Populations and composition of submicron craters on Itokawa regolith particles

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Micrometeoroid impacts are considered to be among the fundemental processes for surface modification on airless bodies in the solar system. In previous studies, submicron sized craters have been reported on regolith particles from S-type asteroid Itokawa [1-3]. These small craters can give us information about the origin of micrometeoroid and the role of micrometeoroid impacts for space weathering. In this study, we examined populations, morphologies, and chemical composition of submicron craters on Itokawa particles.

34 Itokawa regolith particles from approximately 10 μm up to 200 μm in size were observed using a scanning electron microscope (SEM; Hitachi SU6600) at the curation facility of JAXA. Surface elemental composition of an olivine particle was examined by energy-dispersive X-ray spectroscopy (EDS) using a SEM (Hitachi SU6600) equipped with a Bluker XFlash FladQUAD 5060FQ detector at IMS.

The morphologies of the craters are similar to those of submicron sized craters on lunar regolith [4]. EDS analysis for craters on olivine surface revealed that some of craters show excess of Al and Ca against the host olivine surface, indicating that impact residues remain in the caters. We calculated the flux of impactors forming submicron craters, assuming that the craters accumulated during direct exposure to space for 10^3 years. The impactor flux on Itokawa particles is up to two orders of magnitude higher than the interplanetary dust flux [5] and is also comparable to the case of the Moon [4], indicating that secondary ejecta impacts are probably dominant cratering processes in submicron sized range on Itokawa.

[1] Nakamura et al. (2012) *PNAS, 109*, E624-E629. [2] Harries et al. (2016) *EPSL, 450,* 337-345. [3] Matsumoto et al. (2016) *GCA, 187,* 195-217. [4] Morrison and Clanton (1979) *LPS X*, Abstract pp.1649-1663. [5] Grün et al. (1985) *Icarus, 62,* 244–272.