Materials Science

4A/2004G337

Director configuration in the vicinity of defect lines in nematic Schlieren texture by X-ray Micro-Diffraction

Atsuo IIDA[1*], Yumiko TAKAHASHI[2], Yoichi TAKANISHI[3], Youko OHTSUKA[3]and Hideo TAKEZOE[3]

[1]KEK-PF, Tsukuba, Ibaraki 305-0801, Japan

[2] Dept.Phys., Col.Sci.Tech., Nihon Univ., Surugadai, Kanda, Chiyoda-ku, Tokyo 101-8308, Japan

[3] Dept. Organic and Polymeric Materials, Tokyo Institute of Technology, O-okayama, Meguro-ku, Tokyo 152-8552, Japan

Introduction

In nematic liquid crystals between glass plates, the director usually orients parallel to the substrates. If this orientation is not homogeneous, so-called Schlieren textures are observed between crossed polarizers as shown in Fig.1, in which the brushes are two fold at singular points. This singularity corresponds to a topological defect. From the micrograph, both defects are wedge disclinations in nature and are assigned strength s=±1/2. The disclination is the typical defect in nematic and its characterization has been made by the optical method. X-ray scattering from the nematic sample shows the oriented halo-pattern which shows the orientation of the director and the order parameter. In the present report, we have demonstrated the characterization of the Schlieren texture with an X-ray micro-scattering experiment.

Experimental

The experiment was carried out on BL-4A. The x-ray energy was 14.2 keV and the beam size was about 2×3 μm^2. The diffraction pattern was measured by an image intensified X-ray CCD camera (6 in. in dia.) as a function of position. The sample to the camera distance was 16 cm. The sample was a nematic 5CB sandwiched between glass plates. The cell gap was about 25 μm. The sample was kept in the nematic phase at room temperature.

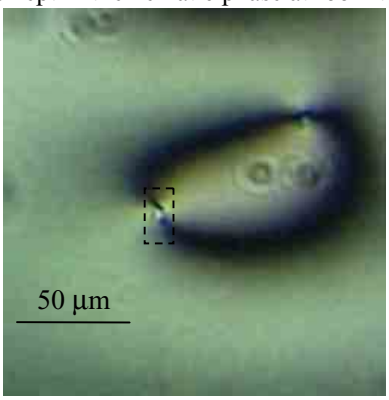

Fig.1 Schlieren texture of a nematic phase under planar anchoring condition by a polarising optical microscope attached to the X-ray micro-beam system. The curved brushes converge into singular point defects.

Results and Discussion

Fig.2 shows a series of diffraction patterns around the singular point shown in Fig.1. The central part of each diffraction pattern was covered with a direct beam stop. The raw data was subtracted by background scattering from the cell without a sample. From each diffraction pattern, the director orientation can be uniquely determined as shown in Fig.3. It is clearly shown that the director rotates by π around the singular point and its strength is s = -1/2 from the rotation direction. The order parameter can be also determined from analysis of each halo pattern. It is also noted that the halo patter at the center loses the clear orientation partly due to the specific structure of the singular point. Micro X-ray scattering study can reveal specific characteristics of the Schlieren texture.

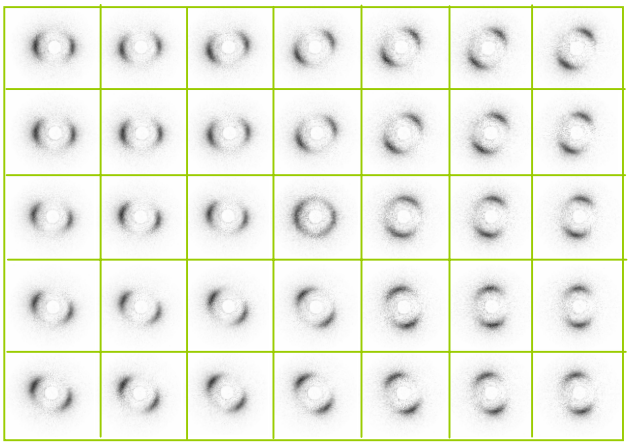

Fig.2 A series of X-ray diffraction patterns from the region of the specimen within the dashed rectangular (12 μm x 20 μm region) in Fig.1. 2 μm / step and 5 μm / step in the horizontal and vertical directions, respectively.

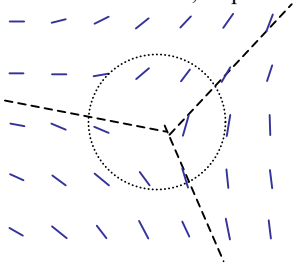

Fig.3 Director orientation around the singular point deduced from Fig.2. The orientation well corresponds to brushes of the micrograph in Fig.1

*atsuo.iida@kek.jp