Portable Online Sample Observation and Ruby Fluorescence System

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Synchrotron X-ray techniques are important for high-pressure research. However, there are only few beamlines truly optimized for high-pressure experiments. One missions of COMPRES at Argonne has been building preferred access to existing, primarily non-high-pressure beamlines, where high pressure experiments can be performed, but specialized infrastructure is lacking. The sample chambers used for high-pressure diamond anvil cell (DAC) experiments are in general smaller than 500 μm. Therefore, accurate measurements with focused synchrotron beam typically require on-axis high-resolution video microscope for sample viewing, and online pressure measurement system, which are often not available at non-high-pressure synchrotron beamlines. A long working-distance lens system with large magnification is necessary for viewing and positioning such small samples. Due to the limited space near sample stage, the viewing system must be moved out from the X-ray path when collecting data. In addition, an online ruby fluorescence spectrometer is essential in every experiment in which data is acquired at more than one pressure. Here, we report on the status of development of portable spectroscopy system for DAC experiments at the non-high-pressure APS beamlines. The system is capable of viewing DAC samples and measuring ruby fluorescence spectrum utilizing modular Navitar microscope components and OceanOptics spectrometer, with the emphasis on portability and ease of alignment. With this system, based on class II laser which does not require enclosure or interlock, we are able to easily view the samples with adjustable magnification controlled by motor (max 120x zoom) and accurately measure (0.39 nm spectral resolution) ruby fluorescence signal in a DAC with ~ 0.5 s data collection time for 10 micrometer ruby sphere.