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Publisher: Taylor & Francis

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## Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information: <a href="http://www.tandfonline.com/loi/gmcl16">http://www.tandfonline.com/loi/gmcl16</a>

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

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Version of record first published: 21 Mar 2007.

To cite this article: S. Diele, A. Mädicke, E-M. Höft, G. Wende & H. Sackmann (1983): Phase Transition from the Smectic G Into the G' Phase in a Binary System, Molecular Crystals and Liquid Crystals, 92:7, 187-191

To link to this article: <a href="http://dx.doi.org/10.1080/01406568308084058">http://dx.doi.org/10.1080/01406568308084058</a>

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Mol. Cryst. Liq. Cryst. Vol. 92 (Letters), pp. 187-191 0140-6566/83/9207-0187518.50/0 © 1983 Gordon and Breach, Science Publishers, Inc. Printed in the United States of America

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

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(Received for Publication September 6, 1983)

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  $\alpha$  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. 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).

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

<sup>\*</sup> Paper No 27 in the series: "Relation of Isomorphism Between Liquid Crystalline Phases"

<sup>\*\*</sup>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 xAABC 12.5 = 0.25, 0.3, 0.4, 0.5 0.6 were submitted to detailed study by texture observations.

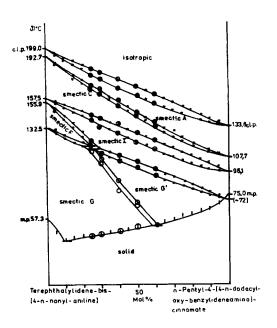
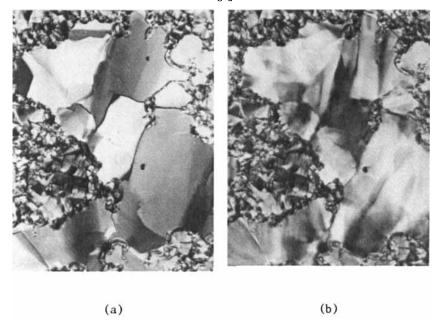


FIGURE 1 Phase diagram. 5 The open circles represent the re-investigated points

For a mixture with xAABC = 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)).



Textures of the mixture with x = 0.4. FIGURE 2

- $T = 95^{\circ}C$ , G' phase  $T = 65^{\circ}C$ , G phase (b)

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  $\alpha = 10.21\text{Å}$ ; b = 5.08Å; c = 45.5Å;  $\beta = 119.5^{\circ}$ .

The structure of the I phase of AABC = 12.5, with a/b < 1is 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  $T = 80^{\circ}C$  (Figure 4). In the wide angle region, the scattering shows maxima the positions of which are

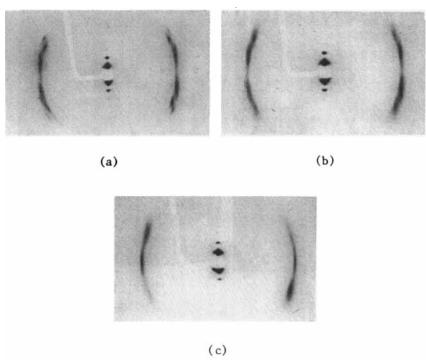


FIGURE 3 X-ray patterns of oriented samples of TBNA in the

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

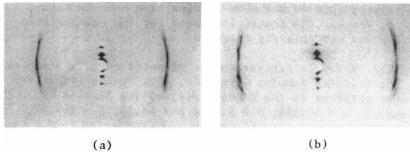


FIGURE 4 X-ray patterns of a mixture with  $\times AABC$  12.5 = 0.4

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

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

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 =  $60^{\circ}$ C) into one with the ratio a/b < 1 (T =  $80^{\circ}$ C).

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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