

Towards in-situ 3-D analysis of noble gases from surface of Itokawa particles and Genesis targets

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A unique feature of Itokawa particles and Genesis targets are exposed intact surfaces to violent space environments. A noble gas mass spectrometry has measured implanted noble gases of Solar wind from these return samples [1, 2]. A TEM study demonstrates that solar wind particles were implanted in the surface thin layer of Itokawa particles [3]. However, spatial distribution of solar noble gases has not been determined ever from natural samples. In order to determine nano-scale 3-D distribution of solar wind particles in astromaterials, we develop a novel mass spectrometer of sputtered neutral mass spectrometry (SNMS) using tunneling ionization. The development was started from 2004 at one year after launching of Hayabusa spacecraft [4]. Recently, we have newly developed new generation SNMS capable to detect tens ppma He from ~50 nm area on solid surface [5]. This project will be figured out how distribute He (and other noble gases and H) in the surface layer of Itokawa particles and Genesis targets with tens nm resolution. If such distribution is clarified, we can apply atomic mechanisms in solid analyzed by mineralogy and crystallography, such as diffusion, partitioning, etc., to conventional noble gas cosmochemistry. As a result, behavior of noble gas in minerals can be used to monitor changes of space environments in such a way as to use trace element behavior applying to terrestrial environmental research. Therefore, this project is the first step to pioneer a new research field of noble gas mineralogy or noble gas astromineralogy although the first target is focused for space weathering.

[1] Grimberg A *et al* 2008, *GCA* **72** 626-645. [2] Nagao K *et al* 2011, *Science* **333** 1128-1131. [3] Noguchi T *et al* 2011, *Science* **333** 1121-1125. [4] Ishihara M *et al* 2010, *Surf. Interface Anal.* **42** 1598-1602. [5] Ebata S *et al* 2012, *Surf. Interface Anal.* **44** 635-640.