

# VUV Beamline Upgrades

Steven N. Ehrlich

Beamline Technical Liaison

## Beamline U2A

There were several beamline technical improvements on the VUV floor during fiscal year 2001. The upgraded U2A beamline, with wavelengths from the mid- to far-infrared was opened to PRT users, as well as General Users, during FY2001. The beamline operation is user-friendly for General Users. Moreover, custom-built far-IR microscopes adapted to the Bruker IFS66v FTIR spectrometer run successfully, and excellent far-IR spectra (to below 100 cm<sup>-1</sup> excitation) of minerals and molecular systems have been obtained. The old computer, controlling the Bruker spectrometer, was replaced by a Gateway G6-350 and an operating system for Bruker instruments is going to be upgraded from OUPS/OS2 to OPUS/NT in FY2002. This will greatly improve the ability of users to collect and manipulate data.

## Beamlines U4A and U4B

The calibration of the U4A monochromator, which was upgraded from TGM to TSGM optical design in FY2000 using NSF facilities initiative funding obtained by the U4A PRT, was refined. The monochromator's included angle was altered slightly to match other optical parameters, and the optimum exit slit distance was determined as a function of photon energy for each grating.

Beamline U4B has incorporated an in-vacuum x-ray CCD camera for experiments involving specular and diffuse x-ray reflectivity measurements of layered magnetic structures. They have also added a 7-element intrinsic germanium fluorescence detector. Software upgrades include transfer of the beamline control and data acquisition to a customized LabView-based program with a GUI-style user interface.

## Beamlines U5UA and U7A

At beamline U5UA, a circular polarizer has been commissioned, making circular polarized light available in the energy range of 15-65 eV.

Technical improvements at U7A included reconfiguration of the Dow/NIST materials characterization facility. The reconfiguration of the soft x-ray facility will require a new experimental chamber, an internal mechanism for holding and swapping multi-layer mirrors, and a rebuild of the sample entry system. Improvements of the Dow/NIST materials characterization facility include a new sample manipulator incorporating three angular motions (and x, y, z) under stepping motor (6 motors) computer control and sample

heating and cooling (includes stepping motor power supplies and sample heating supply and control). The BNL surface chemistry endstation was modified with a Scienta XPS analyzer and surface chamber.

## Beamline U9B

At U9B, they are developing capabilities for stopped-flow mixing. They will be able to measure absorption, CD, Fluorescence and Fluorescence Polarization Anisotrop with temporal resolution to 1 ms. They have developed theory that permits simultaneous measurement of CD and Fluorescence Polarization Anisotrop.

## Beamline U10B

At U10B during FY2001, modification of the Spectra Tech Continuum IR microscope was completed to allow for simultaneous fluorescence microscopy and infrared micro-spectroscopy. Applications utilizing attenuated total reflection (ATR) and grazing incidence (GI) objectives were initiated. A matching pair of 15x Schwarzschild objectives were installed in preparation for low temperature and high pressure work on the Continuum microscope. A liquid helium micro-cryostat was purchased from Oxford Instruments. A high-resolution digital camera was installed for visible light imaging of samples. Methods for enhancing the available spatial resolution, such as by far-field techniques, were investigated. For FY2002, low temperature and high pressure IR micro-spectroscopic capabilities will be initiated. In addition, the Continuum IR microscope will be modified such that low frequency (i.e. far IR) measurements can be made using an external liquid helium cooled detector. Array detector technology and micro-vibrational circular dichroism (VCD) will be investigated.

## Beamline U12A and U12IR

Beamline U12A added a second endstation dedicated to absorption (electron yield and fluorescence yield) of "dirty" samples, especially those of current interest in the environmental sciences. This endstation is vacuum isolated from the first endstation and the rest of the U12A beamline by a thin (1500Å) aluminum window, which is 30-50% transmitting in the soft x-ray range. This permits measurement of real samples without baking in vacuum. The fluorescence detection is critical for soft x-ray absorption measurements of these samples, since the escape depth of soft x-ray photons

is more than an order of magnitude greater than that of the photoelectrons generated in this photon energy range. This endstation is still being commissioned.

Beamline U12IR completed installation of an SPS-200 spectrometer and developed high-field (up to 16T) magnetic field capability.

### **Beamline U13UB**

At U13UB, mirror M1W, its holder, chamber, and mount were installed in December 2000. This mirror will deflect a spatially selectable fraction of the visible and UV portion of the U13U undulator beam vertically upward to the U13UB white light branch. This branch

remains under construction. A new moveable 50 mm Scienta analyzer system is fully assembled and in the initial stages of calibration. This system was funded by a Facilities Initiative grant to Brandeis University (Jensen) and Boston University (Smith). We anticipate moving the analyzer system to the beamline in January 2002.

### **Beamline U16B**

At U16B, the motion controller (Newport ESP7000 with four-axis drivers) procured at the end of FY2000 to replacement/upgrade the U16B motor controller was installed and commissioned early in FY2001.