

CURRENT STATUS OF DEVELOPMENT FOR ACTIVE X-RAY FLUORESCENCE SPECTROMETER FOR FUTURE PLANETARY MISSIONS.

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Introduction: Development of active X-ray fluorescence spectrometer (AXS) has been performed for the embarkation to future planetary roving and/or sample-returned missions [e.g., 1,2]. AXS could analyze the elemental composition on/around landing sites by X-ray fluorescence spectroscopy (XRF), in order to investigate their geochemical characteristics. The AXS consists of an active X-ray generator (XRG) and a silicon drift detector (SDD) [e.g., 1,2]. Here, we will present and discuss the current status of development of AXS.

Developments of XRG: Radioactive sources have been ever used as X-ray excitation source for lunar [3] and Mars [e.g., 4] landing missions. We will make XRF for rock samples with our XRG in place of such radioactive sources. Two kinds of active X-ray generator are under consideration as shown below, and the basic studies for the development of XRG are performed. Our generators have superior advantage in that an on-off switch of the X-ray emission reduces the risk of exposure to experimenters.

Pyroelectric X-Ray Generator: Pyroelectric X-ray generator (PXG) consists of a small pyroelectric crystal (e.g., LiTaO₃, LiNbO₃), a peltier device, and a thin metallic target film. Electrons are generated by using pyroelectric crystals and accelerated to the thin target, and then X-rays are emitted from the target. Because the emission intensity from PXG is not so strong, we are focusing on a study to increase the intensity and stability.

Carbon Nanotube X-ray Generator: Carbon nanotube X-ray generator (CXG) consists of a CNT cathode tip, control gate, and a thin metallic target film. Electrons emitted by CNT field emission induces fluorescence X-rays. CXG is expected to produce higher intensities than those of PXG. Miniaturization and electric power saving are conducted for CXG because of the need for high voltage power supply.

Scientific objects: The major object of the present AXS is the investigation of elemental abundances (e.g., Na, Mg, Al, Si, K, Ca, Ti, Cr, Mn, Fe, Ni) of surface materials of Moon, Mars or asteroids, because these elemental abundances are very important information to reveal the petrogenesis of silicate rocks. In addition, AXS will be applicable in many fields including “analysis in geologic fieldwork”, “security monitor”, “non-destructive inspection”, “X-ray imaging for medical and industrial use” in addition to “planetary explorer mission”, because of the advantage of AXS as light-weight, compact and energy-saving.

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