

Brief Report on the SMS Setup for High Pressure at BL10XU

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In recent high-pressure studies, it becomes important to elucidate various physical properties and phenomena comprehensively under high-pressure conditions using multiple analytical methods. High-pressure experiments using a complementary method to X-ray diffraction, a fundamental technique used to determine the crystal structure, are required for enhanced understanding of a variety of physical and chemical properties.

Iron (Fe) is by far the most abundant transition-metal element in the composition of the Earth and is a crucial element in deep Earth studies. The valence or magnetic state of iron cannot be determined using X-ray diffraction, but ^{57}Fe -Mössbauer spectroscopy is a well-established probe for studying the behavior of iron in a crystal structure and its electronic and magnetic properties. The combination of X-ray diffraction and ^{57}Fe -Mössbauer spectroscopy becomes a powerful technique to understand the complicated high-pressure behavior of iron compounds, such as deep Earth materials.

An energy-domain synchrotron ^{57}Fe -Mössbauer spectroscopy system was designed for combinatorial studies at BL10XU beamline of SPring-8, dedicated to high-pressure X-ray diffraction measurements in a diamond anvil cell. The system has been installed on the downstream side of the X-ray diffractometer in an experimental hutch (Fig. 1), and this equipment arrangement allows to perform the X-ray diffraction experiment. The Mössbauer system has all the components for ^{57}Fe -Mössbauer spectroscopy, including a nested high-resolution monochromator with asymmetric Si(511) and symmetric Si(975) channel-cut crystals, a variable-frequency nuclear monochromator crystal unit, and an NaI scintillation detector. As the nuclear monochromator, a pure nuclear Bragg reflection (333) of iron borate, FeBO_3 , single crystal is utilized. Here, we will introduce the ^{57}Fe -Mössbauer spectroscopy system and some typical results.

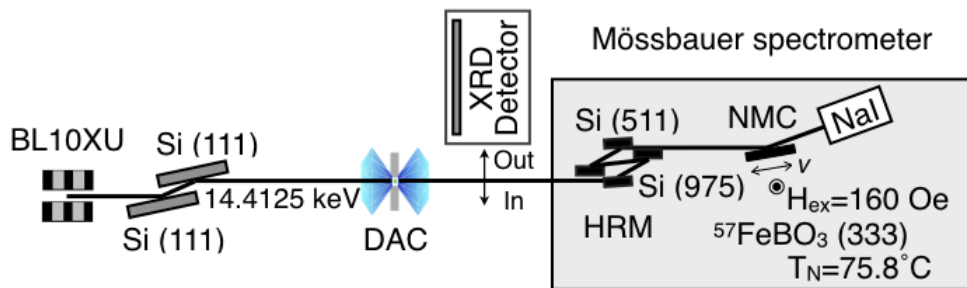


Fig. 1. The setup of energy-domain ^{57}Fe -Mössbauer spectroscopy at the BL10XU beamline