EXPERIMENTAL STUDY ON THE CONDITIONS FOR THE FORMATION OF CHONDRITE PARENT BODIES. N. Machii[1], A. M., Nakamura[1], C. Güttler[1,2], D. Beger[2] and J. Blum[2], [1]Graduate School of Science, Kobe University (machii@stu.kobe-u.ac.jp), [2]Institute for Geophysics and Extraterrestrial Physics, TU Braunschweig.

Introduction: Chondrites are composed of spherical objects called chondrules, which are glassy and typically millimeter-sized, and fine grains called matrix [1]. A lot of work on chondrites has been performed like the measurement of isotopic age, chemical composition and so on. Especially for chondrules, it was found that they were molten in a high temperature environment and rapidly cooled down [2]. By contrast, matrix consists of irregular shaped grains and most of these have not experienced high temperatures [3]. Chondrite parent bodies are assigned to some classes of asteroids. The fact that abundant classes of asteroids change with heliocentric distance indicates that the chondrite parent bodies had some radial distribution. Volume fraction of chondrules in chondrites is different for chondrite types. [4]. There are three major models for chondrule formation: x-wind model [5], shock wave model [6] and lightning model [7]. What is common to these models is that chondrules were formed at a local place in protoplanetary disk.

Chondrules formed around 2 to 3 million years after the formation of Calcium Aluminum rich Inclusions [8]. It takes only 10^4 years for dust to grow to typical sizes of tens of centimeters [9]. Therefore, at the stage of the chondrule formation, dust size is expected at least a few centimeters. In this work, we assumed that chondrules and matrix were formed at different places in the protoplanetary disk and subsequently collided each other. We investigated the condition for a chondrule being embedded into matrix.

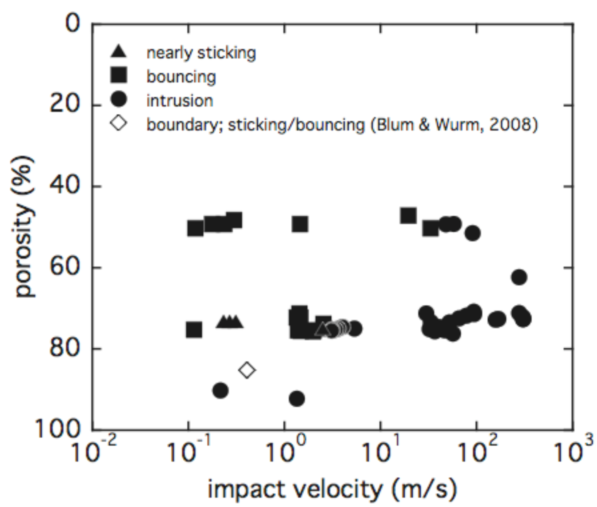
Experiments: We used polydisperse spherical silica particles of 0.8 ± 0.3 μm in diameter and of 2200 kg/m^3 in density as matrix analogs to make agglomerates. The projectiles were mm-sized glass beads representing chondrule analogs. Depending on impact velocities, three different accelerators were used.

In the collision experiments at low velocity (from 0.2 to 2 m/s), glass beads of 1 and 4.7 mm in diameter were used as the projectiles and as targets we used agglomerates with ~ 50, ~75 and > 90 % in porosity. The collisions in vacuum were performed under micro gravity conditions by releasing both, target and projectile, at slightly different timing using a two-level release mechanism [10].

Agglomerates of about 3 cm in diameter, about 7.5 cm in length and ~75 % in porosity were used for the collision experiments at medium velocities (from ~2 to 5 m/s) by using a spring gun. A glass bead of ~ 3 mm in diameter was used as a projectile.

Agglomerates of two porosities, ~ 50 and ~ 75 %, were prepared for the impact experiments at high velocities (from 20 to 300 m/s) using a light-gas gun. The projectiles used in these experiments were glass beads of ~ 3 mm in diameter.

Results: Three different outcomes were observed: intrusion, bouncing and (nearly) sticking. From the measurements of the intrusion depths we can conclude that the drag is proportional to the strength of the target at the low impact velocities where intrusion just started. For higher impact velocities it is found to be proportional to the square of impact velocity. We will discuss the conditions for a chondrule to be embedded into matrix, baced on the impact experiments and the measurements of physical properties of the dust agglomerates.



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