Collisional Fragmentation Experiments of Gypsum Spheres at Low Velocities

Yuichi Fujii[1]; Akiko Nakamura[2]

[1] none; [2] Grad. Sch. of Sci. and Tech., Kobe Univ.

Physical processes of planetary formation from dusts to planetesimals are not well understood. Collision, in particular, low velocity collision, is one of the most important processes in the planetary formation. Collisional outcome varies with critical velocity that is defined as the velocity at which a body begins to break-up. A previous laboratory study of ice spheres showed that the critical velocity is size-dependent at low impact velocity condition (Higa et al.1998). Non-porous ice spheres were used in their experiments. However, dust aggregates have high porosity at least at the very beginning of the planetesimal formation. In order to investigate the collisional process of porous bodies, we performed low velocity collision experiments of gypsum spheres.

In our previous experimental study, spheres of diameter 25,30,40,50 and 70mm were impacted against an iron plate. The impact velocity was from 0.4 to 22m/s. As a result, we could classify the outcome into 3 types from their appearance. They are intact, fragmentation, and the intermediate state between them. We found that usual excavation cratering process did not occur in the low velocity collision of gypsum spheres. No clear size dependence was found in these boundary velocities The restitution coefficient gradually decreased with increasing impact velocity with a power-law index of -0.33 +or- 0.07. This is different from the -1/4 relationship found for steel balls (Johnson et al. 1985).

In this study, we prepared the spheres of diameter 5mm in order to change the size of the sphere over one order of magnitude. We replaced the iron plate by a gypsum block. We will report whether or not any size dependence of the boundary velocities appear and the dependence of restitution coefficient on impact velocity changes.