Experimental study on the sticking velocity of rimmed chondrules

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Chondrite parent body is one of the most realistic models of planetesimlas in the solar nebula, and chondrites are well known to be composed of chondrules, which are spherical glass balls with the size of sub-mm. It could be necessary to coagulate these glass balls in order to form the precursor aggregates of planetesimals. Recent theoretical study on the chondrule coagulation shows that the chondrule covered with porous silicate rim can stick together to coagulate at the impact velocity less than 1 m/s. We then conducted the impact experiments of simulated rimmed chondrules at the impact velocity from 10cm/s to 80 m/s to obtain the sticking velocity and the restitution coefficients. We changed the porosity of the rim from 70 % to 90 % and the thickness from 2 mm to 10 mm, while the rim was composed of sub-micron silica dusts, and a glass ball with the size of 10 mm was used as a chondrule analogue. As a result, we found that the upper limit of the sticking velocity, Vc, varied with the thickness of silica layer (rim) and the porosity. Vc changes from 40 cm/s to 70cm/s with the increase of the thickness of the silica layer having the porosity of 90 %. The restitution coefficient monotonically decreases with the velocity beyond 1 m/s for the silica layer with the porosity of 70% and 80 %, and shows the minimum less than 0.1 at the impact velocity of 52 m/s and 9 m/s for each porous layer of 70 % and 80 %, respectively. These results suggest that the porous rim of the chondrule could help the coagulation of the chondrules to form the precursor of planetesimals at the wide range of the impact velocity beyond 10 m/s.