

The relationship between roughness of the surface of glass beads and their spectral features

Nao Tsuboi[1], Katsunori Iiyama[2], Kazuto Saiki[3]

[1] Engineering and Resource Sci., Akita Univ, [2] Engineering and Resource Sci., Akita Univ., [3] Research Inst. Materials and Resources, Akita Univ.

It is generally supposed that the spectral feature of powdered mineral are clearer than that of massive mineral.

This study investigates the relationship between roughness of the surface of particles and their spectral features using glass beads. The beads are transparent. Three sets of beads, 0.8, 0.4, and 0.1 mm in diameter were prepared. An instrument for roughening uniformly the surface of glass beads was made. A cylinder goes round on its motor wheels. A sandpaper is put on the interior wall of the cylinder. The beads and glass balls for a weight (2: 250 mm, 2: 150 mm) are set in the cylinder. The instrument looks like an overturned two-wheel-drive vehicle. The degree of roughness of glass-beads surface can be reproduced by the regulation of rotation frequency and roughness of sandpaper. Nanometer-scale roughness on the surface of glass beads were measured by Atomic Force Microscope (AFM), Nanopics1000, Seiko Instruments Inc.. The detection limit of Z-axis is 0.5 nm. #240 sandpaper and 180 rpm rotation frequency were selected to obtain ca. 400 nm roughness on the beads, 0.8 mm in diameter.

A mixture of 0.8 mm beads with smooth surface (S08) and 0.4 mm beads with smooth surface (S04) in equal volumes (M08-04), a mixture of 0.8 mm beads with smooth surface (S08) and 0.1 mm beads with smooth surface (S01) in equal volumes (M08-01), and 0.8 mm beads with rough surface ca. 400 nm (R08) were prepared and were measured their spectra. Spectra of original beads were also measured by Spectral Radiometer, MSR-7000, Opto Research Corp. and compared with reproduced beads stated above in a wavelength region of 350 nm to 1100 nm. The incidence angle was fix to 30 degrees and the observation angle were set to 0 degrees and 30 degrees.

The results are as follows: 1) The smaller beads have the higher reflectance, regardless of the measurement conditions. 2) The reflectance of M08-01 is higher than that of M08-04. The reflectance of original beads (S08) is higher than that of mixed samples (M08-04 and M08-01). 3) The reflectance of R08 is lower than that of S08.

Since the glass beads surface looks frosted glass by roughening, the reflectance of rough surface had been expected to be higher than that of original beads. However, the result contrary to the expectation is given (result 3)). If roughness of larger than the wavelength of visible light (e.g. a few μm) can be made on the surface, the result will possibly change. There are still many immature points left in the techniques of increasing roughness of the surface.

It is generally supposed that mineral powders with the same size have the same spectral features. In fact, the effect of nanometer-scale roughness should not be neglected. This study is the first step for the investigation of the influence of nanometer-scale roughness of weathered surface (by micrometeorite etc.) of lunar regolith on the reflectance spectra of lunar surface.