TPS 14A Small- and Wide- Angle X-ray Scattering Beamline

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Abstract

A new TPS 14A small- and wide- X-ray scattering (SWAXS) beamline, with a bending-magnet X-ray source of Taiwan Photon Source of the National Synchrotron Radiation Research Center (NSRRC), in planned for nanostructure-based research. The beamline will be equipped with a double Si(111) crystal with high energy resolution ($\Delta E/E = 2\times10^{-4}$) in the energy range 5–23 keV and a double M_o/B_4C multilayer monochromators for 10–30 times higher flux (10^{12} photons/s) in the 6–15 keV range. These two monochromators are incorporated into one rotating cradle for fast exchange. The SWAXS instrument, situated in an experimental hutch, comprises collimation, sample and post-sample stages. The sample stage can accommodate various sample geometries for thin films, and solution and solid samples. The post-sample section consists of a 1-m WAXS section with area detector (hybrid photo counting or CMOS type), a vacuum bellows (1–7 m), a two-beamstop system and the SAXS detector system with area hybrid photo counting detector, all situated on a motorized optical bench for motion in six degrees of freedom. Synchronized SAXS and WAXS measurements are realized via a data-acquisition protocol that can integrate the area detectors for SAXS and WAXS (Eiger2 X or X-ray flat panel detector); the protocol also incorporates automatic sample changing and programmable temperature control for efficient data collection protocols. In particular, the vacuum bellows of a large inner diameter provides continuous changes in the sample-to-detector distance under vacuum. The performance of the instrument is illustrated via several different measurements, including (1) simultaneous SAXS/WAXS detecting hierarchical structure for block copolymer complexes, polymer crystallization and polymer composites , (2) SAXS/WAXS/XANES for studying the structure change of flexible supercapacitor with external force, (3) GISAXS/GIWAXS for organic photovoltaics thin films formed in situ during spin-coating and thermal annealing (4) anomalous GISAXS for oriented membranes of Br-labelled lipids embedded with peptides, and (5) USAXS for polymer fiber formed during injection and polymer crystallization.

References

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