Contribution ID: **150** Contribution code: **P-MON-9** Type: **Poster**

Non-destructive Elemental Analysis of Lunar Materials with Negative Muon Beam at J-PARC

Monday, 29 August 2022 18:40 (20 minutes)

A muonic atom is formed when a muon is captured in an atom system, and characteristic muonic X-ray emission occurs with the muon deexcitation process. The chemical composition of a material can be known based on the intensities of the emitted muonic X-rays. Non-destructive elemental analysis using negative muon beam has been highly developed in the last decade. This method provides a powerful tool to determine the material composition of meteorites without causing damage.

We performed a muon experiment at the D2 muon beamline of the Muon Science Establishment (MUSE) in the Japan Proton Accelerator Research Complex (J-PARC). Three lunar meteorite samples (NWA482, NWA032, DEW12007) were wrapped with 12.5 μm Kapton foil and installed in a stainless steel analysis chamber filled with Helium gas. The total exposure time of muon irradiation with a momentum of 27 MeV/c for each sample was around 10 hours, and the emitted muonic X-rays were observed by six low-energy high-purity germanium semiconductor detectors, which were installed around the samples.

The peaks with energies of 76.7, 89.2, 92.7, 54.8, and 56.4 keV were clearly observed in the energy spectrum and were identified as the muonic X-rays from Si, Al, Fe, Ca, and Mg, respectively. The intensities of these muonic X-rays were determined by data fitting with gauss functions. Because the self-absorption of the sample and the detection efficiency of germanium semiconductor affect the measurement, the corrections based on the Monte-Carlo simulation were also applied in this study.

We successfully defined the chemical comparison of element/Si ratios of three lunar meteorites based on quantitative analysis for muonic X-ray measurement. The observed chemical composition suggests that the DEW12007 (polymict regolith breccia) could be a mixture of basaltic crust (NWA032-like) and anorthositic crust (NWA482-like) in terms of Al, Fe, Ca, and Mg contents.

Primary authors: Mr CHIU, I-Huan (Osaka University); Mr TERADA, Kentaro (Osaka University); Mr TAKAHITO, Osawa (Japan Atomic Energy Agency); Mr PARK, Changkun (Korea Polar Research Institute); Mr TAKESHITA, Soshi (KEK); Mr MIYAKE, Yasuhiro (KEK); Mr NINOMIYA, Kazuhiko (Osaka University)

Presenter: Mr CHIU, I-Huan (Osaka University)

Session Classification: Posters

Track Classification: Muonic x-rays