

Collisional experiments between silicate-organics mixtures

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The critical step in the planetary formation is coagulation of dust grains in protoplanetary nebula. Greenberg (1998) estimated composition of dust grains and showed that mass ratio between silicates : organics is roughly unity. Therefore, it is suggested that the organics play an important role in the coagulation of dust grains. Kouchi et al. (2002) demonstrated that the interstellar organics are very sticky in the relevant temperature conditions. In this study, I performed a collision experiment using a mixture of silicates and simulated organics.

Four silicon oils having different viscosities (1, 10, 100, 1000 poise, density=1 g/cc) are mixed with glass beads (average diameter=100 micron, density=2.5 g/cc) with various volume ratio (glass beads volume/silicon oil volume). Spheres of 1.5 cm diameter are prepared using the mixture. A sphere is dropped to a layer of the mixture in the atmospheric condition. The collision velocity is 2.4m/s. Experiments with two collision angles are conducted. Coefficient of restitution is measured in 0 degree collisions, and stickiness is measured in 30 degree collisions.

In 0 degree experiments, it was revealed that the coefficient of restitution is almost zero.

In 30 degree experiments, 10 runs are performed for each combination of viscosity and volume ratio. The sticking probability is defined as the ratio of the cases in which the sphere stops around the impact site. The following two points are shown; 1) the sticking probability increases below the volume ratio of 1.8, 2) The volume ratio at which the sticking probability reaches unity decreases as viscosity of silicon oil.

From the results of the experiments, it is suggested that, in a protoplanetary nebula, there is a region where the sticking of dust aggregate is promoted by the organics.