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DIELECTRIC PROPERTIES OF TBBA*

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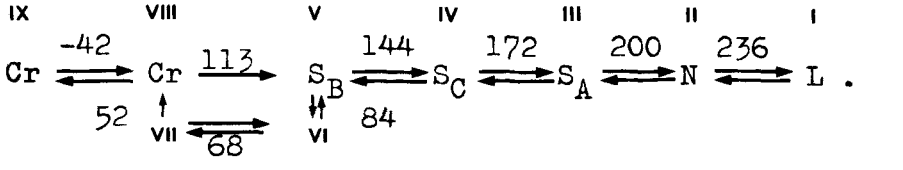
Abstract The dielectric properties of a TBBA single crystal perpendiculary to the smectic layers and along the a axis in the smectic layers in different phases below 120°C were measured. The dielectric constant shows significant anomalies at the phase transitions.

TBBA (terephthal-bis-butylaniline) exhibits nine different liquid crystalline and solid phases. It has been pointed out that two metastable crystalline phases appear[1] when the S_B phase is cooled below 84°C. The various transitions between the different phases are shown here:



The structures of the phases Cr(VIII), S_B and VI are known from X-ray scattering experiments[2].

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The unit cell parameters for the phase Cr(VIII), which has the space group A2/a, are: a = 17.57 Å, b = 5.75 Å, c = 53.2 Å and β = 115.5°. It is possible to obtain monodomain samples of S_B and VI, if we start from a single crystal at room temperature by heating the sample over 113°C and cooling down. The structures of the phases S_B and VI are crystal-like. The smectic B phase looks like a plastic crystal in which the molecules undergo orientational jumps around their long axes with six equivalent positions[3]. In the plane perpendicular to the long axis the molecules are in almost hexagonal order. The molecules are tilted with respect to the layers by the angle 122° at 115°C. The single crystals were grown by the slow evaporation method from a chloroform solution at 5°C. The dimensions of the crystal were a x b ~ 30 x 15 mm^2 along crystallographic axes. The thickness perpendicular to the smectic layers was 3 mm.

The dielectric constant was measured with a 1615 A GR capacitance bridge. The samples were measured in an evacuated sample holder with a temperature stabilization of ± 0.02°C. The electrodes were made from a conducting paste - Degussa 200.

Fig.1 shows the dielectric constant perpendicular to the smectic layers as a function of the temperature close to the phase transition Cr(VIII) to Cr(IX). The dielectric constant has a jump at the transition. The thermal hysteresis ΔT=1°C shows that the transition is of the first order. The dielectric constant along the a axis does not

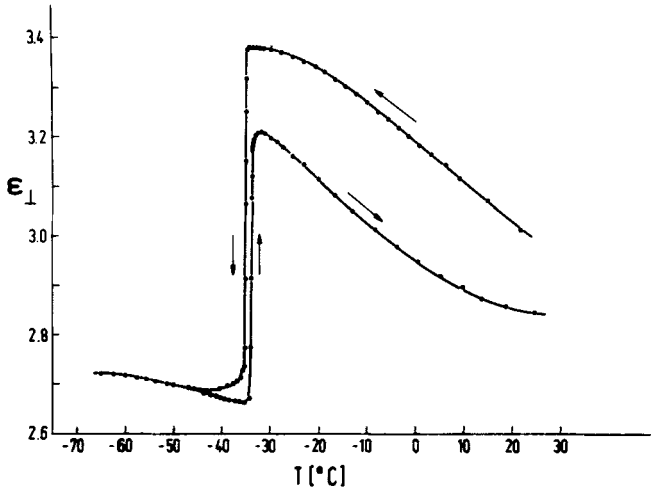

FIGURE 1. Dielectric constant perpendicular to the smectic layers close to the transition from Cr(VIII) to Cr(IX) as a function of the temperature.

change with the temperature and has the value of 3.4.

The temperature dependence of the dielectric constant perpendicular to the smectic layers from room temperature till 120°C is shown in Fig.2. With increasing temperature the dielectric constant is decreasing and has a jump to a higher value at the transition to S_B phase. With decreasing temperature the dielectric constant is increasing and has a small peak at the transition to the phase VI in which it has a constant value till the temperature 63°C where the crystal breaks at the transformation to the solid. The impossi-

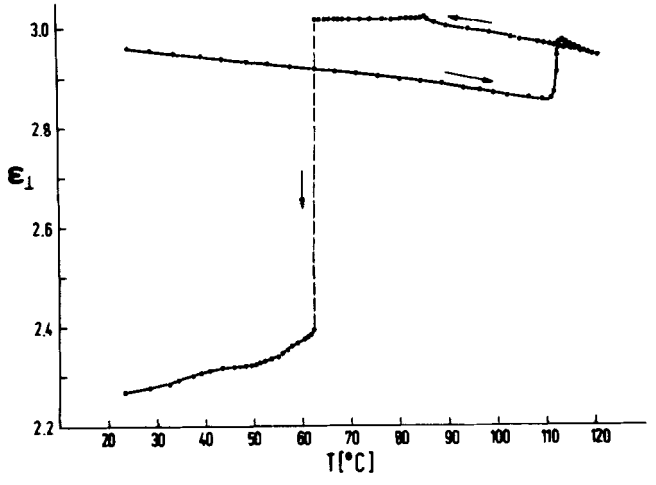

FIGURE 2. The temperature dependence of the dielectric constant perpendicular to the smectic layers.

bility to come back to the solid phase at room temperature was mentioned before[4]. In contradiction there was no problem over getting phase VII in another study[5].

Fig.3 shows the temperature dependence of the dielectric constant along a axis. The jump at the phase transition to the S_B phase is here much more pronounced. The value of the dielectric constant along the a axis is always higher than $\varepsilon_\perp$. The temperature where the crystal breaks is here a little higher (65.5°C).

Studying the phase transitions in TBBA crystal below 120°C via dielectric measurements

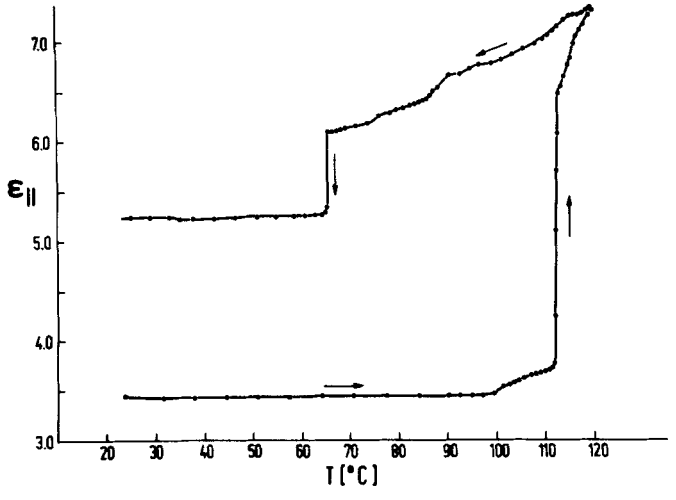

FIGURE 3. The temperature dependence of the dielectric constant along the a axis in the smectic layers.

we can conclude:

a) ε along the a axis is always higher than $\varepsilon_{\perp}$,

b) the jump in the dielectric constant at the transition from the Cr(VIII) to the S_B phase along the a axis ($\Delta\varepsilon_a$) is much higher than $\Delta\varepsilon_{\perp}$,

c) the phase transition from Cr(VIII) to Cr(IX) is a first order transition

d) the crystal breaks at or before reaching the phase VII.

REFERENCES

1. Z.Luz and S. Meiboom, J.Chem.Phys. 59, 275 (1973).
2. J.Doucet, J.P. Mornon, R.Chevallier, A. Lifchitz, Acta Crystallogr. B33, 1701 (1977).
3. A.M. Levelut, J.Physique Colloq. 37, C3-51 (1976).
4. J.Doucet, M. Lambert, A.M. Levelut, P. Porquet and B. Dorner, Journal de Physique 39, 173 (1978).
5. J. Doucet, A.M. Levelut and M. Lambert, Phys. Rev.Lett. 32, 301 (1974).