

## MINERALOGY AND CRYSTALLOGRAPHY OF ITOKAWA PARTICLES BY ELECTRON BEAM AND SYNCHROTRON RADIATION X-RAY ANALYSES.

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**Introduction:** Itokawa particles returned by the JAXA Hayabusa spacecraft are providing significant information about the formation and evolution of meteorite parent bodies [e.g., 1]. The preliminary examination (PE) of these particles revealed that their mineral compositions are close to those of equilibrated LL chondrites [e.g., 2]. In this abstract we report mineralogical and crystallographic studies on 4 new and 3 PE particles that were allocated by JAXA as 1st international AO study.

**Samples and Methods:** At first 3 PE samples were allocated. They are RA-QD02-0036, 0041 and 0049-2. We additionally received 4 new particles (RA-QD02-0179, 0138, 0100, and 0133-01) and made polished sections after being embedded in epoxy. These particles were analyzed by optical microscope, FEG-SEM (Hitachi S-4500) and electron microprobe (JEOL JXA8900L). They were also analyzed by synchrotron radiation (SR) XRD (SPring-8, BL37XU) and Fe-XANES (KEK, PF, BL-4A).

**Results:** The optical microscopic observation showed that all particles were mostly composed of single crystal except for RA-QD02-0179 (polycrystalline plagioclase). The shock stage was estimated to be S2 for all samples because of the presence of minor undulatory extinction. The SEM-EDS analysis revealed that they are mainly composed of olivine with small amounts of plagioclase. Submicron-sized chromite and Ca phosphate were also found. No pyroxene was present in our samples. Olivine shows a homogeneous composition in each particle, and is Fa<sub>30</sub> with 0.4 wt% MnO. Olivine in RA-QD02-0179 is slightly Mg-rich (Fa<sub>26</sub>). Plagioclase is also homogeneous (An<sub>12</sub>Or<sub>6</sub>, ~0.1 wt% FeO). The SR-XRD analysis gave sharp diffraction spots, suggesting minor shock metamorphism. Olivine gives the following cell dimensions:  $a=4.77\text{--}4.78$ ,  $b=10.27\text{--}10.29$ ,  $c=6.02$  (Å), corresponding to the chemical composition of Fa<sub>31-32</sub> [3]. This matches the composition obtained by electron microprobe analysis. The cell dimensions obtained for plagioclase are  $a=8.18$ ,  $b=12.53$ ,  $c=7.13$  (Å) with  $\alpha=93.0$ ,  $\beta=116.4$ ,  $\gamma=90.2$  (°). The Fe-XANES analysis of plagioclase suggests the presence of small amounts of Fe<sup>3+</sup> although longer counting time is required in future analysis.

**Discussion and Conclusion:** The newly-analyzed particles are all compositionally close to equilibrated LL chondrites. The presence of Fe<sup>3+</sup> in plagioclase is consistent with formation under a slightly oxidizing environment which is also consistent with LL chondrites. Because the plagioclase crystallite size is larger than 2 μm, the petrologic type is ≥5. We did not find any unequilibrated particles as reported in [2]. Thus, this study further confirms that the Itokawa particles belong to equilibrated LL chondrites with minor shock metamorphism.

**References:** [1] Nagao K. et al. 2011. *Science* 333:1128–1131. [2] Nakamura T. et al. 2011. *Science* 333:1113–1116. [3] Akimoto S. and Fujisawa H. 1968. *Journal of Geophysical Research* 73:1467–1479.