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Measurements of Sound Velocity of Laser-Irradiated Single Crystal Diamond Foils Around the Melting Temperature

高強度レーザー照射された融点付近の単結晶ダイヤモンドの音速計測

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1. Introduction

Diamond is of great interest for many filelds in industries and sciences. High power laser can create post-diamond phase of carbon at multi-TPa regime. Recent experimental and theoretical studies suggest that the diamond starts to melt at around 700 GPa on the principal Hugoniot, then complete the melting at around 1 TPa [1-4]. There exists two complex phases in between, that is, ñdiamond and liquid carbonò and ñBC8 carbon and liquid carbonò. Since diamond has very large shear modulus, the sound velocity would significantly decrease due to melting.

2. Experiment

We have measured the sound velocity of the diamond foils at around the melting pressures (500 ï 1500 GPa). Experiments were done on GEKKO-XII glass laser system with HIPER irradiation facility. Schematic view of the experimental setup is shown in Fig. 1. Single crystal diamond foils (Ia) of 20~30 μm thickness were irradiated at intensities of 0.2 ï 1.5 × 10^{14} W/cm^2. We measured the sound velocity by side-on x-ray backlighting technique [5]. Trajectories of foil surfaces were observed by x-ray streak camera. We also measured the shock velocity by two VISARs (velocity interferometer system for any reflector), and shocked temperature by an SSOP (streaked spectral optical pyrometer) [6] in order to determine the pressure and the temperature at around the melting.

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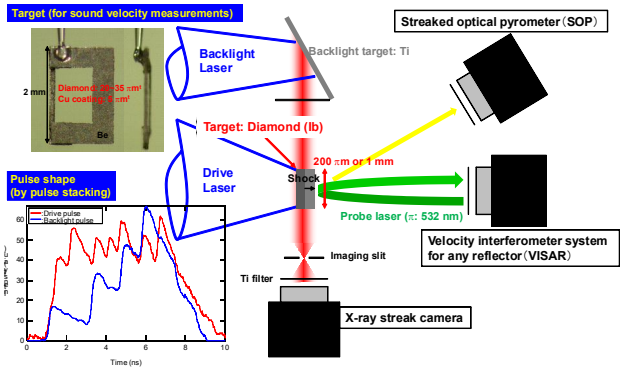

Fig. 1 Schematic view of the experimental setup

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