OBSERVATION OF PENETRATION "TRACK" FORMATION IN SILICA AEROGEL BY HIGH-SPEED CAMERA.
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Introduction: Silica aerogel is an amorphous SiO_2 solid extremely low densities such as 0.01 g cm^{-3} [1]. It has been utilized as a suitable capture medium for hypervelocity microparticles in various space missions because of its unique properties. Although there have been many studies on penetration tracks and/or captured particles as end products, a few studies deal with *in situ* observation of track formation [2, 3]. A model of penetration process is now shown [3], energy partition issue is not fully solved.

Experimental Method: A two-stage light gas gun at ISAS/JAXA was used for this study. The authors succeeded in capturing a single Al_2O_3 particle by aerogel target and in recording a carrot-shaped penetration "track" formation with a high speed camera, by controlling the aperture (i.e. sabot stopper diameter) and the amount of particles mounted in a projectile called 'sabot', analyzing accumulated data from the past shots. These efforts prevented too many projectiles form hitting and breaking the fragile target. At most a couple of tracks are permissible for the subsequent image analysis. We made an attempt to recording penetration track formation in silica aerogel with a high speed camera, making the best use of its optical transparency.

Experimental Results: More than 20 successful shots out of 35 were obtained. Impact angles are normal for all the shots. For the shots #996 to #1535, 0.03 g cm^{-3} aerogels were used as targets, while for shots #1536 to #1541 two-layered (0.01 & 0.03 g cm^{-3}) aerogels were used.

Shot #1003. Projectile is a single 500 μm-Al_2O_3 sphere and a target is 0.03 g cm^{-3} silica aerogel. Velocity is 4.25 km s^{-1}. A single carrot-shaped track was formed and its formation process was successfully recorded, although the entire track growth was halted by a metal back plate. At first cylindrical, smooth track was produced as the projectile penetrated in the target, and then it started to swell into a carrot, showing that moiré patterns gradually emerged. For silica aerogel with 0.03 g cm^{-3} density, the aerogel surface was dragged inward as a particle penetrated into the aerogel. No spallation at the surface was observed differently from higher density aerogels.

Shot #1532. Projectiles are 400-450 μm-glass beads and a target is 0.03 g cm^{-3} silica aerogel. Velocity is 4.25 km s^{-1}. Although single shot were not attained, two comparable tracks to the one in #1003 were produced in this shot.

Discussions & Conclusions: The authors succeeded in recording a carrot-shaped penetration track formation with a high speed camera. The track was made by a single Al_2O_3 particle (500 μm-sphere) penetrating into a silica aerogel target (0.03 g cm^{-3}).

Concerning a so-called "carrot track", a thin track grew in the direction of penetration at first and then it started to swell into a carrot. No spallation at the surface was observed differently from higher density aerogel. Obvious gas or material outward flow was not observed in this study so far. Concerning energy partition, it can be said that that particles can be captured with less damage compared with higher density capture media as the kinetic energy of the particle is consumed for compaction of the target. With an intensive image analysis, shock wave dissipation in aerogel can be recognized.

Image analysis of the high-speed camera movies gives us some solutions to energy partition evaluation. In this study, a fraction of compaction of aerogel is calculated. Combined with a fraction of captured particles (mainly ablation), a new result is shown.

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