# Formation Process of Compound Chondrules: Collision-Induced Crystallization of Supercooled Droplets

*Sota ARAKAWA[1], Taishi NAKAMOTO[1]

1.Tokyo institute of technology

Some chondrules are composed of two (or more) chondrules fused together. They are called compound chondrules. Compound chondrules have several remarkable features. In this study, we focus on three features; (1) textural types, (2) the size ratio between two components, and (3) the fraction of compound chondrules. In previous studies, these three features are remained to explain.
Textural types of chondrules originate from their thermal histories. Non-porphyritic chondrules (e.g., barred olivine, radial pyroxene, and cryptocrystalline) are formed from completely molten precursors, while porphyritic chondrules are formed from partially molten precursors. As for single chondrules, the majority is porphyritic type (84%) and non-porphyritic ones are rare (16%). In contrast, more than 80% of all the compound chondrules have non-porphyritic textures. This significant feature suggests that compound chondrules are crystallized from completely molten precursors.
Experimental studies revealed that floating completely molten precursors turn into supercooled droplets without crystallization, and non-porphyritic chondrules are produced by crystallization of supercooled droplets triggered by contact with something. In addition, theoretical studies suggest that the duration of supercooling can be long.
Here, we propose a new model for the compound chondrule formation: compound chondrules are formed by collision-induced crystallization of supercooled droplets. This model is based on the feature (1) and experimental facts. Additionally, we can obtain the feature (2) that larger ones of compound chondrules keep round shapes while smaller ones are deformed. This feature is explained by the reason that larger ones are likely to be collided more than smaller ones.
We also estimate the product of the number density of precursors $n$ and the duration of supercooling $t$ for reproducing the fraction of compound chondrules. Then the product of the number density and the duration is $n\ t = 0.1\ \mathrm{cm}^{-3}$ s. Thanks to the supercooling, we can explain the fraction of compound chondrules with large $t$ and low $n$.

Keywords: compound chondrule, supercooling, crystallization, collision

 