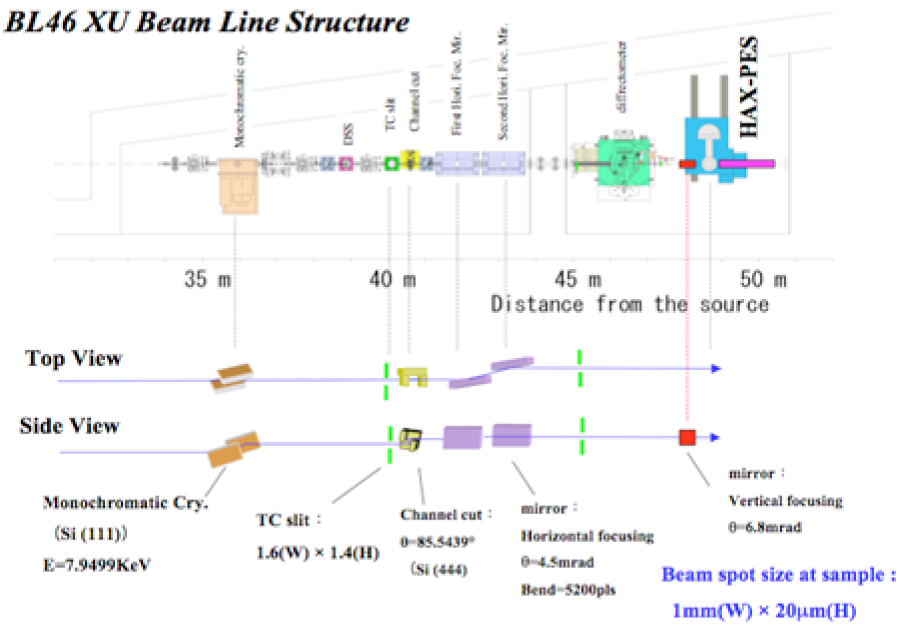
BL46XU

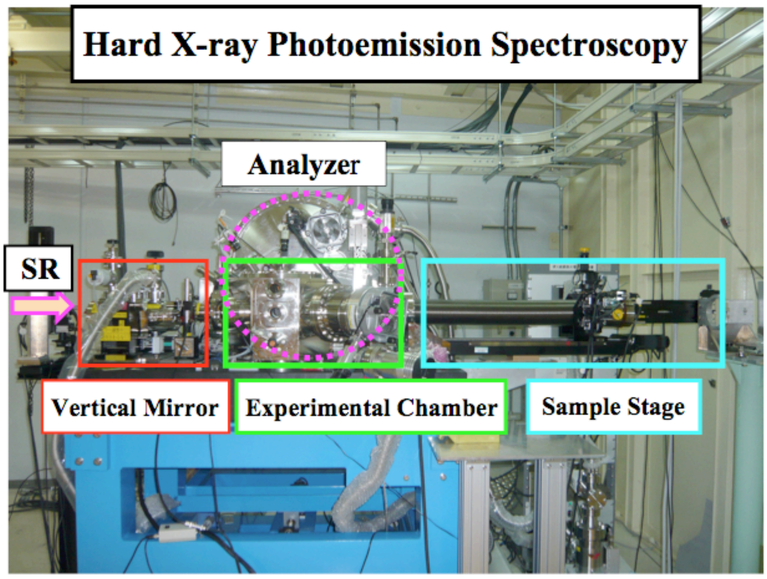
Hard X-ray Photoelectron Spectroscopy

1. Overview

BL46XU is an undulator beamline dedicated to promote the utilization of synchrotron radiation by industry. The light source of this beam line is a standard in-vacuum undulator in SPring-8 and optics adopts a Si (111) direct water-cooled inclined double-crystal monochromator with tunable energy range of 6-35 KeV. Two Rh-evaporated mirrors (70cm length, reflection direction is horizontal) are placed in the most downstream part of the optics hutch to eliminate harmonics. The mirrors also have a curvature for horizontal light focus. A Si (111) channel-cut monochromator is placed between the monochromator and the mirrors to get incident X-ray with fine energy resolution for hard X-ray photoemission spectroscopy. The hard X-ray photoemission spectroscopy (HAX-PES) system at this beamline is equipped with a VG-SCIENTA photoelectron energy analyzer, R-4000.



One of the advantages of HAX-PES compared to conventional photoemission spectroscopy is its potential for bulk sensitive measurements in a precise and non-destructive manner. As we know that the probing depths of PES are determined by the inelastic mean free paths (IMFP) of photoelectrons within the solid. The conventional PESs (ultraviolet photoemission spectroscopy and X-ray photoemission) usually utilize radiation from He discharge tube, synchrotron radiation as well as Al or Mg-anode X-ray tube with energy range of several-ten to several-hundred eV. Their obtained data are strongly dependent on the surface condition of the sample because detection depth is shallow due to a short IMFP of photoelectrons inside the solid material. Therefore, it has been difficult to observe bulk electronic states that contribute to the solid-state properties. One of solutions for this is named depth-profiling with sputtering, however there has been a concern about property changes during the sputtering process. The 3rd generation synchrotron radiation of SPring-8 with undulator light source enable us to use high brilliant (photon flux ~10^{11} photons/sec) hard X-ray (6-8 keV) for high excitation energy photoemission spectroscopy. The large detection depth of several tens of nanometers (typically, as around 20 nm for 8 keV) is sufficient for the observation of bulk sensitive electronic states. Besides standard bulk-sensitive measurements, one can also get deeper core levels as well as a surface-to-bulk profile of electronic states in angle-dependent photoemission spectroscopy experiments where probing depth can be controlled by changing the detection angle of photoelectrons to the sample surface.

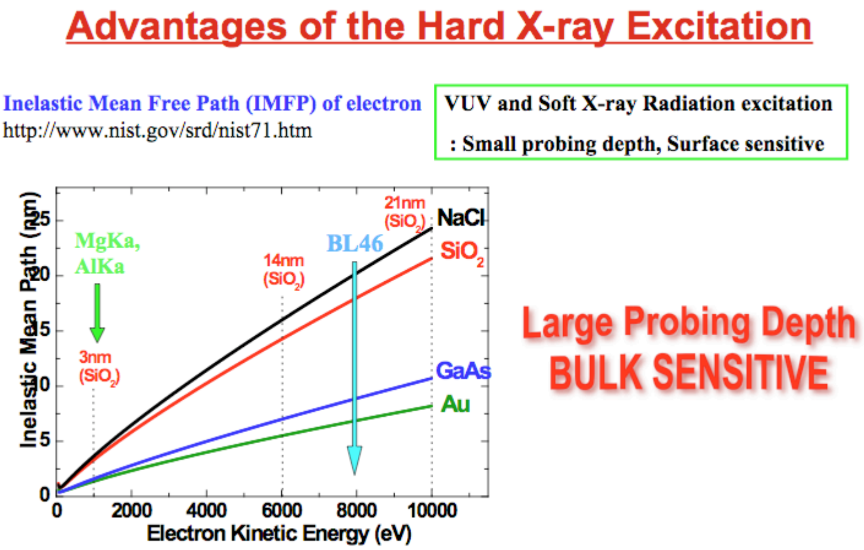


The aim of this course is to learn a principle of HAX-PES and gain experience of measuring photoelectron spectra of various materials with 8 keV monochromated X-ray.

2. Beam Line Practice

On the practices at the BL46XU, we are planning to conduct the followings.

1. Introduction of optics alignment from the ring to the HAXPES.
2. Explanation of HAX-PES and vacuum systems.
3. Sample preparation.
4. HAX-PES Measurement of Au films and depth-profiling by angle-dependent photoemission spectroscopy experiments, and
5. Discussion about experiment and introduction of data analysis.



3. Schedule

A. First day (Sep. 30th, Friday)

1. **09:30~10:00** Introduction of optics alignment from the ring to the HAXPES;
2. **10:00~10:30** Explanation of HAX-PES and vacuum systems;
3. **10:30~12:00** Sample preparation and pumping load lock;
4. **12:00~13:00** Lunch;
5. **13:00~17:30** Beam line adjustment and HAX-PES Measurement of Au films as well as depth-profiling by angle-dependent photoemission spectroscopy experiments;

B. Second day (Oct. 1th, Saturday)

6. **09:30~12:00** continue HAX-PES Measurement of Au films as well as depth-profiling by angle-dependent photoemission spectroscopy experiments;

7. **12:00~13:00** Lunch;

8. **13:00~17:30** Discussion about experiment and introduction of data analysis.