Thermal radiometry to estimate physical properties of asteroid Itokawa during the touchdown with the temperature profile of XRS

Tatsutoshi Inoue[1]; Yukio Yamamoto[2]; # Tatsuaki Okada[2]; Manabu Kato[2]

[1] Earth and Planetary Sci.,Tokyo Univ; [2] ISAS/JAXA

Thermal radiometry using the temperature profile of the XRS instrument onboard Hayabusa was conducted to estimate the physical properties of the surface of asteroid 25143 Itokawa. The surface temperature of planets depends on the surface physical properties and sunshine conditions. For the flat surface, temperature change in a day becomes larger for the surface with low thermal inertia, especially for the case of the powdery regolithed surface, while the change becomes much smaller for the surface with high thermal intertia, especially for the case covered with boulders. This study evaluate the surface temperature derived from radiometry and constrain the physical properties of the surface of Itokawa.

We made the thermal model of Itokawa, based on the polygon shape model of Aizu (developed by Aizu University) and calculate temperature profiles of individual nodes during all the time of touchdown 1 on 19 Nov., 2005. The trajectory of the spacecraft is not yet confirmed but we attempted it by using the data of altitude by LIDAR measurement and position by optical navigation imager. The thermal model of the XRS has been well calibrated and we assumed that the thermal property did not change in space. Then we estimated the temperature profile of the XRS during the touchdown descent to the surface of Itokawa by calculating thermal transform from all the nodes on the asteroid thermal model to the XRS radiator along with the emission from the radiator. And the results are compared with the observed thermal profile.

We found the most suitable thermal inertia of the asteroid are 435 to 1350 [J m^2 $s^{0.5}$ K^{-1}] for the relatively high altitude when the global surface properties are effective, while 300 to 600 just before the touchdown when the local surface properties are effective. This implies that the relatively low thermal inertia at the touchdown site, the MUSES-C area, has full of a small pebbles, not covered with powdery regolith nor large boulders. This is consistent with the interpretation from the most close-up images taken with telescopic imager whose resolution is 6mm/pixel at best. This value is small compared with the ground infrared observation (750 or higher), which might be the global average of the Itokawa thermal properties.