Infrared spectra of asteroid 162173 Ryugu obtained by Near-infrared Spectrometer (NIRS3)

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The asteroid explorer Hayabusa2 was launched in December 2014, and arrived at the target asteroid 162173 Ryugu in June 2018. Near-infrared Spectrometer (NIRS3) onboard Hayabusa2 successfully obtained infrared spectra of Ryugu globally at ~20 km and ~5–7 km above Ryugu surface. The spectroscopic observations of Ryugu are important for estimating the compositional and physical properties of surface material, selecting the landing sites for sampling, and understanding the link between primitive asteroids and carbonaceous chondrites.

NIRS3 is composed of two units: the spectrometric unit (NIRS3-S) and the analog electric unit (NIRS3-AE), which are connected with a harness cable (NIRS3-HNS). A 128-channel indium arsenide (InAs) photodiode sensor is installed in the spectrometric unit and cooled down to 188 K (-85 °C) using a passive radiator. The detectable wavelength range of the spectrometer is 1.8–3.2 μm, and the spectral resolution is ~18 nm. The field of view (FOV) is 0.11° [1, 2] corresponding to the spatial resolutions of 40 m at 20 km altitude and 2 m at 1 km.

We found that Ryugu spectra obtained by NIRS3 are almost homogeneous between places, showing very low albedo (~2% reflectance at phase angle 30°), flat but slightly red slope, and no large absorption features at ~2.7 and ~3.1 μm in wavelength. However, the spectra exhibit slight variety from brighter and bluer spectra on the equatorial ridge to darker and redder spectra in the other areas. No carbonaceous chondrite spectrum collected so far matches exactly with Ryugu spectra. However, some spectra of experimentally-heated hydrous carbonaceous chondrites are similar in terms of their flat shape and low albedo. Ryugu surface might not be totally hydrated because of (1) dehydration due to heating and/or space weathering, or (2) the lack of hydration process.

It is expected that further NIRS3 observations at a lower altitude, at a solar distance larger than 1.027 AU, ONC and NIRS3 observation of the SCI impact crater, MicrOmega observation of the surface regolith, and returned sample analysis will give us more detailed information on the spectral and mineralogical characteristics of Ryugu.

References

[1] Kitazato K. et al. 2015. Abstract #2158. 46th LPSC. [2] Iwata T. et al. 2017. Space Science Reviews 208: 317-337.