SYNCHROTRON X-RAY MICROBEAM CHARACTERIZATION OF LIQUID CRYSTALS

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For the direct determination of the microscopic local layer structure and the molecular ordering in the smectic and nematic liquid crystals (LC), the synchrotron X-ray microbeam diffraction technique has become a powerful tool. Analyses of the dynamic local layer structure and the molecular ordering of the smectic and nematic LC are given.

The experiments were carried out on BL-4A at the Photon Factory (Tsukuba, Japan). Synchrotron X-rays were focused by Kirkpatrick Baez mirrors and the beam size was less than 5×5 μm^2. The x-ray energy used was 8 keV through 14 keV depending on the experiments.

The dynamic local layer response of the stripe texture, which appears in the anti-ferro and ferroelectric smectic liquid crystal (AFLC and FLC), was measured in detail under the high electric field. Time resolved microbeam diffraction measurements were carried out with the time resolution from a few μs to ms. The electroclinic effect is measured in the SmA phase of both materials. For FLC cells, the reversible local layer change from the horizontal chevron to the quasi-bookshelf structure was confirmed under the triangular waveform. The local molecular orientation in the electroclinic effect has been measured by time resolved X-ray wide-angle halo scattering. The molecular orientation varies spatially in accordance with the stripe texture and depends on the applied voltage.

Recently bent-core liquid crystals have attracted much attention due to its anti-ferroelectric response though they comprise achiral molecules. Resonant X-ray scattering (RXS) can reveal the relation between the chirality and the clinicity which plays an important role for the realization of the various phases of bent-core liquid crystals. The local molecular ordering in the B2 phase of Br–substituted bent-core LC was studied using microbeam RXS. The RXS signal from the Br contained LC was observed for the first time.