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# Measurement of shocked amorphous materials by time-resolved single-shot X-ray diffraction

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## Introduction

Direct measurement of the structural dynamics in condensed matter using short X-ray pulse is one of the most important tools for investigation of the intermediate state under phase transition and shock wave loading. The shock compression condition of polycrystalline and amorphous materials has been extensively studied by gas gun and laser-shock experiment. The time-resolved single-shot X-ray diffraction made it possible to observe the shocked cadmium sulfide single crystal at NW14A beamline in PF-AR[1]. This method is that only knowing the detailed structural dynamics in atomic scale, such as polycrystal, and amorphous materials under shock wave loading. We observed shocked amorphous silica glass by nanosecond time-resolved single-shot X-ray diffraction.

## Experimental setup

Time-resolved X-ray measurement system in the NW14A beamline was described in Ref.2. The single-shot experiment is essential for the high flux single X-ray pulse. The energy spectrum of X-rays from the U20 undulator in this beamline has a long tail in low energy side. This is not suitable to the X-ray scattering of amorphous sample and polycrystal sample. We tuned the bandwidth of X-ray energy from $\Delta E/E$ = 15% to 5% in range of 4-20 keV by the multilayer X-ray optics[3]. The shape of tuned X-ray energy spectra was symmetric such as a Gaussian function. The shock experiment adapts to a wide variety of sample conditions, for example amorphous sample and polycrystal sample, with controlling the X-ray energy bandwidth. In this work, we tuned the X-ray energy peak at 15.6 keV and $\Delta E/E$ = 4.4 %. The wavelength, pulse width and intensity of pump laser (Powerlite8000, Continuum) for generating the shock wave were 1064 nm, 8 ns, and 700 mJ/pulse, respectively.

The sample assembly with a plasma confined geometry was fabricated with the ablation layer of evaporated Al layer (thickness = 500 nm) and the cover film (thickness = 25 μm) on the sample, as shown in Fig.1. The thickness of amorphous silica glass was 70 μm. The spot size of X-ray and pump laser was 450 μm x 250 μm and ϕ400 μm.

## Result and Discussion

The difference X-ray scattering of amorphous silica glass at 12 ns delay time after shock wave generation was shown in Fig.2. The X-ray scattering data were subtracted with the data of unperturbed sample at -3 ns. This difference X-ray scattering indicated the intermediate structure of amorphous silica glass under shock wave loading. This analysis is in progress.

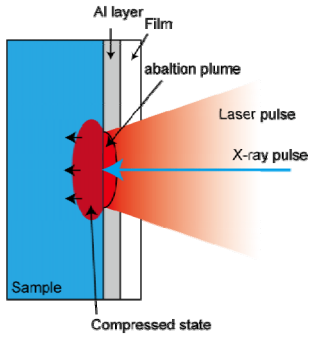


Fig.1 The schematic diagram of sample assembly.

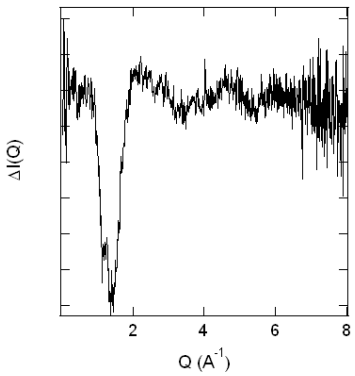


Fig.2 The difference X-ray scattering of amorphous silica glass sample at 12 ns delay time.

## References

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