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Results of the development for NIRS3: the Near Infrared Spectrometer on Hayabusa-2

IWATA, Takahiro[1*] ; KITAZATO, Kohei[2] ; ABE, Masanao[1] ; ARAI, Takehiko[1] ; NAKAUCHI, Yusuke[3] ; NAKAMURA, Tomoki[4] ; HIROI, Takahiro[5] ; OSAWA, Takahito[6] ; MATSUOKA, Moe[4] ; MATSUURA, Shuji[1]

[1]Institute of Space and Astronautical Science, JAXA, [2]University of Aizu, [3]Graduate University for Advanced Studies, [4]Tohoku University, [5]Brown University, [6]JAEA

NIRS3: the Near Infrared Spectrometer is one of the candidate scientific instruments which will be equipped on Hayabusa-2 mission. It aims to observe near infrared spectroscopy at the wave length band of 1.8-3.2 micrometer to detect specific molecular absorption lines, including the absorption by hydrated minerals at 3 micrometer, on the target C-type asteroid. We implemented ground performance tests using the flight mode of the Spectrometric Unit (NIRS3-S) and the Analogue Electric Unit (NIRS3-AE). Infrared rays from the black body source are reflected by the sample and two gold mirrors in a vacuum desiccator, and then injected into NIRS3-S which is refrigerated at -60 to -90^{o}C in a vacuum cryostat. The black body source emission is directly injected into NIRS3-S during amplitude-calibration tests. Lights from a halogen lamp are injected into NIRS3-S through a monochromator during frequency-calibration tests. NIRS3-AE controls the inner calibration lamps, the chopper, and data acquisition by the sensor in NIRS3-S.

Results of flight-model tests implied that the dark current at the InAs sensor is much lower than that of the engineering model, which improves the signals-to-noise ratio (SNR). The projected on-board SNR was confirmed to be sufficient during the one-year observation period of Asteroid 1999JU3 assuming the surface temperature estimated from the heliocentric range and solar phase angle. The SNR exceeds 300 after 2.5 ms integration and 1024-stacking at the home position observations. It exceeds 60 after 1 ms integration and 64-stacking for the observations of artificial crater made by the Small Carry-on Impactor (SCI) on Hayabusa-2. The data obtained after the vibration tests and thermal-vacuum tests indicate that NIRS3 is sufficiently durable for the launching and on-orbit environments. The observed spectra for samples of serpentine, olivine, and CM-chondrites such as Murchison, Murray, and Jbilet Winselwan demonstrated that the derived reflectances are almost the same as those obtained by Fourier-transform infrared (FTIR) spectroscopy. These results show that NIRS3 has sufficient performance for scientific objectives. We will also report the first results on Hayabusa-2 after the launch.

Keywords: Hayabusa-2, asteroid, 1999JU3, NIRS3, near infrared, spectrometer