Development of micro spectroscope for exploration on planetary surface

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In this study, we report on the development of the spectroscope which will be installed in the lander/rover in the next minor body exploration in Japan. The present asteroid explorer, which is called as HAYABUSA, is carrying the small experimental rover which is called MINERVA. The weight and the scale of this rover are 591 g and about 10 cubic-cm, respectively. MINERVA has three visible cameras and a thermometer for the scientific observation. In order to obtain more advanced scientific information we will load such two or more instruments in the next lander/rover compared with the MINERVA. It will be expected to arrive at the sampling point and acquire the information about there. Although there is a margin in size and weight in the next minor body exploration, individual instruments are requested the power saving, the small size, and the lightening.

We are developing the visible and infrared micro spectroscope for the lander/rover of the next minor body exploration. We can obtain the information about major silicate materials, water (ice), and the organic by the measurement of the reflected spectrum from the surface of the planet using this instrument. We expect that our spectroscope will become the future standard instrument for the lander/rover, if the power saving, the small size, and the lightening will be achieved.

In this study, we improve a commercial based micro spectroscope for the space mission. The light reflected from the planetary surface is led to the spectroscope by the glass fiber cable. As the result of the dispersions of the wavelength and condenser of the light are done by a concave diffraction grating, it is detected with the photodiode arrays.

The weight and size of the spectroscope including the dispersion and detection parts are 20 g and 49.40 x 31.75 x 7.35 mm, respectively. This condition of this instrument is small and light enough to be carried by the next minor body exploration. We are examining the usage of the glass fiber cable. The glass fiber cable can adapt flexibly to our objective. It is possible for the glass fiber cable to insert into the regolith. We should investigate the usage of the glass fiber cable in the space environment.

When the characteristic of this system is examined, at first we examine the relation between the wavelength and each diode. At the next, we should investigate the sensitivity and the temperature dependence for all system including the electric circuit. Finally, we should investigate the improvement point for usage of the spectroscope for the exploration on the planetary surfaces. The sensitivity gives the judgment about the necessity for a light source. The light source is effective also in observation of a permanent shadow.

In this study, we report on the objective for our usage of this spectroscope, the system, the characteristics, and the improvement point of this spectrometer.