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Recovery experiment of high-power laser shock compressed olivine and Application to Planetary Science

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It is important to recover the shock-compressed samples for understanding the synthetic mechanism of high-pressure phase, shock metamorphism and shock-melt vein in meteorites. In the past, many impact experiments have conducted by using explosive or gas guns. In fact, although high-pressure phase in meteorites is recovered by the impact experiments (the impact velocity is 1.5km/s and the impact pressure is 26GPa) [1], the impact velocity in these methods is limited below 10km/s less than second escape velocity on the Earth. Recently, impact experiments at the velocity over 10km/s were conducted by using projectiles which were accelerated by high-power laser [2]. In previous experiments on the laser-shocked compression, the samples were recovered on the pressure below 100GPa (the olivine which is samples in this experiment is molten at the pressure of 150GPa).

We developed the recovery technique of the laser-shocked materials at higher pressure (at 200-300GPa in this experiments) by high-power laser system and analyzed the pressure range of the production conditions from the structure of shock metamorphism. We used the single crystal olivine (from San Carlos, USA) which is a major mineral of meteorites and the mantle of the Earth. We used GXII/HIPER laser system at Institute of Laser Engineering, Osaka University [3]. The deformation, fracture and phase identification of the recovered olivine were observed comprehensively by optical microscopy, field emission-scanning electron microscopy, electron backscatter diffraction and micro-Raman spectroscopy.

We designed the new recovery cell. In this cell, Ti plate was put in front of olivine to prevent the sample from blowing off. We could recover 100wt% of the sample by using this cell. In the recovered sample, there are the region of some distinctive structures. We will report the detail of the recovery technique and the results of the observation of the recovered samples.

References
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[3]Yamanaka, C. et al., Nucl. Fusion, 27, 19-30, 1987.