

Drop experiments simulating a collision between chondrules and matrix under microgravity

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It is considered that individual components of chondrites, i.e. chondrules and matrix, were formed at different places in the solar nebula. The physical process of chondrite parent body formation, i.e., when and how chondrules and matrix were mixed and formed the parent bodies, remain highly unclear. It is expected that the studies of the formation condition for a chondrite parent body will give some constraints for the formation process of planetesimals. One possible formation scenario is the capture of chondrules by dust aggregates (matrix). We therefore conducted impact experiments at low velocities. In the impact experiments, two parameters were varied; the porosity of the dust aggregates and the impact velocity.

We performed impact experiments using the 1.5-m drop tube at Braunschweig University, Germany. As projectiles, glass beads of 1 mm or 4.7 mm in diameter were used as the chondrule analogs. These were glued to nylon strings and fixed to a release mechanism attached to the tube. As targets, polydisperse spherical silica particles of 0.8 ± 0.3 micron diameter were used to make aggregates of three different porosities; compacted targets, medium targets and fluffy targets of porosity about 55, 75 and 90 %, respectively. The dust target was set beneath the projectile and was also dropped after the release of the projectile. By adjusting the release height of the projectile and the timings for dropping the projectile and the target, the relative impact velocities between the projectiles and the targets were set to 1-2 m/s and 10-20 cm/s, respectively. A high-speed camera was operated at a frame rate of 1000 frames per second. As a result, in only one out of 12 drops the projectile could intrude into the fluffy target at the lower velocity.

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