2. Status of Beamline BL07LSU at SPring-8

The University-of-Tokyo high-brilliance synchrotron soft X-ray outstation beamline BL07LSU at SPring-8 has been annually maintained by permanent staff members with an adjunct for user operations and to promote advanced solid state materials as well as soft materials spectroscopy. There are currently three regular endstations: time-resolved soft X-ray spectroscopy, 3D-scanning photoelectron microscope and ultrahigh resolution soft X-ray emission spectroscopy, along with one free port station for users who bring their own experimental apparatus.

In 2011, a soft X-ray polarimeter system with a multilayer analyzer (Fig. 1) was installed in the beamline in order to measure the degree of linear and circular polarizations in the soft X-ray region. Using the system more than 97% degree of polarization was confirmed for linearly polarized lights. Elaborate works on alignment of the undulator and monochrometer are ongoing to increase the performance of the beamline: the energy resolution and the degree of polarization. In order to realize rapid switching of circular polarization for future time- and spin-resolved experiments, development of a fast electromagnetic phase shifter has been started with the accelerator group of RIKEN SPring-8 center.

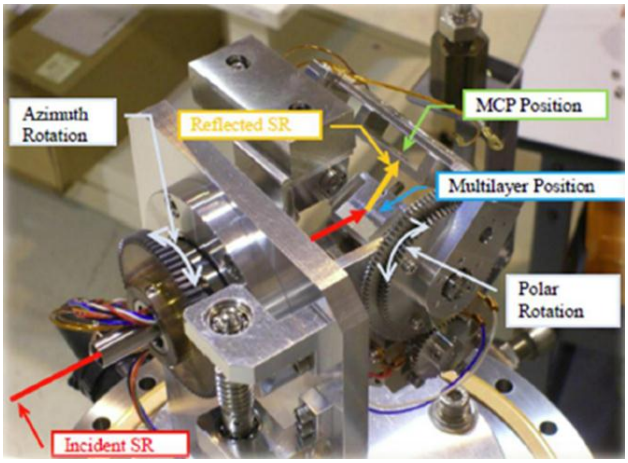

Figure 1 A soft x-ray polarimeter system with a multilayer analyzer.

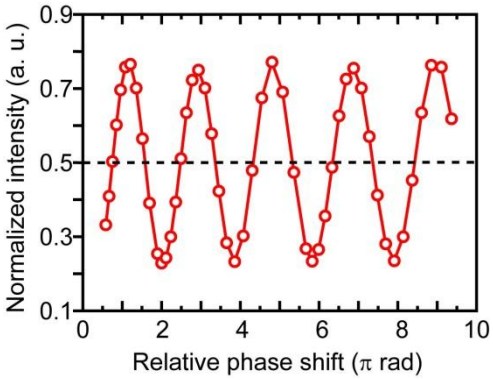

Figure 2 Normalized reflectivity of multilayer analyzer at hν= 720 eV. The azimuth angle of multilayer analyzer was fixed at 45°. The relative phase shift has an offset of -0.342 π rad.

Below are brief introduction of recent activities at each endstation.

(1) Time-Resolved soft X-ray spectroscopy station (TR-SX spectroscopy)

The station is to make time-resolved photoemission spectroscopy experiments by synchronizing the high-brilliant soft x-ray and the ultra-short laser pulses. A new type of the electron spectrometer, the two-dimensional angle-resolved time-of-flight analyzer, has also been developed. Time-resolved photoemission measurement of surface photovoltage effect on Si(111)7×7 surface was demonstrated and two relaxation processes with different

relaxation time, τ_{fast} = 3.3±0.80 ns and τ_{slow} = 500±25 ns were obtained [1].

(2) 3D-scanning photoelectron microscope (3D nano-ESCA)

The station enables scanning photoelectron microscope measurements with a depth profiling analysis capability for three-dimensional (3D) spatially resolved electron spectroscopy for chemical analysis (ESCA) using a sub-μm beam created by a zone-plate [2]. The spot size of the beam on the sample is typically smaller than 100nm. Spatial variation of the electronic states of monolayer graphene in the vicinity of the graphene/metal electrode boundary was investigated and a charge transfer region was clearly identified [3].

(3) Ultra high-resolution soft X-ray emission spectroscopy (HORNET)

The station is for soft X-ray emission spectroscopy measurements with ultra high-resolution ($E/\Delta E > 10^4$) and under various environmental conditions (gas, liquid and solid) [4]. Electronic structure of (Ga,Mn)As was studied using resonant inelastic X-ray scattering (RIXS) at high ($\Delta E \sim 150$ meV) energy resolution. The RIXS spectra clearly demonstrate delocalized nature of Mn 3*d* electronic state in (Ga,Mn)As [5].

(4) Free-port station

The station is equipped with a focusing mirror chamber which can be connected to any experimental chamber. The station has been opened for users with their own machines. In 2011, a wide angle-range photoemission spectrometer was developed and revision of their performance continued.

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