Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.5017

Investigations of grain size and abundance of NaCl on Europa's surface through telescope observations and laboratory experiments: Implications for material transport from the interior to surface

SHUYA TAN[1], YASUHITO SEKINE[2], MASAYUKI KUZUHARA[3], HIROYUKI KUROKAWA[4], CRISTINA DALLE ORE[5] AND DALE P. CRUIKSHANK[6]

[1]Tokyo Institute of Technology
[2]Tokyo Institute of Technology, Earth-Life Science Institute
[3]Astrobioloy Center of NINS
[4]Earth-Life Science Institute, Tokyo Institute of Technology
[5]SETI Institute
[6]NASA Ames Research Center

Presenting Author: shtan@elsi.jp

Europa's surface has been recently observed in near-infrared and visible wavelengths [1,2]. Those observed spectra suggest that NaCl is distributed widely on Europa, including in geologically-active chaos terrains. The spectrum of NaCl on Europa would be changed due to irradiation by high-energy particles, such as electrons [3]; however, the optical constants of irradiated NaCl have not been investigated thus far. Due to lack of the optical constants, together with the limitation in observed wavelengths of Europa, the abundance and grain size of NaCl on Europa have been poorly constrained.

Here, we perform observations for Europa's surface in the wavelengths of 1.0–1.8 μm using the Subaru telescope/IRCS. We also perform irradiation experiments on NaCl by 10-keV electrons to obtain the optical constants of irradiated NaCl in near-infrared wavelengths. To constrain grain size and abundance of irradiated NaCl on Europa's surface, we perform spectral model fitting of our observational data and Galileo spacecraft data with the Hapke model using the obtained optical constants [4]. In our spectral fitting, non-irradiated NaCl cannot reproduce dark reflectance of the surface well in wavelength of 1.1−1.3 μm. In contrast, irradiated NaCl greatly improves the spectral fitting due to a red slope of irradiated NaCl in the relevant wavelength range. In the best fit of the observational data, the abundance and grain size of irradiated NaCl on Europa are estimated as 40−50% and > a few μm, respectively.

The high abundance and large grain size of NaCl on Europa can be explained if chaos terrains were formed through slow freezing of subsurface brine reservoirs within the icy crust, and subsequent eruptions of slurry brines containing NaCl-grains to the surface.

[1] Fischer et al. (2015), *AJ* **150**, 164. [2] Trumbo et al. (2019), *Sci. Adv.* **5**, eaaw7123. [3] Hand & Carlson (2015), *Geophys. Res. Lett.* **42**, 3174. [4] Hapke (1981), *J. Geophys. Res.* **86**, 3039.