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 maintained by the permanent staff members with an adjunct for user operations. A scientific aim of the beamline is to promote advanced spectroscopy for solid state and soft materials. There are currently three regular endstations: time-resolved soft X-ray spectroscopy (TR-SX spectroscopy), 3D-scanning photoelectron microscope (3D nano-ESCA) and ultrahigh resolution soft X-ray emission spectroscopy (HORNET), along with a free port station for users who bring their own experimental apparatus.

In 2012, several improvements and upgrading were made for the undulator and the beamline. There has been a high-heat-load problem at the bending magnet chamber in the storage ring, which has restricted a number of the undulator segments for experiments using photon energy below 500 eV. In order to resolve the problem, a compact photon absorber was constructed and it will be installed in the ring in 2013.

The beamline SPring-8 BL07LSU is a polarization-controlled beamline and the linearly polarized light has been mainly used in the experiment. For the future usage of the circular polarized light, the degree of circular polarization was evaluated and tuned with the soft X-ray polarization analyzer, developed by JASRI (Fig. 1). Measurement of X-ray magnetic circular dichroism was also made with the standard ferromagnetic samples for the confirmation.

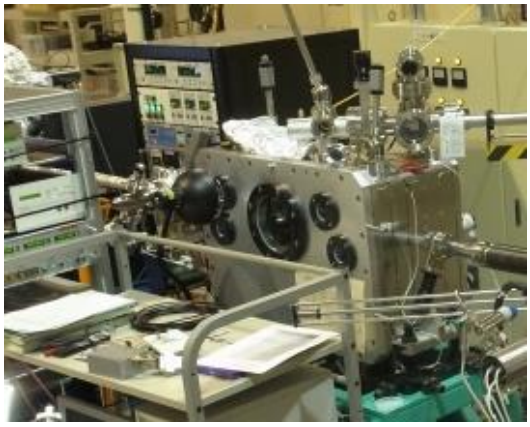

Figure 1 A soft x-ray polarimeter system with a multilayer transmission phase shifter.

Since the undulator is designed to realize rapid switching of the light polarization, an electromagnetic-coil phase shifter has been developed and examined its performance up to 50 Hz with the accelerator group of RIKEN SPring-8 center. By the improvement, advanced time- and spin-resolved experiments will be carried out at the beamline in the future.

At the beamline endstations, various scientific researches were carried out by both the laboratory staff and general users (G-type application). Below are brief introduction of recent activities at each station.

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

The station is to perform 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 (ARTOF) analyzer, is installed. In 2012, a new manipulator stage was installed to allow sample cooling down to 5K. The electronic noise of the ARTOF analyzer was significantly reduced by applying an electronic band-pass filter. Time-resolved photoemission measurements were performed to trace photo-induced phenomena on semiconductor

surfaces, such as photo catalysts of $SrTiO_3$, ZnO, and TiO_2, in *real time*.

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

The endstation is for three-dimensional (3D) spatially resolved electron spectroscopy for chemical analysis (ESCA). With a zone-plate, a spot size of the beam on the sample is typically smaller than 100nm. The scanning photoelectron microscope is equipped with a depth profiling analysis capability. As a consequence, users carried out the 3D nano-ESCA measurements at the station. In 2012, a new preparation chamber was installed for sample exchange and for *in situ* sample preparation, e.g. heating, evaporation, and sputtering. The sample holder in the experimental chamber was improved to allow photoelectron microscopy observation under the applied voltage.

(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]. In 2012, two cylindrical collecting mirrors are installed between the sample position and the grating, which results in the increase of XES signal by a factor of three while keeping the energy resolution within 5% deterioration. A new manipulator stage that allows sample cooling below 50K was also installed. *In situ* experiments in atmospheric pressure were upgraded to enable the study of fuel cell catalysts in the form of membrane electrode assembly or electrode materials for lithium battery.

(4) Free-port station

The station is equipped with a focusing mirror chamber, which can be connected to an experimental chamber brought by a user. In 2012, the station was mainly used for development of a wide angle-range photoemission spectrometer.

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