Development of laser post-ionization SNMS for *in-situ* U-Pb chronology

Y. KAWAI[1,2*], T. MATSUDA[1], K. MIYA[1], H. YABUTA[1], J. AOKI[2], T. HONDO[2], M. ISHIHARA[2], M. TOYODA[2], R. NAKAMURA[3] AND K. TERADA[1,2]

[1]Dept. Earth and Space Science, Grad. Sch. Sci., Osaka Univ. (*correspondence: ykawai@ess.sci.osaka-u.ac.jp)

[2]P.R.C. Fundamental Sciences, Grad. Sch. Sci., Osaka Univ.

[3]Office for University-Industry Collaboration, Osaka Univ.

In-situ U-Pb chronology with Secondary Ion Mass Spectrometer (SIMS) has been widely used to understand the history of the solar system including the Earth, Moon, and asteroids (e.g. [1]). One of the disadvantages of the SIMS, however, is that the secondary ion yield is low (less than a few %), and a large fraction of the samples sputtered by a primary ion beam are lost as neutrals without being analyzed. The severely low useful yield leads to difficulty in analyzing trace elements with a sub-micron scale resolution.

To overcome this difficulty, we have been developing Secondary Neutral Mass Spectrometer (SNMS), which post-ionizes sputtered neutrals with an intense pulsed laser beam [2]. The instrument consists of a focused ion beam, a femtosecond laser and a multi-turn Time-of-Flight (ToF) mass spectrometer (MULTUM). The sample is sputtered by a 30 keV Ga^+ ion beam which can be focused to a spot diameter of 40 nm. The ejected neutrals are irradiated with the femtosecond laser and ionized in the intense laser field through the non-resonant ionization regime, thereby increasing the ionization yield. The produced ions are introduced into the MULTUM which performed an ultra high mass resolving power of 250000 [3]. As the result of the performance evaluation of this system with a lead plate, it was demonstrated that the post-ionization with a high power laser increases Pb^+ signal intensity more than 10000 times higher and the mass resolution greater than 12000 can be achieved by utilizing the MULTUM.

Toward the application to U-Pb chronology, 91500 zircon which contains around 100 ppm uranium and is used as a standard specimen of zircon U-Pb dating was measured. From a sputtered area of around 1 μm in diameter, U^+, UO^+ and UO_2^+ signal peaks were detected. In this presentation, we will also report the result of the lead isotope ratio of the same specimen and discuss the feasibility of sub-micron scale *in-situ* U-Pb chronology with this instrument.

[1] Terada & Sano (2012) Mass Spectrometry, **1**, A0011. [2] Ishihara, et al. (2010) Surf. Interface Anal., **42**, 1598. [3] Toyoda, et al. (2012) J. Mass Spectrom. Soc. Jpn., **60**, 87.