SPring-8 BL27SU Evaluation Report

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1. Preface

At the SPring-8, this Evaluation Committee meeting was held on November 26 and 27, 2003. Before the meeting, each committee member received the following materials:
SPring-8 Overview, and
Beamline Report BL27SU (Soft X-ray photochemistry).
On the basis of these materials, every committee member was requested to make an independent report in advance. On the meeting date, the four domestic committee members all attended the Evaluation Committee meeting. They were given the overview of SPring-8 first. Then, they inspected the beamline BL27SU before evaluation discussion. They were given further detailed descriptions of beamline hardware and software by the beamline staff. The four committee members participated in a question-and-answer session, and communicated with each other. On the basis of the above-mentioned materials, independent reports, and the latest on-site information, the four members held a discussion for approximately six hours. The committee presents the following evaluation report.

2. Beamline and experimental devices

2a) Insertion device and beamline monochromater

(Present status)
Performance of the figure-8 undulator, which is distinguishable due to its original design by the Spring-8 insertion light source group conducted by Dr. Kitamura, is worthy of praise. Without this undulator, it is entirely impossible to utilize linear polarized soft X-rays at high-energy synchrotron radiation ring SPring-8 designed especially for hard X-rays.

The beamline monochromater system has the world's highest level of performance in every respect of resolution, intensity, and stability. The system is well equipped so that it can also be adapted to devices introduced by users. These are the results of elaborating works basing upon unusual ability of the staff that is in charge of the construction of this beamline. The beamline has Branches A, B, and C. Branch C

includes Stations (devices) C1, C2, and C3 in tandem arrangement. Such a beamline can satisfy various users' needs.

(Evaluation and recommendation)
Station C2 is used most frequently. In Station C2, however, beam spots on samples are not small enough to fully utilize the high-brilliance characteristic of the light source. We recommend that the beam spot on the samples be reduced to size in the order of 10 micrometers. Higher-order light shall be eliminated. It is necessary to take a certain measure against carbon contamination of the optical components in the beamline.

2b) Experimental stations
(Present status)
[Branch A] As an R&D, developmental research on focusing mirrors is carried out by the beamline staff.

[Branch B] This is a branch line for research that concentrates on photo-CVD. Installation of experimental equipments in this branch has been delayed until recently. Branch B is installed with supply and disposal system of reactive gases. (Such devices are also used at Branch C.)

[Branch C] Branch C line is used for various studies of soft X-ray spectroscopy and related fields. This branch is the best equipped among the three Branches. Both Stations C1 and C2 are equipped with mechanism to switch experimental apparatus to those introduced by users without serious loss of time. In the first stage, a time of flight (TOF, reflectron) analyzer and a CMA has been installed for Station C1. At present, Station C1 is also used as a general-purpose vacuum chamber. Station C2 is equipped with a Gammadata-Scienta SES2002high-resolution photoelectron analyzer. The plan is being carried out to replace detection system from CCD to a delay line read out type MCP in order to enable photoelectron coincidence measurements. In this station, it is possible to replace the above mentioned photoelectron apparatus with the apparatus equipped with 3D-TOF analyzers introduced for a long-range research plan by a group of Tohoku University, Himeji Institute of Technology, and National Institute of Advanced Industrial Science and Technology. In Station C3, the RIKEN group set up device for photoemission-soft x-ray emission combined spectroscopy for research on physics and chemistry of solids and solid surfaces.

(Evaluation and recommendation)
Referring to the demands from the present users and researchers who wish to use the Branches, the beamline staff has been continuously improved the devices, which was once completed. Even though they are reworked, the number of newcomer user

groups has not been larger than expected. Besides, it seems likely that these efforts will not lead to remarkable research results. The staff should follow a new policy of inviting more and more first-rate research groups of the world to use the completed devices as they are. Such a policy will enable the staff to hear opinions of the first-rate researchers of the world. As the persons in charge of the beamline, staff may improve their ability to judge trends in the research field that the beamline covers. It should be noted that the beamline staff could neither lead important research fields nor push back the frontiers as long as they are assigned dominantly to user support work, which are extremely busy as in the present condition. It may be necessary to review the job given to the beamline staff.

We comment as follows, on devices that are expected to produce the world's highest level of research:

High-resolution gas photoelectron spectroscopy station (C2)
The highly refined SES2002 is installed which can make full use of the beamline performance. This high-resolution gas photoelectron spectroscopy station consists mainly of commercially available products, thus the performance is satisfactory and stable as a whole. It is easy for users to use the device. Remarkable research results have already been produced under the leadership of the group who set up the device. We recommend that the staff invites gas photoelectron spectroscopy scientists in the world to use this device for their state of art researches in order to develop further prosperity of the beamline. For that purpose, urgent business is to enable measurement of CIS (constant ionic state) spectra by controlling undurator-monochromater, and analyzer synchronously.

Solid surface photoelectron spectroscopy and soft X-ray emission spectroscopy station (C3)
This station is introduced by the RIKEN group for a long-range plan. The device is also open to public use.
Surface chemistry, such as studies on molecular adsorbates, is one of the important research field in which this station can be utilized to make most of its performance. Because this device is substantially permanently provided for this beamline, we recommend that a surface science specialist be assigned in order to strengthen support for this research.

3. Research results
A large number of research papers regarding the BL27SU have appeared in Physical Review Letters and other first-rate journals (48 refereed papers, 34 invited lectures at international conferences). On the whole, scientists attained high levels. They made

great contributions especially to spectroscopic research fields.

4. Support for sharing

The beamline staff makes a full effort to support sharing. From the tabulation of questionnaires, it is judged that many users are very satisfied with the beamline.

As research subjects, a variety of gaseous samples are available. Flammable and toxic gases disposal system is provided and operated safely. Because the disposal process equipment is located distant from the measuring devices, it is not at all easy to use. Number of flammable and toxic gaseous samples, which will be demanded to increase by users in future, is quite limited at the present stage. Improvement in gas sample handling system, is needed in order to increase research subjects.

5. Future developments

The beamline has Branches A, B, and C. Branch C includes Stations (devices) C1, C2, and C3 in tandem arrangement. The beamline can support various users. However, we noticed that some of research subjects cannot adequately utilize the features of the beamline. As the beam time, an average of 12 shifts is allocated to an applicant for each half-year plan. Considering the loss of set-up time, we mention that the allocated beam time is inadequate especially for the use of temporary devices introduced by users. Fragmentary beam time allocations for each half-year plan cannot possibly support time-consuming experiments in surface chemistry, for example.

Although it is limited by the proposal assessment system in Spring-8, strategies should be taken to adopt applications for research subjects that will fully utilize the performance of the beamline facilities, with which scientists can carry out the world's highest level of research. Sufficient beam time should be allocated to these researches. We hope that research results based on the BL27SU beamline will be highly appreciated by scientists in the world. For that purpose, it is necessary to take positive steps to invite not only Japanese but also foreign groups who will carry out the most advanced research. The number of independent experiment groups will be thereby increased. Competition will make beamline users active. On the other hand, priority will naturally reduced for some research filed in which most of applications are rejected. We suggest that improvement of devices for research subjects, which have scarcely been applied (for example, research using soft X-rays of more than 2 keV) is not urgently necessary.

On the whole, SPring-8 soft X-ray research is a great success. It should be noted that if similar research plans are adopted and implemented by different soft x-ray beamlines in SPring-8, unneceaary burdens will be imposed on each beamline staff. Similar research plans may decrease efficiency in equipment budget and allocated beam time.

The features of each soft X-ray beamline are to be reviewed and reexamined. Each beamline should be assigned to a distinctive research field in which the beamline is competitive in the world.

6. Summary

The BL27SU is one of the world's best apparatuses because it is provided with the figure-8 undulator designed and built according to the original idea, the high-performance beamline monochromater system, and the high-performance experimental devices. In the past five years of construction and set-up phases, a high level of research using such facility has shown results. We can highly appreciate the research results.

In the next five years of development phase, it is essential to follow a different science policy to operate the beamline. In order to produce a large number of discoveries from the BL27SU, as described in Section 5 titled "Future developments," it is necessary to increase independent experiment groups. Competition among beamline user groups will be thereby produced. Such competition will further improve research levels.