HOW DO ACCRETIONARY RIMS AROUND CHONDRULES INFLUENCE THE FORMATION OF CHONDRITES ?

E. Beitz[1], C. Güttler[1], R. Weidling[1], J. Blum[1], D. C. Hezel[2] and A. Pack[3]. [1]Institut für Geophysik und extraterrestrische Physik, TU Braunschweig, [2]NHM, London and [3]Göttingen University.
E-mail: e.beitz@tu-bs.de.

Up to 80 % of the volume of chondric meteorites consists of chondrules. These mm- sized spherules are high-temperature inclusions and most of these are surrounded by a dusty layer. These rims are hypothesized to have formed by accretion of dust grains in a dense region of the solar nebula [1]. It is likely that these rims would influence collisional interaction between the chondrules [2]. We will present new experiments to study the dynamic behavior of dust-coated chondrule analogues.

To produce chondrule rims we used two experimental methods forming rims with different morphologies and porosities around artificial chondrules. One method uses the aerodynamic levitation of millimetre-sized glass beads (our chondrule analogues) in a gas flow, enriched with µm-sized, monodisperse, spherical SiO_2 dust. Here, the artificial chondrules accrete very even, highly porous rims with a porosity of 82 %. The second method aims at producing dust rims, formed in multiple low-velocity collisions of chondrules with dust aggregates of the same size. Here, dust from the dust aggregates is transferred to the surface of the solid chondrule. This is realized by shaking a glass bead for a defined time in a dust filled container. These collisions also tend to form rims but less even and with a significantly lower porosity of 60 %. To constrain the influence of the different rim structures on the collision behaviour, and thus on the formation of larger bodies in the solar nebula, we set up a multiple collision experiment for studying free particle-particle collisions under microgravity conditions [3].

Results: In November 2010 we performed 4 experiments under microgravity conditions at the Bremen drop tower. Here, we varied the rim porosity (see above) and the particle size (2 and 3 mm glass beads). It turned out that dust coated particles are much more cohesive in collisions compared with non coated particles, and even dust aggregates of the same size are less likely to stick to each other at the same velocities. For the conducted experiments, we found a correlation between the sticking probability, the rim morphology and the chondrule size. Additionally, we observed the formation of clusters of several tens of chondrules as a result of subsequent sticking collisions [4].

Further Steps: Based on the hypothesis that the chondrules could be still very hot when they start accreting their dust rims, sintering effects and changes in the rim morphology should be taken into account. Therefore we improved our aerodynamical levitation experiment by attaching a laser to heat the chondrules while accreting their rims. For these experiments we exchanged the glass beads by artificial chondrules of realistic compositions, and powdered San Carlos olivine was used to simulate the dust of the early solar nebula. We will present the resultant influence of the chondrule composition, the rim material, and the temperature on the morphology and porosity of the rims based on nano-CT and micro-CT analysis of the produced samples.

References: [1] Metzler K. et al. 1992. *Geochimica et Cosmocimica* 56:2873–2897. [2] Ormel C. et al. 2007. *A&A* 679:1588-1610. [3] Weidling R. et al. 2011. *arXiv eprint* 1105.3909. [4] Beitz E.et al. 2011. *arXiv eprint* 1105.3897.