

超高感度極微量質量分析装置を用いた太陽風起源希ガスの分析 Development of novel mass spectrometer to analyze solar wind noble gases

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Solar-gas-rich regolith breccia from asteroids has been studied [e.g., 1, 2], which were irradiated by solar wind (SW) on the parent body surface. Regolith breccia was lithified by compaction process from regolith soils. The compaction processes which were recorded in the breccias should reveal a migration, deposition, SW irradiation of the soil. To figure out the SW distribution in the breccia high spatial resolution is required because SW implanted layer is less than 100 nm [2].

LIMAS (Laser Ionization Mass nanoScope) [3] is a time-of-flight sputtered neutral mass spectrometer (TOF-SNMS) with non-resonant laser post-ionization system which can observe in-situ distributions of all elements in solid materials down to tens nm level. LIMAS is mainly composed of Ga focused ion beam (FIB) for sputtering, femtosecond laser for post-ionization of sputtered particles, and multi-turn mass spectrometer (MULTUM II [4]).

An n-type Si wafer, which was irradiated by 30 keV ⁴He of 2×10^{16} ions/cm² was used to evaluate and confirm sensitivity for He. The sputtering crater was 6.4×15.2 μm² and measurement area is 2.1×4.1 μm² of the center. The detection limit of ⁴He for the system is about 10^{18} ions/cm³ for ⁴He. The performance of LIMAS should be improved towards higher sensitivity and lower background noises because bulk concentrations of solar-He in gas-rich meteorite is 10^{-2} - 10^{-4} cm³STP/g [e.g., 1] which can be translated into 10^{16} - 10^{18} atoms/cm² for rocky material (density ~ 3 g/cm³).

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キーワード: 希ガス, 太陽風, 局所分析, 質量分析

Keywords: Noble gas, Solar wind, Microscopic analysis, Mass spectrometry