BL 43IR
Infrared Materials Science

1. Introduction

BL43IR is dedicated to infrared (IR) microspectroscopy in the wavenumber region from 10000 cm^{-1} to 100 cm^{-1}. The beamline has three microscopes: a high spatial resolution microscope, a long working distance microscope, and a magneto-optical microscope. The microscopes are used with a Fourier transform spectrometer. We are developing new instruments for microspectroscopy not only as countermeasures against deterioration of equipment already in operation but also to recruit new users for various sample environment.

2. Upgrade of the light path of the infrared microscope

The present light path was constructed at the same time as the infrared microscope and spectrometer installation. The light path was designed such that it could be applicable to system expansion such as beam stabilization, and it was branched in the middle of the light path to the old spectrometer. However, this layout needs more mirrors and the alignment became slightly complicated. In FY2020, we reconstructed the light path to that with fewer mirrors and simple conveyance of light. Figures 1(a) and 1(b) show the photographs of the system before and after the light path reconstruction, respectively. This upgrade makes optical alignment easier.

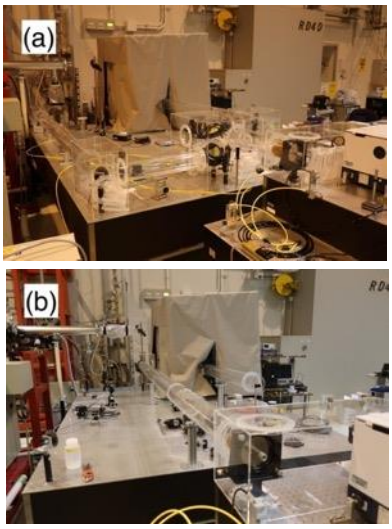

Fig. 1. (a) Old light path and (b) reconstructed light path.

3. Replacement of the microscope observation light

The light source of the microscope is both a halogen lamp and synchrotron radiation. However, a serious situation arose in which the synchrotron radiation beam position shifted when we changed the intensity of the halogen lamp. This is because the heat radiation of the lamp affects the optics inside the microscope. The heat-induced movement of the optics causes a micrometer-scale shift in synchrotron radiation beam position. To eliminate the effects of heat, the halogen lamp was replaced

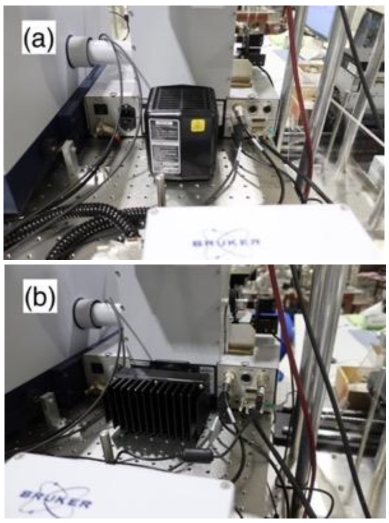

Fig. 2. (a) Old halogen lamp and (b) new LED lamp (rear view).

with an LED lamp, which emits far less heat and is considered to minimally affect the optics and position of the synchrotron radiation on a sample. Figure 2 shows a rear view of the microscope, where Fig. 2(a) shows the old halogen lamp before the replacement and Fig. 2(b) shows the new lamp.

4. Wide-range attenuated total reflection (ATR) spectroscopy

ATR spectroscopy is a technique used to measure IR spectra using evanescent waves. In ATR measurements, the infrared light passes thought an ATR crystal whose refractive index is high, and reflects off the inner surface in contact with the sample. At the reflection point, evanescent waves seeping out of the ATR crystal interact with the sample, which is pressed against the crystal, enabling spectral measurements. ATR spectroscopy is a widely used technique because of its advantages, such as simple sample preparation and the possibility of measuring liquid samples. In FY2020, we established an environment where ATR measurements can be performed in a wide wavenumber region from near IR to far IR. Since a commercial ATR-FTIR instrument usually covers only the mid-IR region, the capability of a wide range of measurements is a feature of synchrotron radiation sources. Figure 3(a) shows a photograph of the equipment, and Fig. 3(b) shows the absorption spectra of water and deuterium water. Blue shaded areas indicate the region where the absorption of the ATR crystal or upstream window materials is observed. The region can be measured by changing the materials. The spectra properly cover the region from near IR to far IR. In the spectrum of water, OH stretching, deformation and libration vibrations are observed at about 3400, 1600 and 500 cm^{-1}, respectively. In the spectrum of deuterium water, the peaks shift toward lower wavenumbers because of the effect of isotope.

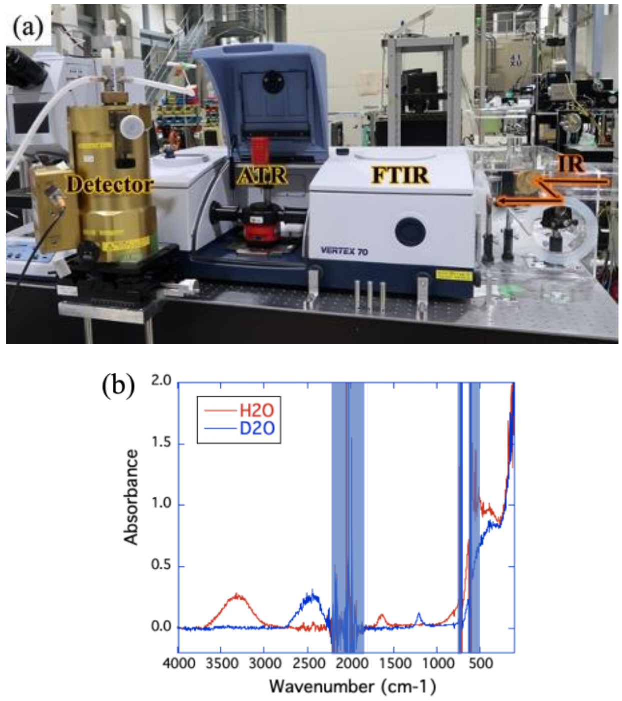

Fig. 3. (a) Photograph of ATR equipment. (b) Absorption spectra of water and deuterium water.

Taro Moriwaki and Yuka Ikemoto
Spectroscopy Division, JASRI