Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PPS24-P17 Room:Convention Hall Time:May 23 18:15-19:30

Nondestructive identification of a single primitive-grain using the translational motion induced by field gradient

Keiji Hisayoshi[1*], Keisei Sawano[1], Kento Kuwada[1], Chiaki Uyeda[1]

[1]Institute of Earth and Space Science, Graduate School of Science, Osaka University

Primitive chondrites are aggregates of small particles composed of different materials, and their origins are considered to be heterogeneous. It is desirable to identify the materials of individual grain before performing refined micro-prove analysis on isotopic, chemical or optical properties. The above method of identification should be non-destructive and easily performed. Moreover the method should be based on an established principle. We previously reported that a translation caused by field gradient force is induced on diamagnetic solid in common, in a condition that effect of gravity and viscous drag are negligible. A material possesses intrinsic diamagnetic susceptibility per unit mass. Therefore it is possible to identify the material of the translating particle by comparing the observed susceptibility with a list of published values. According to a Newton's equation of motional equation considered for a field gradient force, acceleration of particle was expected to be independent to mass of the particle; it is uniquely determined by the intrinsic susceptibility of material in a given field distribution. Accordingly, detection of susceptibility is possible for limitlessly small samples, and so as material identification.

It is noted that most of the particles that compose the chondrites are paramagnetic or ferro- (ferri-)magnetic materials; their size range from mm to sub-micron in diameter. In the present study field-induced ejections were newly observed for particles of diamagnetic, paramagnetic and ferri-magnetic materials; namely graphite, diamond, pyroxene and magnetite. Sample size was reduced to a level below 100 microns for the diamagnetic samples.

The field-induced motion is observable by the chamber-type drop box; the system was realized by introducing small Nd-Fe-B plates as a field generator. Using the above-mentioned box, material identification of a single grain that composes primitive materials becomes possible by a routine process that can be performed in an ordinary laboratory. The setup for observing the magnetic motion was attached inside a rectangular volume of 35x30x20 cm of a drop box. The setup was enclosed in a vacuum chamber; the sample motion was observable from the outside of the Pyrex wall of the chamber, using a high-vision video camera that had time resolutions of 0.033 s. Its spatial resolution was 0.004 cm. The pressure of the medium inside the camber was P ? 100 Pa. Duration of microgravity inside the box was about 0.5 s, with residual gravity of 0.01G. .

Compared to the conventional methods to measure magnetic susceptibility in terrestrial gravity, the proposed principle based on the magnetic translation is free of a back ground signal of a sample holder; it is does not require a mass measurement of the sample. Hence susceptibility is obtainable for samples with a limitlessly small size, provided that translation of sample is detected. The lower limit of sample size may reach several microns by introducing an optical microscope in the compact drop box.

Keywords: magnetic ejection, nondestructive identification, microgravity, translational motion, magnetization measurement, body force