Measurement of diamagnetic susceptibility and magnetic separation and material identification of organic matter using small permanent magnet

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Generally, solid particles released in the microgravity space perform translational motion by magnetic potential. The velocity of the particle does not depend on the mass of the particle but depends only on the magnetic susceptibility specific to the materials. Therefore, by comparing the magnetic susceptibility obtained with the literature value, it is possible to identify the material of a single particle [1] [2] [3]. In previous studies, we have confirmed that it is possible to identify diamagnetic materials of inorganic matter of mm ˜ sub - mm size. Furthermore, we could observe translational motion in volatile solids ice (H_20) and dry ice (CO_2), and obtained diamagnetic susceptibility. In this study, we measured the diamagnetic susceptibility of various organic materials by using the same principle, and considered the possibility of organic matter separation and identification by magnetic field gradient.
Microgravity was generated using a short drop shaft. The length of the shaft is 1.8 m. The effective microgravity duration is about 0.5 seconds. The drop box for observing the translation was set in a box of 30 ×30 ×20 cm. The drop box consists of a small NdFeB magnetic circuit (B ˜ 0.8 T) in glass tube, lighting, battery and high speed camera. The sample was set to the position where the gradient force was the maximum, and then released into the microgravity space. The diamagnetic organic sample translated out of the magnetic field. Magnetic susceptibility was determined from the motion of the sample.
By using a camera used for astronomical observation as a high-speed high-speed camera for this research, the accuracy of the position of the specimen has greatly improved[4].
This new practical possibility of a method of identifying and identifying solid organic matter and separating it by translating the mixture at different speed for each material was newly shown. Under the conventional measurement conditions, the difference in magnetic susceptibility could only be identified at the level of 10-7 emu/g. However, in this setting, we could identify the difference of 10-8 emu/g. We consider that this method is useful as an analytical method in two respects that it can be performed nondestructively by using a simple apparatus and that it can separate a mixture with an organic solid different from other chromatography methods. It is time-constrained in the microgravity environment on the ground. However, this method can measure with high accuracy and low budget within its constraints. Therefore, this method may be applied to any field regardless of some academic research / company research which is required to capture other short-term phenomena at high speed.
In this method, the magnetic susceptibility can be obtained with microgravity and magnetic field gradient. Therefore, there is a possibility of contributing to space exploration from the viewpoint that analysis can be done on the spot without having to bring out materials. When installing the equipment used for analysis on the ground to the planetary explorer, restrictions on size and weight and constraints on performance become major issues. However, this apparatus can translate the specimen over a long period of time with a weak magnetic field gradient in the astronomical space, which is a microgravity environment or only small gravity. Therefore, since the apparatus can be made small and lightweight, it is a great advantage in loading in a probing machine. In ESA's Rosetta mission, organic matter is actually detected in the comet, and the method for detailed analysis of organic matter on the spot can be a big demand in space exploration.

References
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