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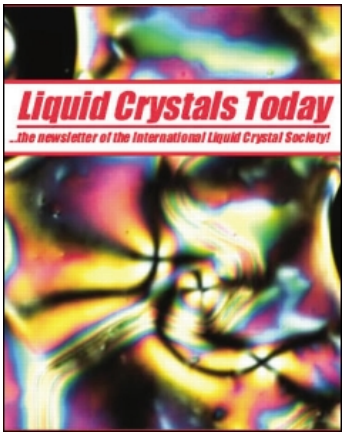

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Smectic A liquid single crystal elastomers—hard! Soft, soft!!

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Smectic A liquid single crystal elastomers—hard! Soft, soft!!

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It was my great honour to have received one of the Glenn H. Brown Prizes of ILCC2000, and great pleasure to write a brief article for *Liquid Crystals Today*. I really would like to thank lots of people.

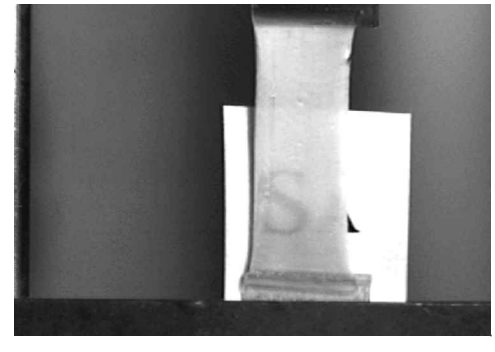
It was my dream to work with Prof. Finkelmann on liquid crystalline polymer networks. Before I started my PhD work under him, nematic liquid single crystal elastomers and smectic C elastomers had been intensively investigated. I was given the task of studying smectic A liquid single crystal elastomers.

This material has a permanently, macroscopically uniformly aligned director and smectic layers, showing no defects in the liquid crystalline order, and is thus completely optically transparent. We managed to produce the elastomer by applying a mechanical field on a swollen state of a newly prepared elastomer. Essentially the deformation of polymer networks by mechanical fields couples to the director orientation of mesogenic side chain groups. During the swelling process forming liquid crystalline order, the uniform alignment of the director is caused by the induced anisotropic backbone conformation, accompanying simultaneous layer formation. When we got the elastomer for the first time, Prof. Finkelmann stretched it parallel and perpendicular to the layer normal direction, saying 'hart! Weich, weich!!'.

Due to the one-dimensional long-range positional order of macroscopically aligned layers of smectic A phase, the elastomer in the direction parallel to the layer normally has a large modulus showing enthalpy elasticity similar to solids (crystals or metals). However in the layer direction there is no positional order, the elastomer behaves like a conventional cross-linked polymer network having a small modulus based on entropy (rubber) elasticity. Actually we have measured that the modulus parallel to the layer normal direction is two orders of magnitude larger than the modulus perpendicular to the layer normal. This elastomer is highly anisotropic on static modulus [1]. Moreover we found some interesting physical properties of the elastomer. By applying mechanical fields in the direction of layers a phenomenon based on the in-plane fluidity of smectic layers is observed [1]. Furthermore structural changes of the uniformly aligned lamella structure of the smectic A phase are induced by mechanical extensive stress in the direction parallel to the layer normal, e.g., the break-down of smectic layers.

The pictures show the elastomer before and after deformation parallel to the layer normal, respectively. Under strain the elastomer becomes completely opaque showing structural changes, which we studied in detail with X-ray scattering technique [2].

Before deformation



After deformation

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I was very happy and lucky to have studied smectic elastomers, enjoyed working with Prof. Finkelmann and his group members. I would like to express my great appreciation. Now I am dreaming that someday I will be able to work with Prof. Finkelmann again to explore new materials.

References

[1] NISHIKAWA, E., FINKELMANN, H., and BRAND, H. R., 1997, *Macromol. Rapid Commun*., **18,** 65.
[2] NISHIKAWA, E., and FINKELMANN, H., 1999, *Macromol. Chem. Phys*., **200,** 312.

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