

Characterization of soft matters and trace element analysis by X-ray microprobe at the Photon Factory

Atsuo Iida

Photon Factory, Institute of Materials Structure Science, High Energy Accelerator Research Organization, O-ho 1-1, Tsukuba, Ibaraki 305-0801, Japan

The X-ray microprobe has become indispensable tool for the material characterization. A Kirkpatrick-Baez (KB) X-ray microbeam system of BL4A at the Photon Factory has been used for the elemental mapping of biological and mineralogical samples. X-ray diffraction experiments, such as micro-grazing exit diffraction from thin films and meso-porous silica films and the intensive study of the dynamical behavior of liquid crystals and polymers, have been also performed. The routine analytical system both for X-ray fluorescence analysis and X-ray diffraction/scattering experiments is working successfully, though the beam size is around 5 micron due to the relatively large source size of the PF ring. For the X-ray fluorescence analysis and elemental mapping, a double multilayer monochromator is used to enhance the incident intensity, while a double crystal monochromator is used for the micro-XAFS and micro-diffraction experiment. The double multilayer monochromator is also effective for small angle scattering. The KB system uses a pair of elliptically shaped Rh coated X-ray mirrors with a glancing angle of 2.8 mrad which covers the X-ray energy up to 20 keV. For spectroscopic applications, a silicon drift detector has recently introduced for the higher counting rate experiment in addition to the conventional Si(Li) detector. Two dimensional detectors, CCD X-ray cameras with an image intensifier or a tapered optical fiber, become indispensable for X-ray diffraction and scattering experiments.

In this presentation, the time-resolved micro-diffraction experiments for the characterization of the dynamic and static behavior of smectic liquid crystals are described. With an appropriate combination of the monochromator and the detection system, the time resolution of a few micro-sec and the spatial resolution of the a few microns were established. The dynamic local layer response of chiral smectic liquid crystals to the external electric field was revealed for the first time.