Operation of Frosting System for Lunar Polar Ice Exploration and Detectability of Ice Growing on the Legolith Simulant by NIR Mesurement

*Ryotaro Araki[1], Aoi Ogishima[1], Kazuto Saiki[1]

1. Osaka University

In recent years, many remote sensing studies have suggested the existence of lunar water, but it is still an open issue how or how much water is on the Moon. Lunar prospector launched in 1998 found the concentration of proton around lunar poles (Feldman et al., 2001). In 2009 Lunar Crater Observation and Sensing Satellite (LCROSS) project observed ejecting debris from Cabeus crater and estimated that concentration of water ice is 5.6±2.9 wt% (Colaprete et al., 2010). The Near infrared spectroscopy data of Chandrayaan-1 and surface temperature distribution data measured by Lunar Reconnaissance Orbiter suggested that water ice is distributed on the surface of the lunar polar region (Li et al., 2018). In December 2017, Japan’s space agency JAXA and India’s space agency ISRO have signed an Implementation Arrangement (IA) for a Joint Lunar Polar Expedition. In preparation for this mission, we have developed a frosting system (presented in JSPS2019).

This equipment produces cold trapped water ice particles attached to the lunar regolith simulant in a cryogenic environment. Icing sample of mineral powder made with the equipment was observed by a newly developed Near-Infrared imaging spectrometer (presented in LPSC 2020) at 850 - 1700 nm. In JSPS2019 , we observed icing sample of olivine and plagioclase powder which particle size is 125 - 250 um and reported that the plagioclase sample has a deeper band depth of water absorption band and a smaller amount of ice can be detected. However, the particle size of lunar regolith does not exceed 100 um in most cases (e.g. Hapke, 1968; King et al., 1971). Therefore, we experimented frosting and NIR measurement with finer powder samples. We compared obtained data and the intimate mixed powder spectrum model (Hapke, 1993). In JSPS2019 we reported that the frosting samples has absorption band of water molecule around 1500nm and are brighter than dry samples overall. This time, it was found that the finer samples resulted in a smaller degree of overall brightening of the spectrum due to frosting. These results are consistent with the trends predicted by Hapke’s intimate mixed powder spectrum model. We will discuss quantitatively the degree of brightening of the icing spectrum of mineral powder samples and the depth of water absorption.

Keywords: Lunar polar remote sensing , Lunar water ice, Near-Infrared spectrometer

