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# はやぶさ回収試料の初期分析：イトカワレゴリス粒子の３次元構造と初期分析におけるＸ線マイクロトモグラフィーの役割
# Preliminary examination of Hayabusa asteroidal samples: 3-D structures of Itakawa particles using X-ray microtomography

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Particles on S-type Asteroid 25143 Itokawa were successfully recovered by the Hayabusa mission of JAXA [1]. This is the first regolith sample of asteroid. Forty-one particles of 30-150 microns has been allocated to mainstream flow of preliminary examination (PE) [2]. These particles were imaged using SR -based X-ray mirotomography to obtain their three-dimensional structures as the first analysis in sequential mainstream analyses.

X-ray absorption imaging tomography system was used at BL47XU of SPring-8, Hyogo, Japan [3]. Each particle was imaged using two X-ray energies at 7 and 8 keV. As these energies are smaller and larger than the K?adsorption edge of Fe (7.11 keV), respectively, we can recognize olivine, Ca-poor pyroxene, Ca-rich pyroxene, plagioclase, troilite, taenite, kamacite, chromite and Ca phosphate easily using the contrasts of CT images, which correspond to linear attenuation coefficient (LAC) obtained by tomographic reconstruction. Relatively smaller thirty-five particles were imaged with the voxel (pixel in 3-D) size of about 90 nm (effective spatial resolution: 300-400 nm), while 6 particles with the voxel size of about 210-250 nm (effective spatial resolution of >˜400 nm).

3-D internal structures (3-D distribution of LAC values) of the particle were obtained. Based on the LAC values, we recognized most of the mineral phases and their three-dimensional distribution. Nineteen particles are mono-mineralic or almost mono-mineralic, fifteen particles are poly-mineralic (some of them contains accessory minerals), and seven particles have specific textures, such as a particle containing a porous aggregate of sub-micron grains. Voids are usually observed. As the particle size is comparable to the typical mineral grain sizes of LL5 and 6 chondrites, candidates of Itokawa surface sample, information of 3-D volume will help to reconstruct original textures of Itokawa materials.

From now on, modes of the minerals will be obtained. By using and image analysis, the external shapes of the particles will be also extracted to obtain volume, porosity and three-axial lengths. These shape parameters will be compared with those of boulders on Itokawa [4], fragments of collisional experiments [5] and lunar regolith [6] to obtain information on formation process of Itokawa regolith. By combining the chemical compositions of the minerals [7], the chemical composition and density of each particle and bulk composition and density will be also obtained.

After the tomographic imaging, the samples moved on to the non-destructive XRD and XRF analysis at KEK-PF and SPring-8, and then will move on to destructive analyses, such as those by SEM, EPMA, SIMS and TEM. Combination of the non-destructive analyses, microtomography, XRD and XRF, used for design of the later destructive analyses is one of the key features in this

PE. 3-D phase map gives information where should be cut for the later destructive analyses to obtain suitable areas of specific minerals in cross sections of small particles. Carbonaceous materials in a particle can be identified by the microtomography if they are present.

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