NIRS4/MacrOmega: a near-infrared hyper-spectral imaging camera for the Martian moon’s sample return mission

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We report the current status of the MMX (Mars Moon eXploration) mission, particularly on the development of a near-infrared hyper-spectral imaging camera. We also discuss near- and mid-infrared spectroscopy for next generation space-borne planetary missions with advanced imaging technology. MMX spacecraft is scheduled be launched in the early to mid 2020s, will orbit Phobos and Deimos, and returns samples from Phobos back to Earth in the late 2020s. Near-infrared imaging spectroscopy is useful to understand the material distribution on Martian moons (e.g., hydroxide minerals at 2.7 −2.8 um, hydrated minerals at 3.0 −3.2 um, and organics at 3.4 −3.4 um) and dynamics and climatology in the Martian atmosphere (e.g. H2O at 2.5 −2.65 um, and pressure with CO2 absorption at 1.2 −2.2 um). We proposed a near-infrared hyper-spectral imaging spectrometer NIRS4/MacrOmega for the MMX mission to observe such properties on Phobos, Deimos as well as in the Martian atmosphere. NIRS4/MacrOmega will adopt an acousto-optic tunable filter (AOTF) as a monochromatic imaging filter. We are now discussing a conceptual design mainly for optics, and currently an AOTF device with a diameter of 15 mm (or 20 mm) is located at the fore-optics which enable us to obtain an image with a field-of-view of 6 x 6 deg. for a wide wavelength range from 1.0 to 3.6 um with a wavenumber resolution of 20 cm^-1. field-of-view. The detector is a Sofradir Neptune SMW HgCdTe 512 x 256 array with a pixel size of 30 x 30 um with an operational temperature of 110K. Using this optics and detector, we will take a Phobos surface area of 2.1 x 2.1 km with a pixel resolution of 8.2 x 8.2 m in case of a spacecraft altitude of 20 km. Directing its field-of-view to Mars, the Mars surface area of 630 x 630 km will be observed by a single shot. The advantage of AOTF device is high flexibility in wavelength selection which enable us to obtain images efficiently at the wavelengths in which important spectral feature will be expected on Phobos, Deimos and Mars. In the presentation, we will give the current status of optical design of NIRS4/MacrOmega, expected optical performance, and operation plan, and strategy to achieve the scientific goals on Phobos, Deimos and Mars.

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