THREE DIMENSIONAL STRUCTURES OF AGGREGATE-TYPE ITOKAWA PARTICLES ANALYZED BY TWO ENERGY SYNCHROTRON COMPUTED TOMOGRAPHY.

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Introduction: Particle aggregation is one of the essential processes in the early solar nebular [1, 2]. It should occur also on the surfaces of asteroids, although their processes are poorly understood. Hayabusa spacecraft returned samples from asteroid Itokawa [3, 4]. Among Itokawa particles recovered from Hayabusa's sample catcher, there exist certain amount of aggregate-type particles which are aggregate of small constituent grains. In order to understand the aggregation processes on asteroid surface, we started studying about this type of Itokawa particles.

Samples and Methods: We selected five Itokawa particles (RA-QD02-0184, RA-QD02-0236, RB-CV-0026, RB-CV-0036 and RB-CV-0044) which seems aggregate-type from their surface morphology in their electron micrographs for this study. They were placed on SiN holders and analyzed by two energy synchrotron computed tomography (CT) in BL47XU of SPring-8 for their three dimensional structures and mineral distributions [5].

Results: As a result of synchrotron CT, one of the particles is not aggregate-type but enriched in cracks, which should have been misidentified as aggregate-type from its surface morphology. Rest of them are aggregate-type, and they are divided into two groups; the ones in which small constituent grains stick together and the other which consist of small constituent grains bound each other.

Discussion: The former type of aggregate Itokawa particles could have been formed on the surface of low gravity conditions like asteroid Itokawa. On the other hand, the latter type needs higher temperature or higher gravitational forces in order to form such a binding structure. This indicates that it would have been formed in a lager parent asteroid before Itokawa.

Future works: We are now preparing simulated aggregate particles made of soda-lime glass beads. With these particles, we will test focused ion beam (FIB) process to make a ultra thin section (UTS). After checks of whole the processes of transmitted electron microscope (TEM) observation of their UTSs, we will analyze the real Itokawa particles in order to observe detail structures of grain boundaries of small constituent grains and clarify their formation processes. We are also planning to perform a test measurement of their fracture strength before measurements of real Itokawa particles [6], in order to measure one of the essential physical properties of asteroid regoliths.

References: [1] Dominik C. and Tielens A. G. G. M. 1997. Astrophys. J. 480, 647. [2] Poppe T., Blum J. and Henning T. 2000. , Astrophys. J. 533, 454. [3] Abe M. et al. (2011) LPS XXXXII, #1638. [4] Nakamura T. et al. (2011) Science 333, 1113. [5] Tsuchiyama A. et al. (2011) Science 333, 1125. [6] Kuzumaki T. et al. (2012) Diam. Relat. Mater. 25, 1.