BL15XU WEBRAM

The concept of WEBRAM (Wide Energy Beamline for Research in Advanced Materials), constructed by AML/NIMS (Advanced Materials Laboratory, National Institute for Materials Science, Japan) , is "wide, bright and simple". Monochromatic photon flux ($\Delta\lambda/\lambda \sim 0.01\%$) on samples can be obtained from 0.5 keV to 60 keV at about 10^{13} photons/sec. The minimum photon energy 0.5 keV is nearly equal to the K absorption edge of oxygen, and the maximum 60 keV covers the K absorption edge of almost all the rare earth elements. This beamline has no mirror system in the optical hutch, so that the degree of parallelization of the X-ray beam at the sample position is expected to be almost the same at the front end or in the area in the upstream. In addition, the extracted beam axis is kept constant. It is now possible to carry out the following tasks in substance / material research ; the analysis of atomic arrangement (10 ~ 20 keV highly monochromatic photons) and the analysis of atom configuration and electronic structure (0.5 ~ 2 keV for analysis of valence electrons, 0.5 ~ 60 keV for inner-shell electrons).

Area of research

Highly precise characterization of advanced materials

- High resolution X-ray photoemission microscopy
- Study and analysis for synthesis process of thin films assisted with X-ray irradiation
- High energy excitation X-ray photoelectron spectroscopy
- High resolution X-ray emission spectroscopy
- Highly precise X-ray powder diffraction study and ultra-small angle scattering

Keywords

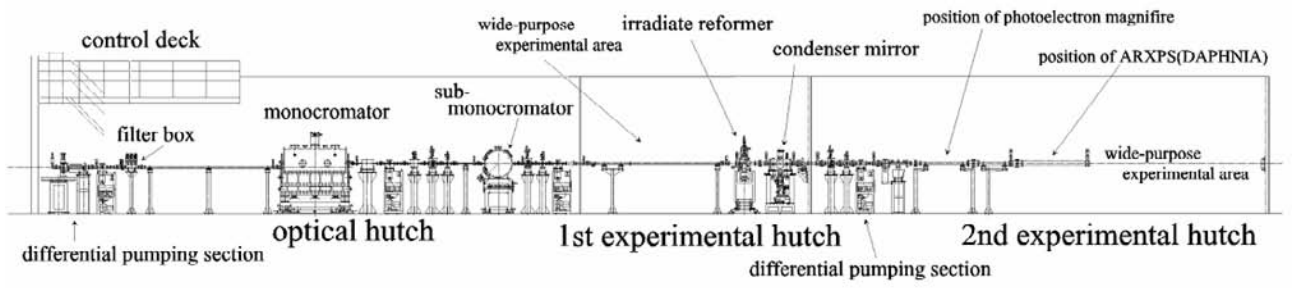
Scientific field

Analysis for advanced materials, X-ray photoelectron emission microscope with high energy excitation, X-ray photoelectron spectroscopy with high energy excitation, High resolution X-ray powder diffraction, Ultra small angle X-ray scattering, High resolution characteristic X-ray spectroscopy

Equipment

X-ray photoelectron emission spectrometer, Angle resolved X-ray photoelectron spectrometer (DAPHNIA), High-precision powder diffractometer, Johann type high-resolution X-ray spectrometer, Solid state energy dispersion detector, APD detector

Source and optics



X-rays at sample

	YB_{66}(400) monochromator system [1~2 keV]	Si (111) monochromator system [2~20 keV]	Si (333) or (444) monochromator system [20~60 keV]
Energy resolution	$\Delta E/E \sim 10^{-4}$ (purely monochromatized)	$\Delta E/E \sim 10^{-4}$ (purely monochromatized)	$\Delta E/E \sim 10^{-4}$ (with higher order light)
Photon flux	$\sim 10^{8\sim9}$photons/sec	$\sim 10^{12\sim13}$photons/sec	$\sim 10^{12\sim13}$photons/sec

Beam size : > 0.8 mm (at the 1st experimental hutch, front-end slit : 0.3 mm × 0.3 mm)

Experimental stations

The experiment hutch of WEBRAM is divided into two regions: a high-vacuum and atmosphere (1st) experimental hutch part and an ultra-high-vacuum (2nd) experimental hutch.

High-precision powder X-ray diffraction equipment (photo 1) and high-resolution X-ray spectrometer (photo 2) are usually installed in the 1st experimental hutch, but not fixed for enable to install any other equipment of user. By a realization of high brightness high parallelism monochromatic light over 7~8 keV (it is possible to about 5 keV by the sample), the measurement of a small angle scattering in at smallest 0.0005 degree step became possible to the region of 0.01 degree or less. For example, the resolution of 0.07 peak widths degree or less can be realized of 111 reflection of Si at 8 keV. The measurement by θ-2θ scan for the plate sample is difficult at present, and a measurement only of the capillary filling sample is available. Of course, it is also available to execute high resolution X-ray powder diffraction measurement. However, due to so high resolution, it is not available to scan so wide angle range. Only precise scan on small angle range can be accepted.

And, by a realization of high brightness high monochromatic light over 2 keV, the high-resolution X-ray fluorescence spectroscopic study is also available. It became possible using this equipment that the chemical state of the specific element of any sample was precisely decided without receiving the effect from the sample surface. This machine showed is prepared by Kyoto Univ., and new one will be install in the near future.

As mentioned above, it is possible to remove the experimental equipment from the 1st experimental hutch. In the become space, it is possible to install the equipment in which the user specialized for the original research. Available area size is 2 m long and 2 m wide. The beam height is 1.5 m, connectable with ICF70 flange, or 150 micron Be window is also available.

In the 2nd experimental hutch, photoelectron spectroscopy equipment named "DAPHNIA" (Dual Angle-resolved Photoelectron Intelligent Analyzer) is installed and fixed (photo 3). Another equipment of user is able to be installed at the general-purpose experiment area (Available area size is 2 m long and 2 m wide. The beam height is 1.5 m, connectable with ICF152 under UHV condition only).

By high degree of freedom of measurement geometry for light source of this equipment, the experiment of angle resolved photoelectron spectroscopy including total reflection is also possible. It is effective in the state analysis of important heavy element in the nano material research, because not only tuning excitation energy but also high energy excitation. And, the supersensitive excitation condition with small interfering line can be freely chosen. In addition, it is also possible to utilize the high kinetic energy photoelectron. By this method, the effect of the surface contamination is reduced. Especially, it is suitable for analysis of the difficult sample of the sputter cleaning.

Development research about the high resolution photoelectron emission microscope is also executed at the 2nd experimental hutch, and the equipment is not opened for public use because under the fabrication still now.

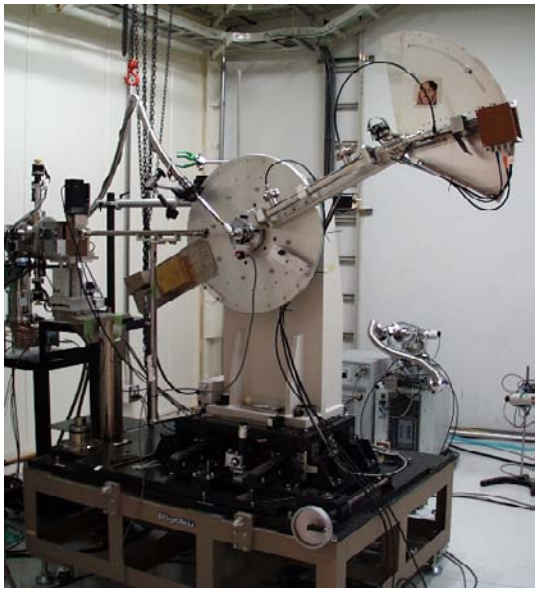


Photo 1

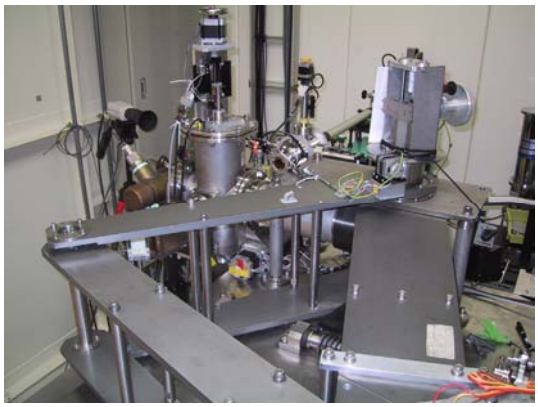


Photo 2

Photo 3

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