Experimental Study on the Collisional Properties of Gypsum-Glass Beads Mixtures

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Ordinary chondrites (OCs) recovered on the earth could be originated from asteroids produced by high-speed impact among planetesimals and re-accumulation of impact fragments. The OCs have the components of mm-sized chondrules and submicron-sized silicate dusts so called matrix. Thus, it is expected that the planetesimals forming the parent bodies of OCs could be mainly composed of chondrules and matrix. In this study, we conducted impact experiments with porous gypsum-glass beads mixtures having various diameters simulating chondrules and examined the impact strength and the fragment velocities and we discussed the collisional and the re-accumulation conditions of planetesimals forming the parent bodies of OCs after catastrophic disruption.

We prepared the gypsum-glass beads samples with the volume fraction of glass beads of 0 and 60 %, and the glass bead size from was 100 μm, 1 mm, and 3 mm. We used two types of gas gun to examine the effect of impact velocity on the impact strength, a single-stage gas gun for 60 to 180 m/s, and two-stage light-gas gun for 3.3 to 4.1 km/s. The collisional disruption was observed by using a high-speed digital video camera to measure the impact velocity.

We examined the fragment velocities and the impact strength, and studied the effects of glass bead size, volume fraction, and impact velocity on them. Particularly, the edge velocity from two corners on the impact surface of target in the center of mass system, $V_{c\text{-}g}$, which is estimated to be a representative of high-velocity fragment[1], was found to be independent of the glass bead size and volume fraction, and impact velocity. The results of $V_{c\text{-}g}$ were compared to the escape velocity of the parent bodies of OCs to study the re-accumulation condition (Figure). As a result, the fragments of the parent bodies of OCs after the catastrophic disruption could be re-accumulated at the radius of bodies larger than 3 km, irrespective of chondrule size.