Measurements of antipodal velocity in impact experiments of porous sintered targets

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Porous structure is common in the asteroids and satellites of the outer planets. In order to study the relationship between the structure of small bodies and their thermal and collisional evolution, we prepared porous targets and performed impact experiments. The results of the experiments will be used as a reference for future numerical simulations of collisional process of porous bodies.

In order to produce porous targets, we sintered soda lime glass beads of 50 micron diameter and 2.5g /cm3 nominal density. As a result, sintered glass beads targets had porosity of 10-40% and various compressive strengths. We performed three series of impact experiments. First impact experiments were carried out in air using a light gas gun at Kobe University. We used targets of roughly the same porosity but different strength (Setoh et al. 2007). The targets were about 50 g in mass and had the shape of a truncated cone with diameters of 40 and 30 mm and height of 40 mm. The projectiles were polycarbonate cylinders of 10 mm in diameter and 15 mm in length. The impact velocity was varied from 10 to 120 m/s. Second impact experiments were carried out in air using another light gas gun at Kobe University. We used targets that have roughly the same porosity with the targets of the first experiments but the shape of targets and projectiles were different. The targets were about 65 g in mass and had the shape of a cylinder with diameters of 48 mm and height of 24 mm. The projectiles were glass spheres with diameter 3.2 mm. The impact velocity was varied from 140 to 200 m/s.

The third experiments were carried out using a two-stage light gas gun at ISAS. We used targets of 9.8˜15.7% porosity. The targets were about 168g in mass and had a shape of sphere with diameters of 53 mm. The projectiles were nylon sphere with diameter 7.0 mm. The impact velocity was varied from 2120 to 3280 m/s.

A comparison between the results of these experimental series and a previous one (Love et al.1993) suggested that high velocity impacts need higher specific energy than low velocity impacts for catastrophic disruption when the targets have same compressive strength.

For the purpose of studying the attenuation of the stress wave in the porous targets in both high and low velocity impacts, we measured the antipodal velocity of the targets using high-speed camera images taken at 2,000 - 5,000 fps. We will present a comparison between the low and the high impact velocities.