

The effect of coexisting iron sulfide on space weathering by nanosecond pulse laser irradiation

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High-velocity impacts of micrometeorites and solar-wind particles change the surface optical properties of airless silicate bodies such as asteroids and the Moon. This process is called "space weathering". Experiments using nanosecond pulse laser confirmed the prediction that the formation of nanometer-size metallic iron particles should cause darkening, reddening and attenuation of absorption bands in visible and near infrared reflectance. The space weathering may explain the spectral mismatch between S-type asteroids and ordinary chondrites.

Previously sulfur depletion from asteroid surface was advocated on the basis of low sulfur abundance on Eros.

Recently on the surface of dust particles from Itokawa's surface returned by Hayabusa, a thin layer containing nano particles of FeS over amorphous zone containing nano iron particles. A 10 micron size FeS crystal is also found in one Itokawa-derived grain.

To examine the effect of FeS on the space weathering, we conducted simulation experiments of the space weathering of silicate-FeS mixture using nanosecond pulse laser irradiation.

Then S is rich in volatility, so we guessed if sulfur has a certain influence on space weathering at the astronomical surface, and the experiments on chondrites with S by using nanosecond pulse laser.

We prepared pellet samples of powdered olivine and pyroxene (45-75 micrometer) mixed with iron sulfide particles (of 10, 20wt%) with same (and smaller) size range. We also prepared olivine pellet samples containing metallic iron particles of 10 to 20 wt%.

We found that the addition of Fe should enhance reddening and also darken near infrared reflectance (about 20% in the case of 10-20wt % FeS), as compared with the case of the addition of Fe.

Although it was space weathering which has so far attracted attention from reddening, such as reddening by weathering in case Fe is contained, in the case where FeS is added, darkening was also seen and it has checked that space weathering became strong. Although existence of nano iron particulates can be considered about reddening, about overall darkening, it is under examination.

The samples were irradiated by nano-second pulse laser.

Keywords: space weathering, iron sulfide, experiments using pulse laser, asteroids, Itokawa

