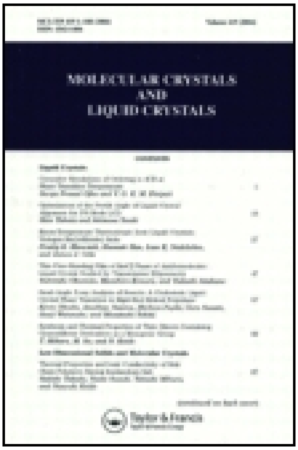

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Reliable Methods for Alignment of LC Polymer

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RELIABLE METHODS FOR ALIGNMENT OF LC POLYMER

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Abstract Magnetic field and alternating shear were used to align a LC polymer.

Similarly to low molar weight liquid crystals, the alignment of polymeric liquid crystals is very important for the physical investigations. For the possible practical applications it is necessary to obtain uniformly aligned samples as well.

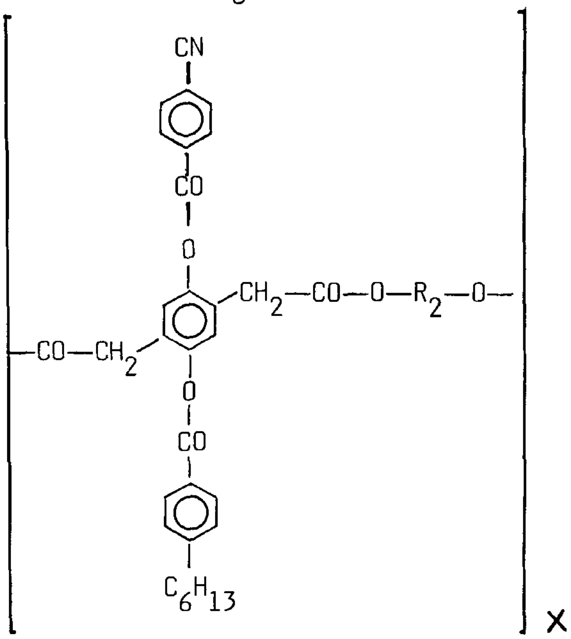
Large part of substances tend to align themselves homeotropically /the optical axis is parallel to the plate normal/ when making from them thin polymeric LC film /a couple of ten microns/ and cooling the sample from isotropic to LC.

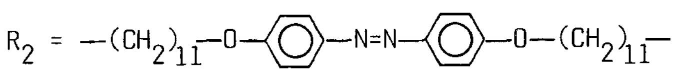
It is a hard task however to obtain homogeneous planar alignment /the optical axis is parallel to the bounding plates./ Sometimes surface treatments combined with the application of electric fields, such as polyimide coating with rubbing, parallel direction, and application of electric fields lead to appropriate planar alignment.[1]
The application of large magnetic fields also may lead to good enough planar alignments.[2]
Similarly, the application of shear and elongational flows may be effective.[3,4]
During these latter treatments the alignment was obtained by time--constant shear and elongational flows.

Based on low molar weight liquid crystal experiences[5,6,7] we tried to induce planar alignment by alternating shear and large magnetic fields applying them at different temperatures.

In this short communication we summarise breafly our investigations regarding these methods.

For investigations the following material was used:





molecular weight > 20.000

phase sequence:

g 36°C S_C 47°C N 91°C Is

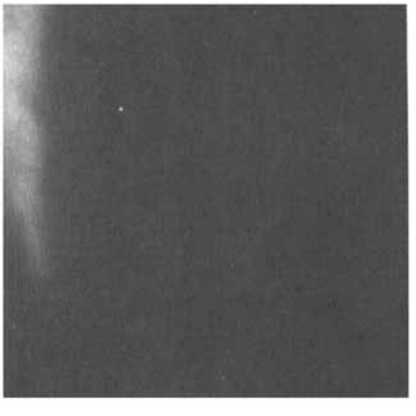
During alternating shear investigations the sample was treated by the same set-up which was used in low molar weight alignments[7], thus the alternating shear was ensured connecting one of the plate to the membrane of an electrically excited loudspeaker /the other plate was fixed/.

The best alignments were obtained when the shear amplitudes were about 5-10 times larger than the sample thickness and the shear frequencies were less than 2-3 Hz.

As a general tendency it was observed that closer to the isotropic phase the obtained alignment is better. /It is in agreement with the conclusions of[7]. / We also observed that after the induced homeotropic - planar transition, letting the sample to rest, it relaxed again to the homeotropic state. This relaxation time however increased very much as the temperature decreased. However cooling the sample rapidly to its glassy phase /in several minutes/ the planar alignment remained stable.

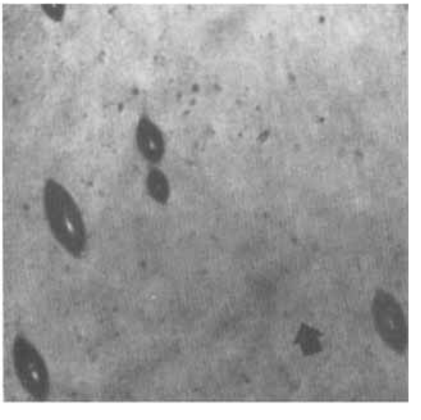
The above mentioned results are represented in Fig.1 where the homeotropic alignment is shown /the sample is seen between crossed nicols/ as it is established letting the sample to cool from the isotropic phase without any external treatments.

In Fig.2 the planar alignment can be seen after several minutes alternating shear treatments /T=54^{o}C, d=15 μm/. The visible defects indicate the shear direction. /Their long axes point to the direction of the vibration/.



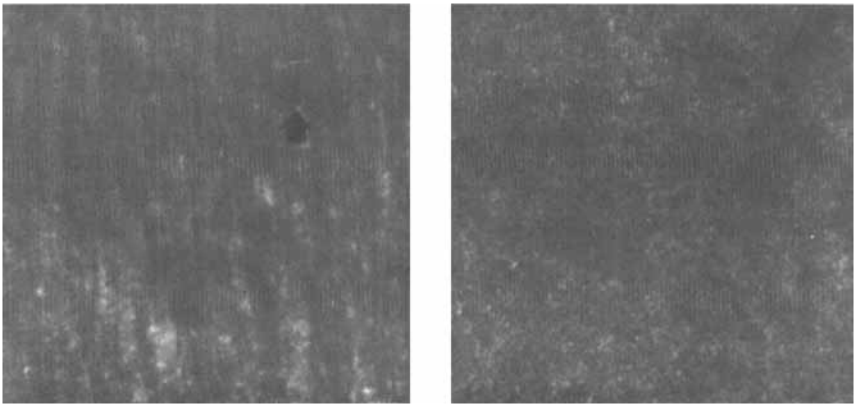
See Color Plate VI

FIGURE 1. Photomicrograph obtained without any treatments.



See Color Plate VII

FIGURE 2. Photomicrograph, when the alignment was made by alternating shear. The arrow denotes the direction of shear.



See Color Plate VIII

FIGURE 3. Photomicrographs observed when the orientations were made by magnetic field.
a.) H $\parallel$ to the plate. b.) H $\perp$ to the plate.

We also studied the effect of magnetic fields on the alignment. According to the low molar weight experiences[6,7] it was found, that the magnetic field is the most effective applying it at near to the isotropic - liquid crystal phase transition temperature.

If the magnetic field is parallel to the bounding plate the induced alignment is planar, while if it is perpendicular to it the homeotropic alignment is favoured.

The effect of a H=75 kOe magnetic field applying at $T=90^{0}C$ during 10 minutes is represented in Fig.3

In Fig.3a the magnetic field is parallel to the bounding plate /its direction is indicated by an arrow/, and in Fig.3b the magnetic field is perpendicular to the bounding plate.

SUMMARY

Anything which causes shear or elongational flows in the direction of bounding plates is applicable for planar alignments /main chains lay in the flow direction/.

Magnetic fields are more effective keeping the sample

/plate ॥ H/ close to the isotropic - N phase transition temperature.

Surfaces induce realignment to homeotropic one at high temperatures /e.g. at T=90^{o}C back to homeotropic in several seconds/. By quick cooling to S_C phase or glassy state - the planar alignment remains.

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