

Ferroelectricity and structure of free standing films of smectic liquid crystals

by Peter Fortmeier

In this work experiments on the spontaneous polarization P_S and the switching behaviour were carried out depending on temperature, layer number N and time in free standing films (FSF) of smectic liquid crystals.

Furthermore the molecular order in the surface layer in FSF was measured with NEXAFS – spectroscopy.

The following results were observed:

- I. In thick films ($N < 100$) P_S has the same value as it has in bulk samples. In films with $N < 100$ P_S increases rapidly.

This effect can be explained by the following two models:

1. According to theoretical predictions the dipole-dipole-interactions in a two dimensional system (thin FSF) suppress the thermal fluctuations in the surface layers which leads to higher polar ordering at the surface of the FSF.
 2. The thermal fluctuations are suppressed by the surface tension γ which leads to enhanced polar ordering in the surface layers.
- II. Ferrielectric and antiferroelectric switching was observed in FSF for the first time. The switching processes depend on time due to reorientation in the surface layers resulting from a change of the surface tension.
 - III. By NEXAFS-spectroscopy a tilt angle was observed **directly** in the surface layer of a S_A -film. As these experiments were carried out under high vacuum conditions, so it can be excluded that the enhanced polar ordering at the films surface is caused by molecules from the atmosphere attaching to the film.