Non-destructive material identification of volatile particles using translational motions induced by magnetic field gradient

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Recently, we developed a new method of magnetization measurement method, in which translation induced by the magnetic field gradient was used, and proposed a material identification based on this method. Due to the field-induced energy, the solid particles which were released in a diffused area (in a condition that effect of gravity and viscous drag are negligible), causes translational motion by a practical field intensity of the permanent magnet. Because this motion derives from a magnetic volume force, the motion of the particle is independent to the mass. The material possesses the intrinsic susceptibility per unit mass. Therefore, the material of individual particles can be estimated by comparing the measured susceptibility with a list of published values. In the present study, we apply the above method to identify volatile solid grains of H_2O and CO_2.
The translational motion is observed by the chamber-type drop box. The system was realized by introducing small Nd-Fe-B plates. The setup for observing the motion was attached inside a rectangular volume of 35×30×20 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-speed video camera that had time resolutions of 0.033 s. The pressure of the medium inside the camber was P =100 Pa. Duration of μG was about 0.5sec with residual gravity of 0.01G.
Previously, identification of particles using magnetic field was limited on materials with spontaneous magnetization. However, it's possible to expand the method to general solid particles. Provided that the motion of particle is observable, it's possible to measure the susceptibility of the sample no matter how small the particle may be. In the field of the organic chemistry and the biochemistry, the method to separate a mixture of organic molecules has been established by introducing the technique of chromatography. The proposed principle of material identification can be applied in an apparatus developed for a mission to examine the surface of the icy satellites.
Reference
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