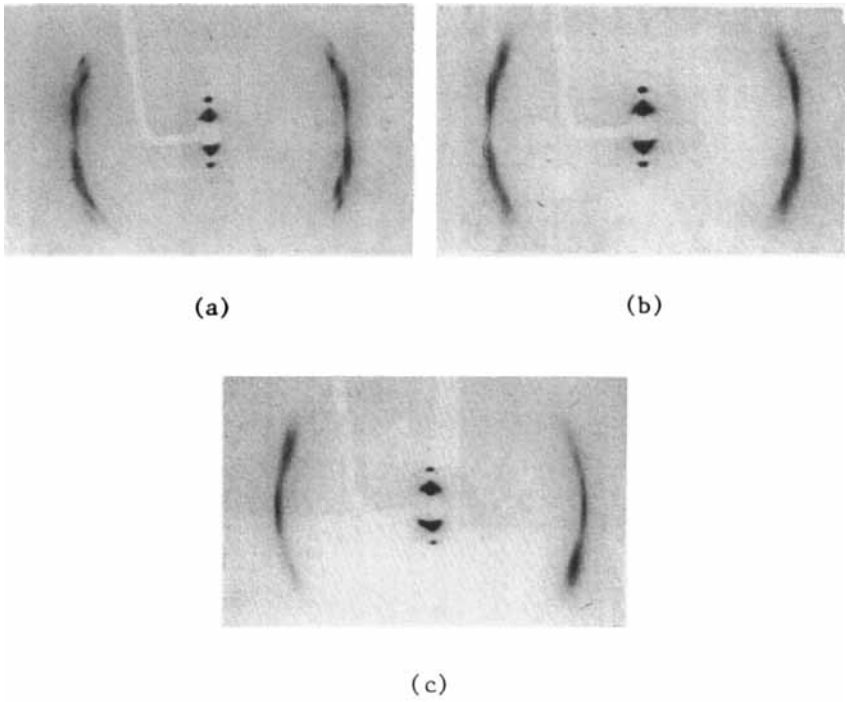


FIGURE 3 *X-ray patterns of oriented samples of TBNA in the*

(a) G phase
(b) F phase
(c) I phase

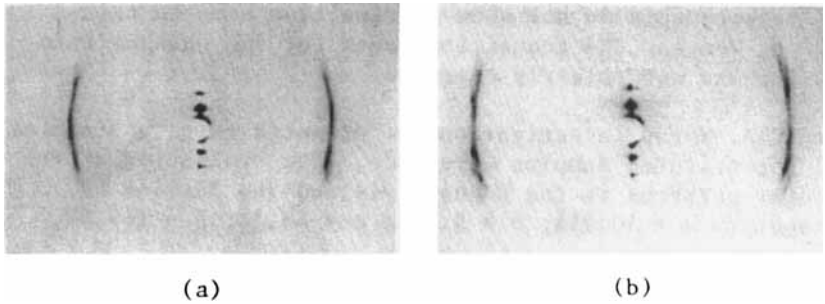


FIGURE 4 *X-ray patterns of a mixture with* $\times_{AABC}$ *12.5 = 0.4*

(a) $T = 80^{\circ}C$
(b) $T = 60^{\circ}C$

reversibly changed, dependent on the temperature. The alteration of the patterns taken within a region, originally labelled as G, corresponds with a change of the monoclinic structure with the cited ratio $a/b > 1$ ($T = 60^oC$) into one with the ratio $a/b < 1$ ($T = 80^oC$).

As can be seen in Figure 1, the two phase regions G and G' are distinguished now by a phase transition. Two sequences in the region of the mixed phases can be observed: G F I C A and G G' I C A.

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