The University of Tokyo Soft X-Ray Materials Science Beamline

The University of Tokyo Synchrotron Radiation Research Organization (UT-SRRO) has constructed a new soft X-ray undulator beamline for materials science, "University-of-Tokyo Synchrotron Radiation (SR) Outstation" at beamline **BL07LSU**, in collaboration with RIKEN and JASRI. Eight figure-8-type undulators consisting of four horizontally polarized undulators and four vertically polarized ones are installed in a 30-m-long straight section of SPring-8. The undulator can provide us with polarization-controlled soft X-rays (SX) in the photon energy range from 250 eV to 2 keV. By adopting seven electromagnetic phase shifters between horizontally and vertically polarized undulators, we are able to switch between right- and left-circular polarizations of undulator light faster than 10 Hz. The optics of the beamline consists of a pre-focusing mirror (M0), a Monk-Gillieson type varied line spacing plane grating monochromator (VLS-PGM), and a post-focusing mirror (M2). By using two gratings (G600 and G1200), the energy resolution better than 10,000 can be achieved with the photon flux of 10^{12} photons/s and with the beam spot size of less than 10 μm.

The schematic of the beamline is shown in Fig. 1. At this beamline, three main experiments began to be performed from autumn in 2009. The first project (Fig. 2(a)) is 3DnanoESCA, where the electronic structures of the sample irradiated by about 50-nm-size SX beam can be investigated by angle-resolved photoemission. The pin-point in-depth profiles of the electronic structure can be obtained for LSIs, quantum dots, magnetic patterned media, environmental catalysts and other nano-fabricated materials. The second one is soft X-ray emission spectroscopy (Fig. 2(b)) for biomaterials and operating polymer electrolyte fuel cells, where a submicron beam is incident on liquid/solid interfaces. The third project is time-resolved photoemission spectroscopy (Fig. 2(c)). The apparatus was equipped with an angle-resolved time-of-flight (ARToF) electron energy analyzer, where pump-probe experiments with the combination of fs laser and SR for the studies of photoinduced phase

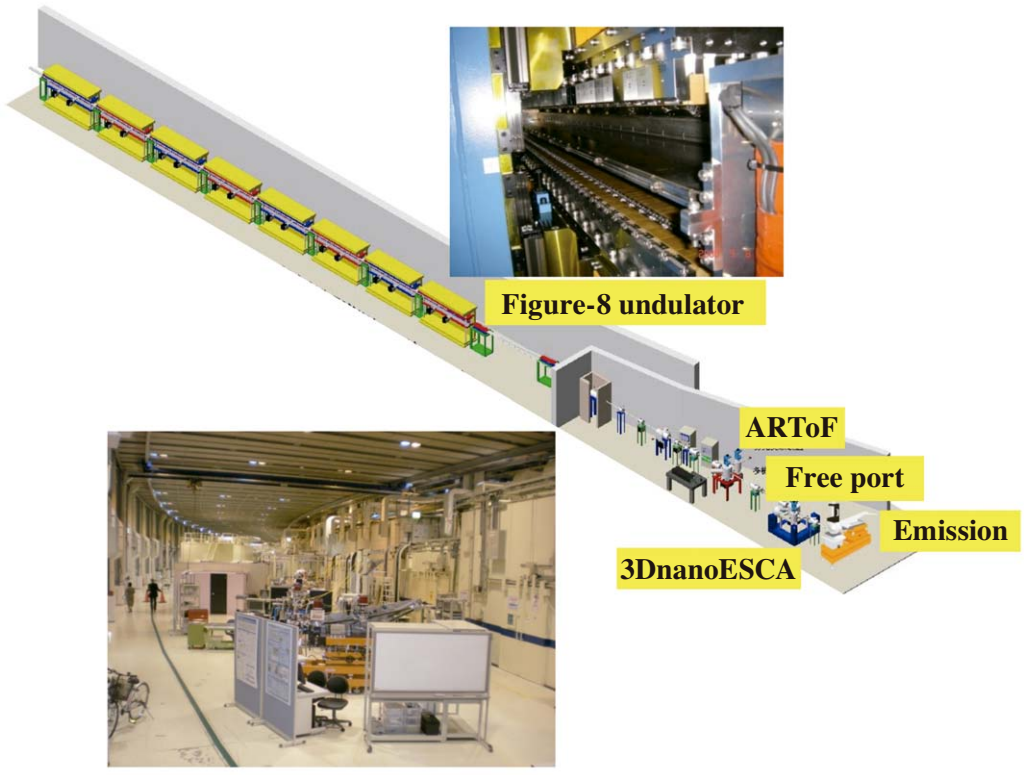

Fig. 1. Schematic of the University-of-Tokyo Materials Science SR Outstation with eight figure-8-type undulators.

transitions and photocatalytic reactions can be performed. The three experimental apparatuses have been fully opened for collaborative. In addition, the beamline has a free port for users who bring their own experimental apparatuses, such as those for stereoscopic photoelectron microscopy and soft X-ray microscopy using the coherence of undulator light. All the beamtimes should be allocated on the basis of a review by the Proposal Assessment Committee of UT-SRRO.

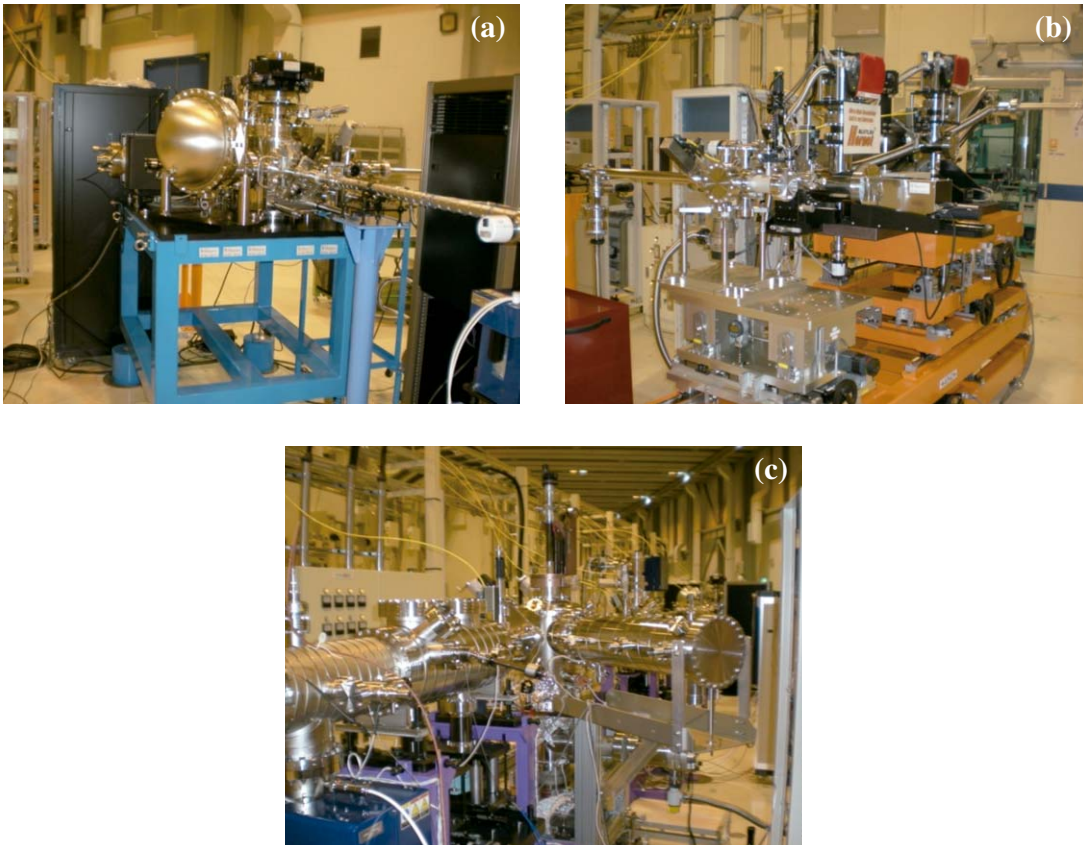

Fig. 2. **(a)** 3DnanoESCA. Electronic structures of the sample within an area of 50 nm can be investigated by angle-resolved photoemission. **(b)** Soft X-ray emission spectroscopy apparatus for biomaterials and operating polymer electrolyte fuel cells. **(c)** Time-resolved photoemission spectroscopy apparatus equipped with an angle-resolved time-of-flight (ARToF) electron energy analyzer.

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