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# Preliminary examination of Hayabusa asteroidal samples: mineralogy and mineral-chemistry

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中村 智樹 [1*], 野口 高明 [2], 田中雅彦 [3], Mike Zolensky[4], 木村真 [2], 中藤亜衣子 [1], 大神稔皓 [1], 石田初美 [1], 土山 明 [5], 上椙 真之 [5], 矢田 達 [6], 白井 慶 [6], 岡崎 隆司 [7], 藤村 彰夫 [6], 石橋 之宏 [6], 安部 正真 [6], 岡田 達明 [6], 上野 宗孝 [6], 向井 利典 [6]
Tomoki Nakamura[1*], Takaaki Noguchi[2], Masahiko Tanaka[3], Mike Zolensky[4], Makoto Kimura[2], Aiko Nakato[1], Toshihiro Ogami[1], Hatsumi Ishida[1], Akira Tsuchiyama[5], Masayuki Uesugi[5], Toru Yada[6], Kei Shirai[6], Ryuji Okazaki[7], Akio Fujimura[6], Yukihiro Ishibashi[6], Masanao Abe[6], Tatsuaki Okada[6], Munetaka Ueno[6], Toshifumi Mukai[6]

[1]Tohoku University, [2]Ibaraki University, [3]WEBRAM, SPring-8, [4]NASA JSC, [5]Osaka University, [6]JAXA-ISAS, [7]Kyushu University
[1]Tohoku University, [2]Ibaraki University, [3]WEBRAM, SPring-8, [4]NASA JSC, [5]Osaka University, [6]JAXA-ISAS, [7]Kyushu University

We have carried out (1) FE-SEM/EDS analysis of small particles (mostly smaller than 10 microns in diameter) collected by a Teflon spatula from room A of the sample catcher, and (2) FE-SEM and synchrotron X-ray diffraction analysis of particles with diameter from 30 to 150 microns that are collected from a silica glass placed at the bottom of the room A. All results show that the Hayabusa spacecraft succeeded to collect Itokawa surface dust particles upon the 2nd touchdown performed on 26th Nov. 2005.

Teflon spatula collected many particles during sweeping of approximately 10% of the surface of sample catcher room A. Particles on one side of the spatula were analyzed individually without any conductive coat at 10KeV, a low electron current, low vacuum mode (60Pa ambient pure-nitrogen pressure), and low magnification of 600X. Each particle on the spatula was irradiated by a focused electron beam and a quantitative composition was obtained. Among particles analyzed, approximately 1800 particles are manmade including small bits of Al and stainless steel, but approximately 1500 particles are natural rocky particles. More than 90% of the rocky particles are smaller than 10 micron in size and the largest one is 40 microns. Most particles are angular - they are probably broken pieces of larger rocks.

Among the rocky particles analyzed, 580 are olivine, 118 are low-Ca pyroxene, 56 are high-Ca pyroxene, 186 have feldspar compositions (172 plagioclase and 14 K-feldspar), 113 are Fe sulfide, 13 are chromite, 10 are Ca phosphate, 3 are FeNi metal, and 447 are mixtures of several mineral phases. Several particles of silica minerals and K-bearing halite were found. The average and one sigma variation of Fa# for olivine, Fs# for low-Ca pyroxene, Fs# and Wo# for high-Ca pyroxene, and Ab# for plagioclase are 28+/-4, 23+/-6, 12+/-9 and 38+/-6, and 86+/-7, respectively. Fe sulfide contains only Fe and S with an average Fe/S ratio of 1 and, in one particle, coexists with FeNi metal. Therefore, Fe sulfide is probably troilite. Both kamacite and taenite are present as FeNi metal.

Many particles were recovered on a silica plate that was placed on the bottom of the room A of the sample catcher, after gentle beating by a metallic rod. Many of the particles are 100 microns or larger in size and thus they are larger than those on the Teflon spatula. Many particles are angular and have very fine adhering particles. We have analyzed approximately 50 particles. They are usually composed of multi-mineral phases such as olivine-low Ca pyroxene and olivine-plagioclase. Fe sulfides and FeNi metal are found as small inclusions in the particles, but not identified as discrete single particles.

Synchrotron X-ray diffraction analysis of approximately 40 particles with diameter from 30 to 150 microns indicates that silicates are very highly crystalline. Silicates are olivine, low-Ca orthopyroxene, high-Ca clinopyroxene, and plagioclase. Other phase detected is troilite.

The mineralogy and mineral chemistry of the rocky particles on the Teflon spatula are very similar to LL chondrites, suggesting that the small particles of the Muses-C regio are mostly LL-chondrite materials. Our results are consistent with the results of remote sensing measurements made of asteroid Itokawa by on-board instruments of Hayabusa [1-3]. However, our analysis

indicates that the particles captured by Hayabusa are depleted in FeNi metal compared with typical LL chondrites (0.5˜7.2%) [4].

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