HELIUM FROM CORONAL MASS EJECTA COLLECTED BY NASA'S GENESIS.

H. Yurimoto[1], A. Tonotani[1], K. Bajo[1], C. T. Olinger[2], D. Reisenfeld[3], A. J. G. Jurewicz[4], S. Itose[5], I. Sakaguchi[6], M. Ishihara[7], K. Uchino[8] and D. S. Burnet[9], [1]Depertment of Natural History Sciences, Hokkaido University, IIL, Sapporo 001-0021, Japan (yuri@ep.sci.hokudai.ac.jp). [2]Physics and Nuclear Engineering, United States Military Academy, West Point, NY 10996, USA. [3]Depertment of Physics & Astronomy, University of Montana, Missoula, MT 59812, USA. [4]CMS/SESE, Arizona State University, Tempe, AZ 85287-1404, USA. [5]JEOL Ltd., Musashino, Akishima, Tokyo 196-8558, Japan. [6]National Institute for Materials Science, Tsukuba, Ibaraki 305-0044, Japan [7]Department of Physics, Osaka University, Toyonaka, Osaka 560-0043, Japan. [8]Graduate School of Engineering Sciences, Kyushu University, Kasuga, Fukuoka 816-8580, Japan, [9]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125, USA.

Introduction: The energy distribution of solar wind (SW) is an indicator of solar activity. The implantation profiles of SW particles in a solid material directly irradiated by the SW echo that energy distribution. Accordingly, the depth distribution of a SW element in a SW collector tells us about the solar activity during the time of collection. Helium is the second most abundant element of SW and almost free from terrestrial contamination, so it is one of the best candidates for measuring a detailed implantation profile. But, analysis of SW He by conventional depth-profiling methods have either extremely low He ionization yields or require extremely large sample volumes. Using the secondary neutral mass spectrometer, LIMAS, at Hokkaido University [1], we previously measured a SW He implantation profile from a bulk solar wind collector from the NASA *Genesis* SW sample return mission [2]. However, only the shape of the low-speed and high-speed SW He contributions were observed at that time, because the SW He component from coronal mass ejections (CMEs) was below our detection limit. Here we report our new, more sensitive measurements, which show CME flows collected by *Genesis* in the bulk solar wind collector.

Experimental methods: Depth profiles were measured on a diamond-like-carbon (DLC) film on a Si substrate (DOS60939) from *Genesis* bulk collectors [3]. Experimental procedures for depth profile measurements are similar to those of [2]. However, the femto-second laser originally installed for post ionization was exchanged to a higher power laser of 35-fs-wide pulses with pulse energy of 6 mJ (Coherent Astrella) [3]. The vacuum system of LIMAS has been largely improved. A small pinhole in the ion injection column of the mass spectrometer has been found and sealed, and we added a sputter ion pump (SIP) combined with a non-evaporable getter (NEG) pump (SAES NEX-Torr D200-5) to pump the column. The vacuum pump system of the sample chamber was exchanged for a larger pumping speed SIP (Agilent VacIon Plus 500 StarCell) combined with a NEG pump (SAES CapaciTorr 1300 L s^{-1}). As a result, the vacuum of the sample chamber improved over an order of magnitude, from 3×10^{-8} Pa to 5×10^{-9} Pa. Our system upgrades decreased the background level for the ^{4}He signal from 10^{18} cm^{-3} to 10^{17} cm^{-3}.

Results and Discussion: SW helium-4 is observed from the surface to 300 nm in depth in the DOS target. The depth profile has a peak of concentration of ~2×10^{20} cm^{-3} at ~20 nm in depth indicating that energies of the SW ^{4}He are dominant in ~4 keV during the *Genesis* mission. Unexpected He signal enrichments were observed at the surface: this suggests that ^{4}He migrated to trap in the higher defect region (i.e., radiation enhanced segregation). The ^{4}He profile decreases to ~10^{18} cm^{-3} at 100 nm in depth. Then, the rate of decrease slows after the 100 nm depth to show a tail. The tail profile is clearly traced at concentrations of 10^{17} cm^{-3} at 300 nm. The tail corresponds to implanted ^{4}He with velocities faster than 1000 km s^{-1} showing a CME origin. Using ACE/SWICS data [4], the CME tail has been identified as corresponding to the Halloween solar storms of 2003.

SW Neon-20 and ^{22}Ne are observed in areas from the surface to 100 nm in depth in the DOS target. The depth profile has a peak concentration of ~2×10^{17} cm^{-3} for ^{20}Ne and ~2×10^{18} cm^{-3} for ^{22}Ne at ~20 nm in depth, as expected for SW Ne of ~20 keV dominating the energy distribution during the *Genesis* mission. The Ne profiles decreases to ~10^{16} cm^{-3} at ~100 nm in depth, corresponding to the detection limit of Ne signals. No clear CME tails are observed in the Ne profiles, consistent with our expectation that CME signals for Ne are below our detection limit.

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