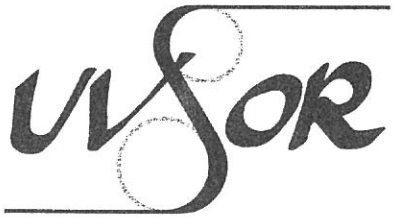

UVSOR
ACTIVITY REPORT
1998

edited by

T. Kinoshita, M. Hosaka, S. Tanaka

Preface

This Activity Report covers the research activities done by over 800 users from about 60 institutions at the UVSOR facility in 1998. This is the fifth volume in the red-covered Activity Report series. For these five years, the improvement and upgrade projects of monochromators and end stations for the second 10 years of UVSOR are going well, where the first SR was emitted in November 1983. I would like to acknowledge various kinds of supports to the projects by the government and the outside users, and efforts of the UVSOR staff. The following are some of the highlights of monochromators in 1998.

BL2B2: Construction of the spherical grating monochromator for the energy range of 20-200 eV has reached its terminal stage. Available photon flux and resolution were evaluated by measuring the double excitation of He in the photon energy range from 59 to 67 eV; a series of Rydberg states were observed up to n=9+ in the case of the slit widths of 100 μm. After further improvement, we will start inner-valence and shallow core photoionization study of gas-phase molecules.

BL4A: A multilayered mirror monochromator was completed. This beamline is uniquely designed for the study of the excitation energy dependence in SR-stimulated photochemical processes. The first measurement shows that the photoexcitation around the Al 2p edge induces a very effective deposition of the Al thin film on the Si substrate from dimethylaluminium hydride .

BL5A: A new high-resolution monochromator called SGM-TRAIN (Spherical Grating Monochromator with Translational and Rotational Assembly Including a Normal incidence mount) was completed. The monochromator is combined with the helical undulator. The photoelectron spectroscopy for solids, solid surfaces, metal deposited Si surfaces, and quasi-crystalline solids has been carried out using the radiation from the bending magnet. The use of the undulator is now in preparation.

BL7A: The focusing mirror system was installed between the front-end and the soft X-ray double crystal monochromator chambers to obtain the higher performance. In conjunction with the use of the Wiggler radiation and a variety of the monochromator crystals, the experiment at the wide energy region (especially, lower than 2 keV) with high photon flux is now available.

BL7B: The 3m normal incidence monochromator (3m NIM; McPherson upgrade model of 2253) has replaced the 1m Seya-Namioka type monochromator for extended solid-state researches with the higher resolution and intensity, the wider wavelength region available and so on. The performance of the monochromator is now being checked. The throughput and resolution are achieved as expected in the design. The beamline will be opened to the users from April 1999.

The following are some of the highlights of end stations in 1998. We are now trying to develop new fields in molecular science towards the next century, by combining various detection systems and light sources, such as synchrotron radiation, laboratory laser and FEL (free electron laser).

BL2B1: Several groups are using the electron-ion coincidence apparatus for investigating the mechanism of the ion desorption from various types of solid induced by the core-level excitation and ionization. A modified apparatus is now completed. The coincidence signal intensity has been improved by about one order. We will get more reliable data to discuss the mechanism in detail.

BL4B: A scanning tunneling microscopy (STM) system is installed. The mechanism for SR-stimulated desorption of SiO_2 thin films on the Si(111) surfaces is investigated. An atomically flat and clean Si(111)-(7×7) surface was obtained after two hours SR irradiation at a surface temperature of 700 °C. The STM topograph shows that the desorption mechanism may be completely different between thermal and SR-stimulated desorption of the SiO_2 film.

BL8B1: We have applied the UV/ozone cleaning technique to two mirrors (M1 and M21) and two gratings (G2 and G3). After the cleaning, "dark holes" in the output spectra from the monochromator around 290 eV due to carbon-containing contaminations on the surfaces of the mirrors and gratings were successfully removed.

BL3A2: Pump-probe experiments combining synchrotron radiation and a mode-locked Ti:sapphire laser are performed to study the formation mechanism of N_2^+ ($X^2\Sigma^+$,v=0) from VUV photoexcitation of N_2 and N_2O. An RF ion trap is utilized to increase the effective density of ions. In the case of photoionization of N_2, rotational lines of the ($B^2\Sigma^+$,v'=0)←($X^2\Sigma^+$,v"=0) transitions are well resolved. The rotational temperatures of N_2^+ ions from N_2 and N_2O are estimated to be ca. 300K and <250K, respectively.

BL3B: Photoionization dynamics of polarized rare gas atoms has been studied by photoelectron spectroscopy. Aligned Rydberg atoms were produced by the linearly polarized SR excitation and were subsequently ionized by a YAG laser whose electric vector can be rotated by means of a half-wave plate. Measuring the angular distribution of photoelectrons, as a function of the angle between the electric vector and the linear momentum vector of photoelectrons, allows us to perform complete experiments of photoionization, if a particular Rydberg state is chosen as the initial state.

BL6B: A new setup for time-resolved measurements in the far-infrared region was completed by combining a Michelson-type interferometer, a bolometer and a picosecond mode-locked Nd:YAG laser. A full one-to-one 90MHz synchronization between the laser pulse and synchrotron radiation is achieved and the delay time between pump (laser photoexcitation) and probe (FIR-SR) is controllable. The time-resolution is predominantly determined by the SR duration width of about 1 ns. The reflectivity change as small as 10^{-3} is detectable. Pump-probe measurements were carried out for an organic semiconductor, β'-(BEDT-TTF)$_2$$ICl_2$, and some spectral changes induced by laser irradiation were observed.

We hope much more breakthroughs in science will be brought by the users of the improved and upgraded beamlines.

The UVSOR facility has only two associate professors and three or two research associates in the beamline division. In FY98 one associate professor and one research associate were changed. In April 1998 Dr. Shin-ichi Kimura was promoted to an associate professor of Kobe University. In November 1998 Associate Professor Toyohiko Kinoshita moved to the University of Tokyo to join in the VSX project. In May 1999 Dr. Eiji Shigemasa will come as a new associate professor from the Photon Factory, the Institute of Material Structures Science. On the other hand, the UVSOR has only one associate professor and one or two research associates in the light source division. In August 1998 we could have Dr. Shigeru Kouda as a second research associate. The machine group is very important to propose the UVSOR-II project. Now we are discussing how to reinforce the light source division with the Ministry of Education, Science, Sports and Culture (Monbusho).

March, 1999

Nobuhiro Kosugi
Director of UVSOR