# Laboratory study for near infrared multi-phase angle light scattering by simulated C-type asteroids surface

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Albedo and reflectance phase curve are important quantities for investigating the surface of asteroids, but they are affected by the surface conditions such as the surface structure and the size of regolith particles.

Laboratory measurements of the scattered light from simulated surface are useful to estimate for the structure and condition of asteroids surface by comparing with the space probes' data, but the laboratory have not covered wide range of parameter space.

For example, carbonaceous chondrite meteorites are thought to have their origin in C-type asteroids. Although the geometric albedo of C-type asteroid 253 Mathilde is 0.047 at 700nm, bi-directional reflectance in the laboratory of Allende powder's surface was 3 times brighter than Mathilde (Kamei and Nakamura 2002). The measurements were performed for Allende particles at 632.8mn, and the results can be different if the types of meteorites or surface condition are changed.

In this study we measured the scattered light from the surface made of carbonaceous chondrite meteorites using Allende(CV3) and Murchison(CM2).We made three particle sizes and three degrees of surface compaction for each, and measured the scattered light over 0-30 degree in phase angle. Particle sizes were below 45micrometer, 45-75micrometer and 180-500micrometer. Surface preparation was as follows. First was the 'fluffy' surface which was made by sieving the powders over a sample tray. Second, was the 'knocked' surface which had intermediate porosity and roughness. It was made from the 'fluffy' one by the tray being vertically knocked against a horizontal plane. Third, the 'compacted' surface was made by the surface being compacted tightly so it had the smoothest surface. We used a multi-phase angle near infrared spectrometer at Kobe University. We fixed the incident angle at 0 degree, and the phase curves were measured with 0.25 degree interval. Light source was a YAG laser (wavelength 1064nm), and results were relative reflectance to Spectralon surface.

The opposition surge width of Allende and Murchison were larger than those found for ordinary chondrites, where opposition surge is a nonlinear increase in the intensity of scatterd light, and it occurs as the phase angle decreases to 0 degree. The large width of the surge indicated that shadow hiding mechanism dominates in the opposition surge of those low reflectance, carbonaceous chondrite surfaces. The surfaces consisted of the meteorite particles are much brighter than Mathilde, although we changed particle size and degree of surface compaction. The phase curves of carbonaceous chondrite are smaller than that of Mathilde calculated from Hapke's parameters.