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# Characterization of the local layer structure in the ferroelectric liquid crystal with cholesteric-chiral smectic C phase transition sequences

Kazuhiro TAKADA[1], Takashi NOMA[1], Taihei MUKAIDE[1], Takeshi TOGANO[1] and Atsuo IIDA[2]
[1]Canon Research Center, Atsugi, Kanagawa 243-0193, Japan
[2]KEK-PF, Tsukuba, Ibaraki 305-0801, Japan

## Introduction

The surface-stabilized ferroelectric liquid crystal (SSFLC) cells have been studied for optical device applications. The layer structure in the SSFLC cells has been interpreted as a chevron structure. In this study, we investigated the local layer structure in another type of FLC cells using a synchrotron x-ray microbeam.

The FLC has cholesteric-chiral smectic C (Ch-SmC*) phase transition sequences. The main difference from materials conventionally used for a SSFLC cell was the exclusion of the SmA phase. The FLC cells show the monostable switching characteristics. Cooling these cells from isotropic phase to the SmC* phase, two smectic layer normal directions are generated. The layer normal can be controlled by applying low DC voltage only near the phase transition temperature from Ch to SmC* [1].

## Experimental

The sample was the FLC sandwiched between two ITO-coated glass plates (80μm thick). Both of the inner surfaces of the glass plates were coated with an alignment film and rubbed in antiparallel directions. The cell thickness was about 1.5μm controlled by the glass spacer beads.

The x-ray micro diffraction measurements were performed at the photon factory on BL4A. The x-ray microbeam system was used [2]. The beam size was about $7\times7\mu m^2$ at the sample position. The angular divergence was about 1mrad in both horizontal and vertical directions. The x-ray energy was 8keV. The experimental arrangement around the sample is shown in Fig.1. A position sensitive proportional counter (PSPC) was used to detect diffracted x-rays. The PSPC was placed at 2θ position corresponding smectic layer spacing. The diffracted position on the PSPC corresponds to the χ-rotation angle of the smectic layer around the surface normal from the rubbing direction (χ profile). The sample cell was mounted on a ω-rotation stage with a vertical rotation axis to obtain rocking curves (ω profile) [3].

## Results and Discussion

Figure 2(a) shows a typical optical micrograph of the sample cell. A stripe texture running almost parallel to the rubbing direction was observed. The arrow indicates the analysis point. The χ-ω profile in Fig.2(b) shows the deformed layer structure in the FLC. The smectic layer bends in both ω and χ-directions.

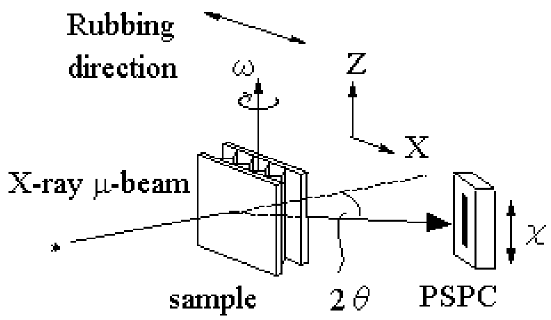
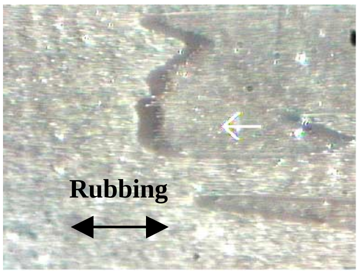
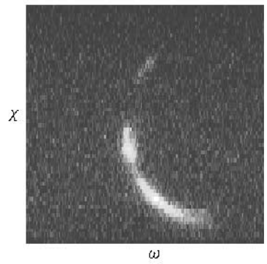



**Fig.1** Experimental setup around the sample. The sample in the figure was assumed the chevron structure.




(**a**) (**b**)

**Fig.2** (a) The optical micrograph of the FLC.
(b) The χ-ω profile. The arrow in Fig.2(a) shows the point of measurement.

The diffraction intensity distributions in the χ-ω profile suggests the layer structures of this sample mainly asymmetric chevron structures, which includes of a small amount of inclined-bookshelf structures. We consider that these layer structures generate the stripe texture. Detailed analysis is now underway.

## References

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* noma.takashi@canon.co.jp