Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

PPS002-11 Room: 301A Time: May 27 09:51-10:06

A Chondrule Formation Theory with Shock-Wave Heating Mechanism

Taishi Nakamoto[1*], Hitoshi Miura[2], Seiji Yasuda[3], Masao Doi[1], Shizuka Nakajima[1]

[1]Tokyo Institute of Technology, [2]Tohoku University, [3]NEC Aerospace Systems

Chondrules are mm-sized spherical silicate objects in chondrite meteorites. They are abundant in primitive chondrites, so chondrules are thought to be formed ubiquitously in the early solar nebula. Thus, to reveal the formation process of the chondrule should be one of the keys to understand the formation process of the Solar System.
Chondrules are spherical and there are some evidences that they experienced melting. So it is considered that chondrules were heated and melted once, and due to the surface tension, they became spherical. On the other hand, it is hard to imagine a phenomenon that heats the silicate particles to melt in the cool solar nebula. The heating mechanism for the chondrule formation remains an unsolved problem.
We have investigated the shock-wave heating chondrule formation model. When a shock wave is generated in the gaseous solar nebula, dust particles in the nebula, which are precursors for chondrules, are heated due to the gas friction. If the frictional heating is strong enough, the silicate dust particle can be heated and melted. This is the shock wave heating mechanism.
Generally, to validate a theory, we should compare model results with observations/ measurements. We have examined our model results with observations and measurements, and found that some features of chondrules can be naturally explained by the theory. The features include the melting of silicate dust particles, the temperature variation in the temperature rising phase, the temperature variation in the temperature decreasing phase, the maximum size of chondrules, the minimum size of chondrules, and the 3-D shape and the degree of deformation.
Recently, we have investigated following topics: (1) Formation of compound chondrules, (2) formation of small silicate crystals in matrix, (3) generation of bow shocks by fast moving planetesimals and chondrule formation, and (4) origin of cosmic spherules and the relation of cosmic spherule to chondrule formation. We would like to discuss these results in view of the chondrule formation by shock wave heating.