BL15XU
WEBRAM

1. Introduction

BL15XU, which is officially referred to as WEBRAM (Wide Energy Beamline for Research in Advanced Materials), is the contract beamline of the National Institute for Materials Science (NIMS). The light source of the beamline is a revolver undulator, which has two sets of magnet arrays. One array is a planar undulator, and the other is a helical undulator. A liquid nitrogen–cooled double-crystal monochromator installed into the beamline provides monochromatic X-rays from 2.2 keV to 36 keV. In addition, a channel-cut monochromator, a focusing mirror system, and a diamond phase-retarder system are installed.

The beamline was established for materials science with a mission to support users inside and outside of NIMS and to promote the development of new functional materials research. Users conduct the following studies: (1) hard X-ray photoelectron spectroscopy (HAXPES), (2) crystal structure analysis by high-resolution X-ray powder diffraction, and (3) structure analysis of functional thin films with an 8-axis diffractometer.

2. Beamtime use and publications

Public use of the NIMS beamline is classified into two groups: NIMS researchers and outside users. Researches inside NIMS include collaborations with Tokodai Institute for Elements Strategy (TIES). Most of the accepted proposals from outside users were selected by the Nanotechnology Platform (NanoPF) project. In FY2019, 55 proposals were accepted. (In FY2018, 67 proposals were accepted.) Of these, 33 were for NIMS researchers and 22 were for outside users.

The beamtime utilization ratio was 44% for HAXPES, 35% for thin-film X-ray diffraction, and 21% for X-ray powder diffraction, including X-ray total scattering measurements for pair distribution function (PDF) analysis (Fig. 1). In the past few years, the percentage of beamtime for HAXPES has shown a slightly decreasing trend. Additionally, there have been no experiments using helical undulator since FY2017, and experiments using incident energies below 5 keV have become rare.

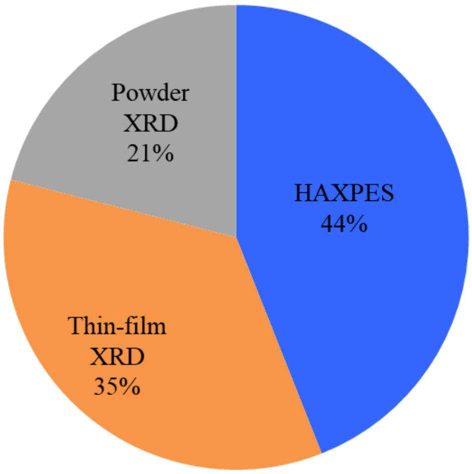

Fig. 1. Percentage of usage by method.

Figure 2 shows the utilization ratio of beamtimes categorized by research area and material. The utilization percentage of electrochemistry, which accounted for approximately 10% of research until FY2017, has decreased noticeably.

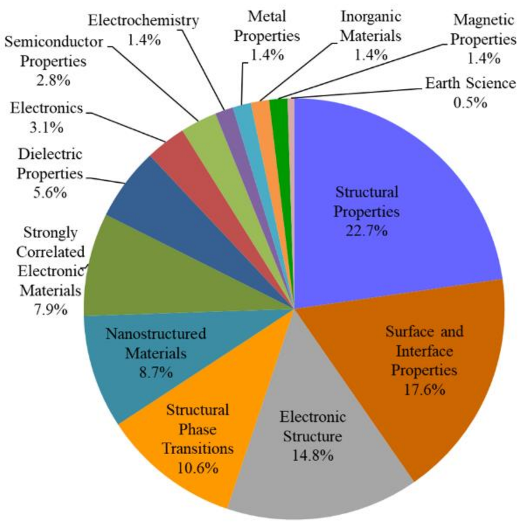

Fig. 2. Percentage of research areas and materials.

In FY2019, 39 peer-reviewed articles were published based on research at the beamline. This number is slightly lower than that published in FY2018, but it is the same as that of FY2016.

3. Improvement of experimental apparatuses

Powder X-ray diffraction experiments have been conducted using high-resolution powder diffractometers with one-dimensional detectors. However, one-dimensional detectors are not sufficient for coarse grains such as in experiments using a diamond anvil cell (DAC) diffractometer. Such samples require a two-dimensional detector that can record the entire Debye ring. In past years, a combination of an imaging plate and an off-line reader had been used as a two-dimensional detector. However, the long readout time due to the off-line reader was a serious obstacle. To reduce the throughput time, we installed a flat-panel detector (Hamamatsu Photonics C7942CA-22) to the high-resolution powder diffractometer for the 30 keV energy range. The flat panel detector has a 120 mm × 120 mm sensor area, its pixel size is 50 μm × 50 μm, and the number of effective pixels is 2240 × 2344. Figure 3 shows the flat-panel detector attached to the high-resolution powder diffractometer.

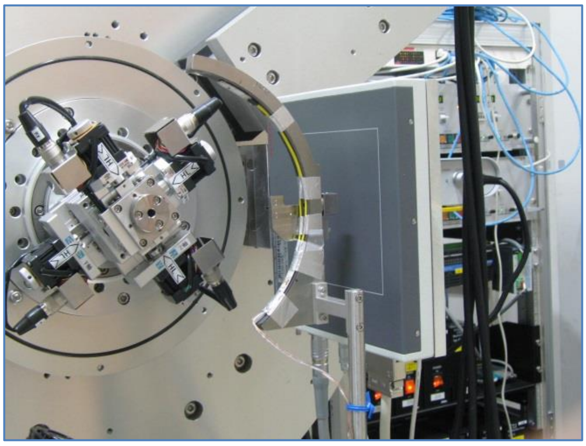

Fig. 3. Flat-panel detector attached to the high-resolution powder diffractometer.

We plan to use the flat-panel detector to screen powder samples for the evaluation of crystallinity and grain size prior to powder X-ray diffraction data collection.

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