BL12B2
(NSRRC BM)

BL12B2 is one of the two contact beamlines based on the 1998 collaborative Memorandum of Understanding among the National Synchrotron Radiation Research Center (NSRRC, Taiwan), Japan Synchrotron Radiation Research Institute (JASRI), and RIKEN SPring-8 Center (RSC). The user support and end-station maintenance of the beamlines are provided by NSRRC. Since 2000, BL12B2 has supported materials science and protein crystallography users. Due to the completion of the 3 GeV Taiwan Photon Source (TPS) at NSRRC, the beamtime distribution between these research fields has changed. In 2017, 90% of the beamtime was assigned to materials science users and about 75% of the users were from Taiwan. The rest of the beamtime was shared between international users.

Figure 1 depicts the current schematic layout of the beamline. The beamline is equipped with a collimating mirror (CM), double crystal monochromator (DCM), and focusing mirror (FM). The measured spot size and total flux of the beam are about 250-μm square and about 1.5×10^{11} photons, respectively, at the protein end station and an incident photon energy of 12 keV. Five end stations are equipped tandemly inside the experimental hutch of BL12B2: EXAFS, projection X-ray microscopy (PXM), X-ray diffraction (XRD), X-ray scattering, and protein crystallography (PX) end stations.

EXAFS experiments are measured using two ion chambers at the EXAFS table located at the most upper stream of the BL12B2 experiment hutch. Users can perform experiments by placing the sample in between these two ion chambers. Temperature-dependent powder X-ray diffraction is measured using an image plate at the XRD table, which is located next to the EXAFS table. X-ray scattering experiments can be conducted using the HUBER six-circle diffractometer. The sample environment for these two experiments

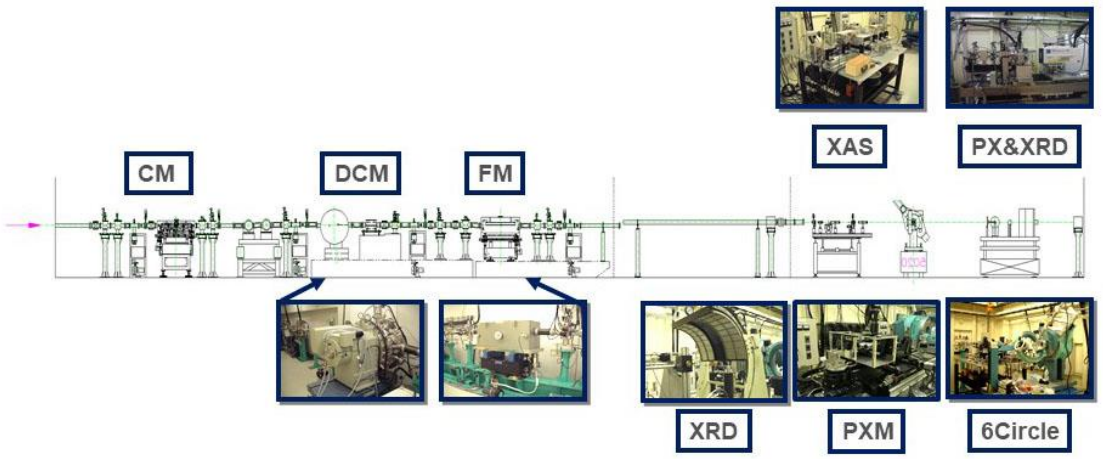

Fig. 1. Schematic layout of BL12B2.

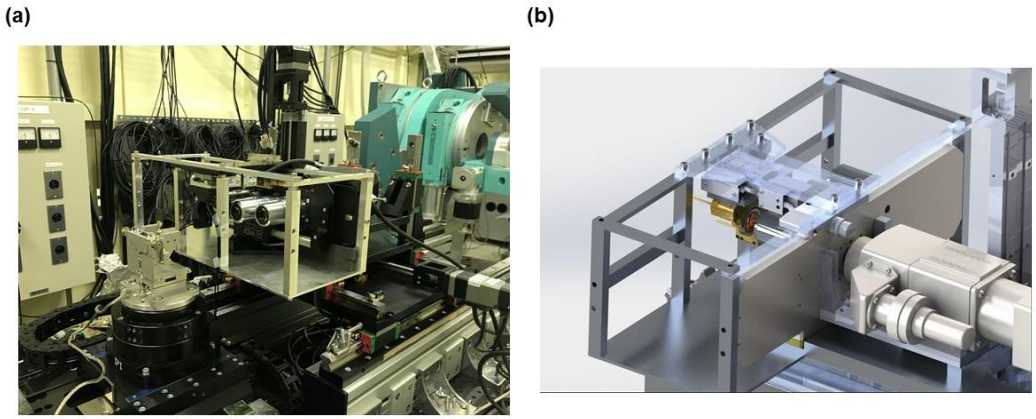

Fig. 2. Projection X-ray Microscopy (PXM) end station installed at BL12B2. (a) Photo and (b) schematic layout.

can be changed from 20 K to 400 K. In FY2018, a PXM end station was installed at the XRD table (Fig. 2). High-pressure X-ray diffraction studies are carried out using a charge-coupled device (CCD) camera at the protein crystallography table. The protein crystallography (PX) end station, which is equipped with a CCD and SPring-8 standard auto sample changer system, was installed in 2009. The user interface software for XRD experiments is SPring-8 standard BSS. In 2014, the CCD detector was upgraded to Raynox MX225-HE. The fast readout and wide detection area of the new detector help collect high-quality data. Electrode (AUTOLAB PGSTAT204; Metrohm) is prepared for *in situ* electrochemical experiments.

Materials science experiments cover diverse topics such as new material research, energy science, nanoscience, and geophysical science. In 2018, BL12B2 users published 20 papers in SCI journals. *In situ* X-ray experiments are the main target at our beamline. These experiments include electrocatalysis such as battery research, oxygen reduction reactions, and CO_2 conversions. The electrochemical conversion of CO_2 to chemical fuel is a promising strategy for global carbon balance. The lack of an effective electrocatalyst for this process is the main challenge in this research field. Prof. H. M. Chen's (Taiwan University) group has studied Ni K-edge X-ray absorption of atomically dispersed nickel on nitrogenated graphene under *operando* conditions [1].

Other researchers investigated samples under extreme conditions. A new type of superconductivity study is also a hot topic in the field of solid-state physics. Figure 3 shows pressure-dependent XRD spectra of low- and high-Tc phases of $(NH_3)_yNa_xFeSe$ from Prof. Y. Kubozono (Okayama University). A metal-intercalated two-dimensional layered system $(NH_3)_yNa_xFeSe$ was prepared under pressure [2].

User support is provided by three local beamline scientists and one engineer.

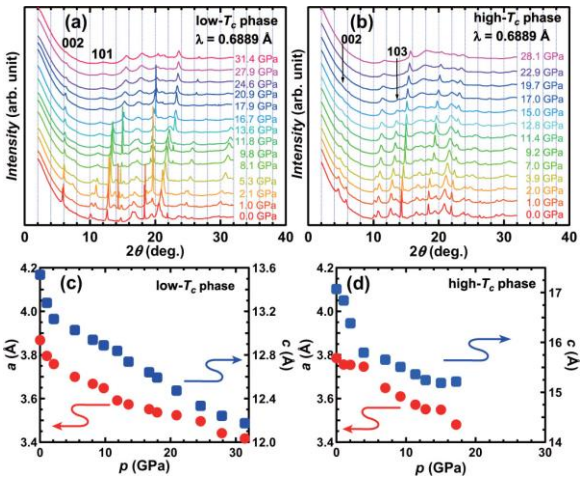

Fig. 3. Pressure-dependent XRD patterns for (a) low-T_c and (b) high-T_c phases of $(NH_3)_yNa_xFeSe$. Pressure dependences of lattice constants (a and c) for (c) low-T_c and (d) high-T_c phases are plotted as functions of pressure [2].

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References:

[1] H. B. Yang et al., *Nat. Energy* **3**, 140 (2018).

[2] T. Terao et al., *Phys. Rev. B* **97**, 094505 (2018).