Surface scattering property of asteroid Itokawa from NIRS observations of HAYABUSA mission

K. Kitazato (1,2), B.E. Clark (3), M. Abe (2), S. Abe (4), Y. Takagi (5) and T. Hiroi (6)

(1) Department of Earth and Planetary Science, The University of Tokyo, (2) Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, (3) Physics Department, Ithaca College, (4) Department of Earth and Planetary Science, Kobe University, (5) Toho Gakuen University, (6) Brown University

We present the results of near-infrared photometry of asteroid 25143 Itokawa obtained by the near-infrared spectrometer (NIRS) on-board the Hayabusa spacecraft. The main components detectable in near-infrared spectra of S-type asteroids are the minerals olivine and pyroxene, which exhibit absorption features in reflectance spectra centered near 1 and 2 microns. From previous work, it is known that S-type asteroid spectra exhibit variations in brightness and color due not only to compositional differences but also due to viewing geometry changes. A photometric correction is needed for the purposes of comparing spectra obtained at highly variable viewing geometries.

During the rendezvous phase from 12 September 2005, until 24 November 2005, NIRS observations were conducted from the Home Position (HP) where the altitude of the spacecraft from the asteroid was about 7 km. NIRS obtained the disk-resolved spectra at phase angles ranging from 0.1 to 38.4 degrees. Spectra were obtained with 64 channels covering the wavelength range 0.76 to 2.25 microns. The field-of-view of NIRS is 0.1 x 0.1degrees and typical spatial resolutions at HP are about 12 x 12 m.

We found that each of the phase curves at different wavelengths show a strong opposition effect (a non-linear increase in brightness with decreasing phase angle near 0 degree). By estimating the Hapke parameter at each wavelength, this phenomena could be corrected with wavelength or albedo. According to theory, a strong wavelength dependence in opposition surge is consistent with coherent backscattering phenomena near opposition. This suggests that Itokawa's opposition effect may not be entirely due to shadow-hiding. During fitting, we found that the amplitude of the opposition surge did not exceed 1.0. Since Eros' photometric behavior could not be fit with values less than 1.0, this indicates that the surge is stronger at Eros than it is at Itokawa.

Relative to the reflectance behavior at a wavelength at the bottom of the 1-micron absorption band and that at a continuum point, the spectra of Itokawa's surface exhibit "phase reddening". The observed phase reddening (approximately 8% higher reflectance at longer wavelengths at 40 degrees phase angle than at 0 degrees phase angle) is consistent with that detected by NEAR at asteroid 433 Eros.