# Chondrule Recipes from the Kitchen of the Early Solar System

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Chondrules are millimeter-sized objects found in chondrites and the early solar nebula is the preferred location for their formation. They are spheroidal and show evidence for formation as fully or partially molten droplets. Others, such as amoeboid olivine aggregates and irregular-shaped olivine-rich aggregates, have highly irregular shapes and are considered to be aggregates of material that experienced no or very low degrees of melting.

In this presentation, we will report the results of analogue fluid experiment on the formation process of the chondrules and discuss how the difference in shape between spheroidal chondrules and irregular-shaped aggregates is produced, although both aggregates consist of similar grains such as mineral phenocrysts and small fragments. Here, we will focus on the effect of interstitial melt between the grains on the shape of the aggregates.

We have conducted simple experiment in the range of room temperature by using thermo-gel powder and water as the analogue of constituent grains and melt in the chondrule in order to control the amount of the interstitial melt (water) between the grains (gels). The thermo-gel is temperature sensitive gel that absorbs water when the temperature is low and releases the water from the gel if the temperature is increased above the transition point temperature (~30 degree C).

We put the aggregates of the swelling thermo-gel on the surface of the fluorinarte fluid and heated them by the heating plate. The thermo-gel aggregates did not change their shape in the case of the lower temperature, although the molecular (water) diffusion was observed within the aggregates. As the temperature was raised above the transition point temperature, the irregular-shaped thermo-gel released the water and deformed their shape, and finally the aggregates show the spheroidal shape. A plausible explanation of this deformation process is that the released water from the gel grains decreases the average viscosity of the aggregates, and it causes the mobility of the gel grains within the aggregates and the formation of the spheroidal aggregates by the surface tension of the water.