Detection of CME components of solar wind noble gas from DOS sample of *Genesis*

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Introduction: Solar wind (SW) noble gases can be utilized as a tracer to investigate solar activity from the SW irradiated materials. Recently, depth profiling of solar wind He was firstly observed from diamond-like carbon layer on Si substrate (DOS) from NASA's *Genesis* mission [1], which is a sample return mission of SW [2]. They analyzed interstream and coronal hole components, but not coronal mass ejection (CME) components because the detection limit was limited by residual noble gases in the sample chamber vacuum. We have exchanged sputter ion pumps and added getter pumps to improve the chamber vacuum of LIMAS.

Experimental: A DOS sample of *Genesis* was prepared in this study. Laser ionization mass nanoscope (LIMAS) [3] was used to measure depth profile of SW noble gases implanted in the DOS.

A pulsed primary beam of 1.5 μm in diameter with ~50 nA was used. Sputtered neutrals were ionized by the newly installed fs-laser (Astrella, Coherent) with a pulse energy of 5.6 mJ at the repetition rate of 1 kHz and a power density of ~10^{20} W m^{-2}. Mass spectrometer setting of LIMAS was adjusted according to [4]. Multi-turning of $^{4}He^{+}$ ions was set to 100 cycles and ion gates were used for elimination of interfering ion such as $^{12}C^{3+}$. After depth profiling, atomic force microscope was used for measurement of crater shapes.

Results and discussion: ^{4}He background in this study was reduced to ~4×10^{17} atoms cm^{-3} for DOS sample, which is one order of magnitude lower than that of [1] (3×10^{18} atoms cm^{-3}). As a result, Depth profile of SW He was traced to the depth of 300 nm from surface. The profile deeper than 100 nm corresponds to CME components. Moreover, depth profile for SW Ne was determined from the DOS sample.

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Development for in-situ radiogenic ^{4}He analysis in zircon for U-Th-He dating

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Introduction: Zircon has been used for U-Th-He dating of various rocks because zircon contains relatively large amounts of U, Th, and radiogenic ^{4}He which is produced by α-decay of U and Th [e.g., 1]. The closure temperature of U-Th-He dating of zircon is ~180°C. Therefore, a low-temperature thermal history of rocks, e.g. the process of uplift and denudation of mountains, are revealed by using the U-Th-He dating of zircon [e.g., 2]. Radiogenic He atoms close to zircon crystal surface produced by the α-decays escape from the crystal because a typical range of the α-decay is ~20 µm. Conventional measurements, of which spatial resolutions were tens of µm [e.g., 3] are difficult to identify the He escaped region. If the He distribution can be observed with micro-meter resolution, we can trace a track of the α-particle by α-decay from U and Th, and evaluate radiogenic ^{4}He loss from the crystal. LIMAS (Laser Ionization Mass nAnoScope) is an analytical system developed for analyzing noble gases in submicro-meter resolution on sample surfaces, which should be a key instrument to realize the analysis.[4]. LIMAS would be analyze spatial distribution of the ^{4}He concentration in a zircon crystal. Moreover, the analysis may be clarified ^{4}He re-distribution during low-temperature thermal history. Here, we apply LIMAS to measure ^{4}He in Jack Hills zircon crystals.

Analysis for Jack Hills zircon: Jack Hills (JH) zircon crystals are collected from Jack Hills sedimentary belt, Western Australia, Australia. Ages of JH zircon range from 4.4 to 1.2 Ga by U-Pb dating [5]. We carried out quantitative analysis of ^{4}He in a JH zircon by LIMAS . The ^{4}He intensities are calibrated by an ion-implanted silicon standard. We implanted ^{4}He of 4 keV with a fluence of 1×10^{15} cm^{-2} into silicon wafer. A single crystal of JH zircon homogeneously contained radiogenic ^{4}He about 150 ppm, but a ^{4}He-rich area of 10 µm across was observed. The concentration was ~ 700 ppm, which was 5 times larger than surrounding. We will carry out line profiles of zircon crystals to obtain distribution of radiogenic ^{4}He.

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