Micro-distribution of solar wind helium implanted to Itokawa particle

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Depth profile distributions of solar wind (SW) He from a NASA Genesis target were recently measured by a time-of-flight sputtered neutral mass spectrometry (TOF-SNMS) [1]. They used post-ionization method by using fs-laser to detect He sputtered neutrals from ~1 μm^2 area on the surface developed by [2]. Nagao *et al.* [3] determined isotopic compositions of noble gases from asteroid Itokawa particles of JAXA Hayabusa mission. They demonstrated that bulk SW irradiation ages among the samples were variable, of which ranged from 150 to 550 yr based on amounts of SW ^{20}Ne. SW-He was depleted because $^{4}He/^{20}Ne$ ratios were 4–6 times smaller than that of the SW [4].

Itokawa particle of RA-QD02-0169 and a San Carlos olivine, irradiated by $^{4}He^{+}$ of 4 keV, were used in this study. The TOF-SNMS instrument called LIMAS was utilized [2]. We measured depth profiles of $^{4}He^{+}$, $^{12}C^{3+}$, $^{16}O^{+}$, $^{24}Mg^{2+}$, $^{28}Si^{4+, 3+, 2+, +}$, and $^{56}Fe^{2+}$ in the samples. A primary beam size was ~1 μm in diameter and a raster size was ~10 × 10 μm^2.

The depth distribution of ^{4}He has a peak at ~20 nm in average, which is consistent with projected range of SW-He observed in Genesis DOS sample [1], but the peak depth and the concentration is variable within the raster area. The variations classiified into: One was ideal shape of depth profile of SW-He, which indicates simple SW exposure to a surface of the particle. Another was a featureless profile, suggesting that more complex history after the SW irradiation. Areas of low He concentration might be covered with other particles or locally eroded. The He fluence shows that SW expousure age of the particle is to be ~120 years. From the heterogeneous 3-D distribution of the He, we may analyze geological dynamics arisen on the asteroid Itokawa for 120 years.

[1] K. Bajo *et al.* (2015) *GJ.* **49**,559. [2] S. Ebata *et al.* (2012) *SIA* **44**, 635. [3] K. Nagao *et al.* (2011) *Science* **333**, 1128. [4] V. S. Heber (2009) *GCA* **73**, 7414.