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Magnetic anisotropy of amorphous silicate

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Depth profile of paramagnetic anisotropy was experimentally obtained for the first time on an amorphous sample, namely tektite, with a spatial resolution of 0.5mm. In order to realize the above measurement, quadrangular prism was cut from the amorphous sample with its long axis normal to surface plane, then paramagnetic anisotropy of square plate (2mmx2mmx0.5mm), separated from the above prism, were measured one by one. In order to detect anisotropy of the small square plates, field-induced rotational oscillation of the plates were measured; the plates were released in a micro-gravity area. According to the observed results, the magnetic unstable-axis of the plates was all normal to surface plane, and the magnitude of anisotropy was comparable to the values previously obtained for popular rock forming minerals. Possibility of magnetic alignment by anisotropy has not been considered as yet for an amorphous material, because an amorphous material is generally believed to be isotropic. An anisotropic crystal field assigned to a isolated Fe ion in the material was detected on the above sample plates by ESR measurement, which indicated that anisotropy obtained by micro gravity experiment may derive from a single magnetic ion. According to recent astronomical survey, dust particles in the planet formation area are mainly composed of crystalline silicate and amorphous silica. Hence a model to explain the cause of magnetic dust alignment, commonly observed to estimate the cosmic field direction, may be constructed based on the field-induced anisotropy energy that originates from anisotropy assigned to the dust materials.

Keywords: magnetic alignment, dust alignment, micro gravity, rotational oscillation, paramangetic anisotropy, amorphous silica