BL12XU
NSRRC ID

1. Introduction

2005 has witnessed a few major events for BL12XU. The most important of these was the Interim Review of the Taiwan Contract Beamlines (BL12B2 and BL12XU), in which the configuration, performance, facility operation and utilization, and research proposals and results of the two beamlines were reviewed. We have received excellent comments from the SPring-8 Contract Beamline Review Committee, and as a result, the Taiwan Contract Beamlines will continue to operate for a second term.

For BL12XU, user operation has reached its full capacity. In 2005, we have had over 100 user runs for more than 25 experiments. Majority of these experiments are again IXS experiments on the dynamical response of electrons in superconductors, the electronic structure of strongly correlated systems, and phase transitions in materials induced by pressure and temperature. We are seeing increasing number of excellent publications generated from results obtained from the beamline.

The Interim Review also identified two major upgrades or plans that will strengthen substantially the research capabilities and thereby the productivity of BL12XU, which we would like to report here with some details.

2. Micro-Focusing System for HP Research

Due to the high penetration depth of hard x-rays, IXS has great potential in providing crucial information on the dynamic behavior and the electronic structure of materials under high pressure. In turn, high-pressure research provides numerous possible applications for IXS, and therefore represents an excellent long-term strategic research direction for BL12XU. However, the sample volume available from diamond anvil cells is generally on the order of $10^{-3}mm^3$. One must therefore have a beam focus on the order of a few microns in order to study these systems.

The upgrade uses a set of KB mirrors (Fig.1) near the sample position of the IXS spectrometer which is compatible with the existing focussing optics of the beamline. The system has already been implemented on the beamline (Fig.2) at the time of writing this report, and has achieved a beam focus of ～13(H)×16(V)μm^2 with a transmission of 86%. This gave us a flux density gain of more than 50 times compared to the previous focus. Coupled with the multiple analyser system of the spectrometer, we expect to gain more than two orders of magnitude higher counting efficiency for high-pressure related experiments. This upgrade will therefore greatly benefit high-pressure research in the coming years.

3. Construction of the Branch Line

The branch beamline planned and reserved for BL12XU is another valuable resource for the Taiwan users. We have planed to construct this branch beamline to perform high kinetic-energy photoemission (HE-PES) experiments, which provides bulk-sensitive information on the electronic structure of correlated electron systems due to the higher penetration depth of the high energy photoelectrons. This technique has recently attracted a great deal of interest. Most of the pioneering work in fact has

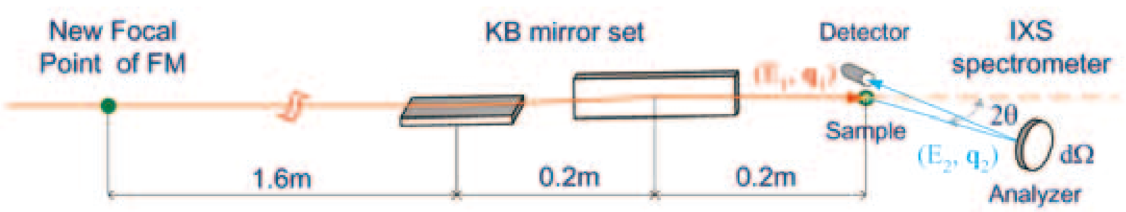

Fig.1 Schematic layout of the micro focussing system for BL12XU to achieve a focus of ～10×10μmP2P at the sample position of the IXS spectrometer for high pressure research.

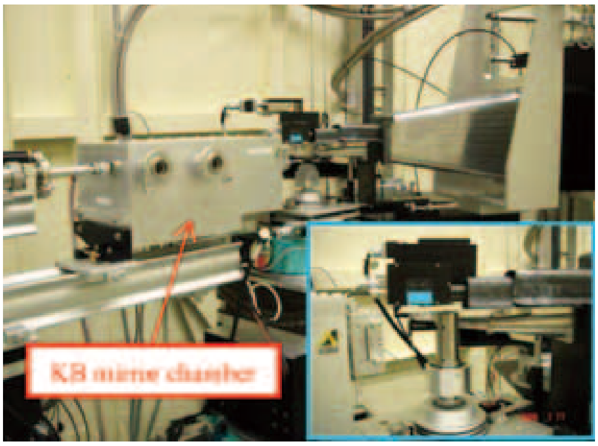

Fig.2 The KB mirror chamber as installed on the beamline. The insert shows a DAC sample for HP experiments.

been done at SPring-8. The required energies are in the range of 6～12keV with energy resolution up to 10meV.

Right now the conceptual design of the branch beamline has been completed. The layout of the beamline and end station is shown in Fig.3. Briefly, the beamline will extract monochromatic beam using a semitransparent diamond crystal (the diamond monochromator) over the energy range of 6～12keV with a scattering angle of 28～60°. The experimental end station and the beamline optical components will be placed on a tracking stage to follow the scattered beam for energy tuning. Beamline components will include an exit XY slit from the diamond monochromator to define the scattered beam, a high-resolution monochromator to reduce the energy width to the desired level up to 10meV, and a set of KB mirrors to focus the beam to～ $10 \times 10 \mu m^2$ at the sample position. The construction will be carried out jointly by NSRRC and the University of Cologne, Germany, and is expected to be completed in 2007.

Two major scientific programs will be pursued on the sideline: (1) bulk-sensitive, high-resolution (10～50meV) density-of-state measurements on the valence electronic structure of strongly correlated materials. Because the kinetic energy of the photoelectron is so high, in addition to the increased probing depth, one basically gets no secondary background. Theoretically the photoelectrons can be truly treated as plane waves, and the data can be compared directly with calculations to test theoretical models. This will be the focus of the research programs to be conducted. (2) ESCA-like applications with medium resolution (0.2～0.5eV), where the main interests are in materials analysis, deep depth profiling, buried interfaces and biological systems. HE-PES is a relatively new research area and will provide another great research opportunity for BL12XU.

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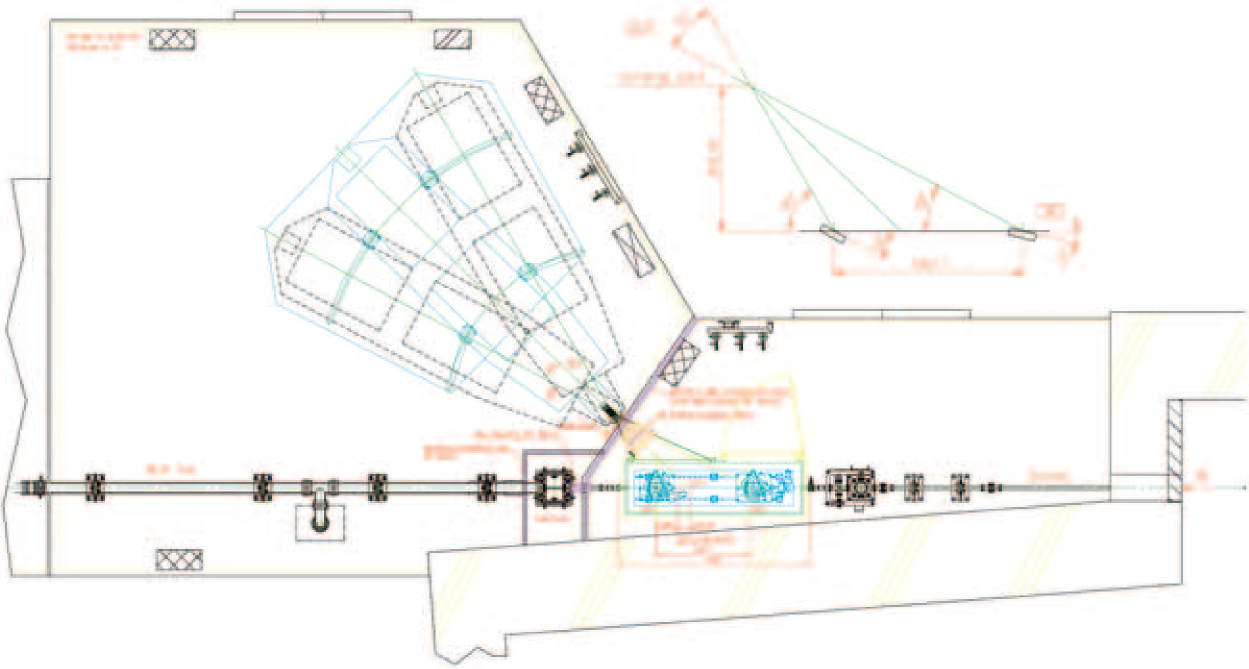

Fig.3. Layout of optical hutch and experimental hutch of the BL12XU branch beamline.