MICRODISTRIBUTION OF SOLAR WIND HELIUM ON ITOKAWA PARTICLES.

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Introduction: Depth profile distributions of solar wind helium from a NASA Genesis target were recently measured by a sputtered neutral mass spectrometry (SNMS) [1]. They used tunneling ionization by using fs-laser to detect He sputtered neutrals from ~1 μm^2 area on the surface. Nagao et al. [2] determined isotopic compositions of noble gases from asteroid Itokawa particles of JAXA Hayabusa mission. They demonstrated that $^{20}Ne/^{36}Ar$ ratios corresponded to a solar wind ratio [3]. Contrary, the $^{4}He/^{20}Ne$ ratios were 4-6 times smaller than the solar wind ratio [3]. They inferred He depletion from the particles due to higher mobility of He compared to the other noble gasses. Noguchi et al. [3] demonstrated that surface layers of Itokawa particles have been damaged for about ~50 nm in depth probably by solar wind irradiations. In this study, we measured microdistribution of solar wind He from Itokawa particles by using the SNMS technique.

Experimental: Itokawa particles of RA-QD02-0169 and RBQD04-0055, and a San Carlos olivine irradiated by $^{4}He^{+}$ of 4 keV were used in this study. The particles were handled by Axis Pro manipulator (Micro Support Co., Ltd.). The SNMS instrument called LIMAS was utilized [4]. A pulsed primary beam of ^{69}Ga with 30 keV and 65 nA was focused on a sample surface of ~1 μm in diameter. Sputtered neutrals were ionized by a focused (φ50 μm) fs-laser pulse under a tunneling ionization condition. The primary beam was rastered on the sample with a square pattern of 15 × 15 spots with a step of 500 nm interval. Positive ions were introduced into a multi-turn time-of-flight mass spectrometer. These pulses of fs-laser and mass spectrometer were synchronized with the primary ion pulses in 1 kHz repetition rate. We measured $^{4}He^{+}$, $^{12}C^{3+}$, $^{16}O^{+}$, $^{24}Mg^{2+}$, $^{28}Si^{4+, 3+, 2+, +}$, and $^{56}Fe^{2+}$.

Results and discussion: The depth distribution has a peak at ~20 nm in average, which is consistent with solar wind projected range observed in Genesis [1], but the peak concentrations and the peak depth are variable within micrometer scales on surface. These might indicate that He escaped from the particles and heterogeneous distribution in particle surfaces was caused by mechanical erosion.

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