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Extraction and Identification of Primitive Grains Driven by Magnetic Volume Force.

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Magnetic volume force caused by a field gradient has been commonly used to extract ferro-(or ferri-) magnetic materials from weak magnetic materials. The separation was realized because the field-gradient forces that operated on the spontaneous magnetizations of the above category of materials were considerably large with respect to terrestrial gravity. It was considered that dynamic motion of a weak magnetic material generally require a strong field above B = 10T .

Primitive materials are generally obtained as an ensemble of grains with different elemental composition with heterogeneous origins. At an initial stage of investigating this type of material, it is important to extract and identify the material of individual particles included in the ensemble. Such method should be non-destructive and easily performed. Moreover, it should be based on a well-established physical or chemical concept. In the case of analyzing a fluid sample of organic molecules, the stage separation and identification has been established by introducing the technique of chromatography; such method has not been established as yet on mixture of solid samples. Here we propose a new principle of grain separation that is driven by magnetic volume force. By comparing the measured χ_{DIA} of a particle by their published values, material of the particle is identified. This is because an intrinsic χ_{DIA} value is assigned to a material.

Microgravity was generated using a compact drop shaft system, which can be introduced in an ordinary laboratory. The length of the shaft was 1.8m, and the duration of microgravity time was about 0.5 second. The sample is released in the field-gradient produced by a by a magnetic circuit composed by a NdFeB permanent magnet. Maximum field intensity of the circuit was 0.8 T. The experimental apparatus was set inside a rectangle box which had a size of 30x30x20cm. The vacuum chamber equipped with an electric actuator, sample releasing signal reception device, the sample holder controller, the magnet, the battery, and the high-vision video camera are installed in the above box. [1-3]

The present results achieved on sub-millimetre-sized diamagnetic grain have a large significance as a step to realize the extraction and identification of micron-sized grains that compose the primitive materials. The technique described is useful in the search for new types of pre-solar grains that are not identified as yet.

Reference

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