Mesoscopic Structures of Liquid-Crystal Molecules Probed by Resonant Soft X-Ray Scattering

UVSOR Synchrotron Facility
Division of Advanced Photochemistry

IWAYAMA, Hiroshi
Assistant Professor

We study soft matters such as liquid-crystal materials with soft x-ray, whose energy region covers K-edge energies of carbon, nitrogen and oxygen. Soft matters exhibit their intriguing properties due to mesoscopic physical structures by self-organizations. To understand properties of soft matters, we need to investigate their structure in the mesoscopic scale.

1. Resonant Soft X-Ray Scattering Method

Resonant soft x-ray scattering measurements can probe mesoscopic structures and periodic spatial variations of the orientation of molecules with both elemental and chemical environment sensitivity and have orders of magnitude scattering intensity enhancement over conventional small angle (non-resonant) x-ray scattering, which is sensitive only to the electron density modulations.

In this year, we performed RSoXS experiments at UVSOR BL3U for the first time. Our sample is S-MHPOBC, which is a chiral smectic liquid crystal molecule and shows ferro- and antiferroelectric phases depending on its temperature.

We successfully obtained diffraction images at the wavelength of 4.34 nm (285 eV), which correspond to C 1s-to-π* core excitations. From the analysis of images, we found a resonant enhancement of diffractions corresponding to a period length of 6.4 nm. Considering single molecular length of 3 nm, this shows the sample is antiferroelectric under the measurement conditions. We investigate intermediate phases between ferro- and antiferroelectric one by changing sample temperatures.