Measurements of Bidirectional Reflectance of Ordinary Chondrites and Comparison with S and Q Type Asteroids

Natsumi Tomita[1], Akiko Nakamura[2]

[1] Science and Thecnology, Kobe Univ, [2] Grad. Sch. of Sci. and Tech., Kobe Univ.

Recently, spacecraft observations have brought us more detailed photometric data, that is, disk-resolved bidirectional reflectance data, of S-type asteroids (Gaspra, Ida, and Eros). The NEAR-Shoemaker found the surface composition of Eros is similar to that of ordinary chondrite meteorites [1]. Although we have got and will get more detailed photometric data of S-type asteroids, there are few bidirectional reflectance data of ordinary chondrite meteorites to compare with these detailed data.

In our previous work, bidirectional reflectance of rough surface of an ordinary chondrite (OC) sample, Tuxtuac meteorite (LL5), was measured by changing both incident (i) and emergent (e) angles. We found that the results were in agreement with previous laboratory results on other OCs (Gao (H5)[2] and Bruderheim (L6)[3] meteorites) within error bars. We further measured the reflectance of a darker meteorite, NWA539 (LL3.5), which belongs to a different petrologic type from those of the previous samples. Four types of surfaces, bulk and powders (5-20um, 45-75um, and 180-500um) for each of the meteorites were prepared. Hapke parameters were preliminary determined to fit the experimental data taken at i = 0deg. and the disk-integrated reflectance for a spherical body was calculated from the parameters. Through this process, we derived geometric albedo and phase coefficient [4] of a body covered with each of the samples. The values of geometric albedo of these two meteorites, 0.19-0.37 for Tuxtuac and 0.17-0.24 for NWA539 (less evolved) , are similar to those of S-type asteroids.

For the purpose of comparing the ordinary chondrites and S and Q-type asteroids, a geometric albedo-phase coefficient plot was made. In this plot there is a strong correlation among observed main-belt asteroids including S-types. However the data of Q-type asteroids and ordinary chondrite meteorites are plotted below the empirical relation. This indicates the ordinary chondrite meteorites may have similar photometric property to the Q-type asteroids.

For the measurements of bulk samples, we can see smaller mirror effect and larger opposition effect according to larger mean slope angles of sample surface [5].

We discuss on more detailed comparison with asteroids based on newly derived parameters by adding the data with i = 75deg. to the fitting and the effect of surface roughness.

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