In-situ X-ray diffraction technique for shock-compressed MgO

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MgO is one of the major components in the Earth's lower mantle, and the high-pressure behavior is important for understanding deep interior of the Earth. Furthermore, MgO is used as a standard material of pressure calibration in the high-pressure experiments. Because of its high melting point and of a simple B1 structure with wide range of stability field under pressures and temperatures. The accuracy of the equation of state (EOS) affects directly to reliability of the pressure determination. Most pressure-volume data reported so far is fairly consistent with each other up to about 50 GPa. However, at higher-pressure region, only few experiments are reported and there is a significant difference between static and shock compression data due to pressure calibration and thermal energy correction. In this study, to obtain a more accurate EOS of MgO, we developed a simultaneous measurement technique for lattice volume using X-ray diffraction image of the compressed sample together with a conventional optical measurement. We performed several shock experiments of MgO by high-power laser (GMII) at Institute of Laser Engineering, Osaka University (ILE). Since the shock duration is about 6 ns, we improved the measurement system so as to obtain X-ray diffraction pattern in comparable time. The X-ray diffraction technique developed in this study could be applied to not only MgO but for several materials with high melting point, and enable to determine their crystal structures at multi- megabar region. The further improvement to realize a high precision measurement of lattice volume in-situ, is going to proceed.