The effect of sulfur on space weathering

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Space weathering alters surface optical properties on airless rocky bodies; the spectral darkening, reddening, and weakening of absorption bands are shown as for the optical changes. The cause of these changes is nanophase iron particles (np) generated by irradiation of solar wind or bombardment of micrometeorites. Although space weathering is also observed on the surface of Mercury, Messenger showed that there was a little iron, which was the main driver of space weathering, while there was more sulfur in weight abundance. Not only np but also sulfur or its compounds would contribute to space weathering. Okazaki et al. (2016) showed that addition iron sulfide to olivine samples had the effect of promoting space weathering. Moreover, SEM observation suggests that there is sulfur deposition on an olivine particle and which causes Mercury-like space weathering. In this study, we irradiated laser to the sample containing pure sulfur in order to simulate and examine the effect of sulfur on space weathering. First, we performed experiments of pulse laser irradiation to olivine and S mixture samples in a vacuum chamber. The samples were made with olivine and 10 weight % of S mixture (both particle size 45-75 m), and they were irradiated at 5 mJ. Moreover, we carried out additional thermal fatigue experiments to some of laser irradiated sample. After laser irradiation and/or thermal fatigue experiments, reflectance spectra (wavelength range 250-2500 nm) of these samples were measured by a spectrometer in order to examine alteration in optical properties.
The result of laser irradiation experiments showed that the spectra of samples including S reddened more than those without S. The result of thermal fatigue experiments showed that the spectra of samples including S changed complexly going with vaporization loss of S. It is confirmed that sulfur influence changes of optical properties in space weathering.

