Consortium study of the largest Itokawa particle.

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Introduction: RA-QD02-0136-01 is currently the largest sample of Hayabusa-returned samples recovered from asteroid Itokawa [1-6]. Major axis of the particle r_a is around 310 μm. We constructed a consortium for a series of studies of this particle, and started non-destructive analysis.

We report the result of synchrotron radiation computed tomography (SR-CT) and research plan of subsequent studies.

Result of SR-CT observation: Imaging CT with analytical dual energy tomography [7], X-ray diffraction CT (XRD-CT, [8]) and projection CT were applied to the sample, using special holder for SR-CT which enable us to observe the sample without any adhesives and direct exposure to the terrestrial atmosphere.

We confirmed that the particle is mainly composed of olivine, low and high-Ca pyroxene, plagioclase and troilite using the analytical dual energy tomography. However, we could not obtain three-dimensional data of the whole particle because of the low X-ray energy used in the experiment, 7keV and 10keV. By applying the projection CT analysis with higher X-ray energy, 20keV, and comparing it to the result of analytical dual energy tomography, we could obtain the distribution of mineral phases of the whole particle. The distribution of the mineral phases was confirmed by XRD-CT method.

We also found anomalous number of voids in the CT images. Two-dimensionally, the voids are trails of elongated pores [1], and three-dimensionally, the voids are connected each other, and form irregular shaped surface. Porosity of the particle is 16% and larger than the range of Hayabusa returned samples analyzed in the preliminary examinations (2-14%, [5]). Some of the voids seem to be healed incompletely, suggesting moderate thermal annealing after the breaking of the particle, probably on the parent body of Itokawa.

Future research plan: Currently, we finished the CT observation and high resolution observation of the surface of the particle by FE-SEM. We will cut the sample into several pieces after the SEM observation, and will perform further destructive analyses such as TEM observation of space weathering rim, solar flare track and dislocations of the crystal, oxygen isotopic analysis, Ar-Ar age analysis and analysis of cosmogenic nuclides.

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