DESIGN OF SAMPLE TRANSPORTATION CONTAINER FOR THE FIRST AO DISTRIBUTION OF HAYABUSA SAMPLES.
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Introduction: The "Hayabusa" spacecraft captured particles at the surface of a near-Earth asteroid (25143)Itokawa [1]. The sample was stored in the reentry capsule of Hayabusa, and the capsule was successfully brought back to JAXA's planetary sample curation facility in June 2010 [2]. The environment of the facility and processes experienced by the capsule and its sample container is detailed in [3].

15 particles have been distributed to NASA, based on the Memorandum of Understanding between Japan and U.S. for Hayabusa mission. The 1st international announcement of opportunity (AO) for sample analysis will be announced to any interested researchers in January 2012 [4]. We hereby report the design and preparation of the sample transportation container for its ditribution.

Container Design: The most important concept of the sample container is to deliver the small samples safely, with prevent them from terrestrial contaminants during its transportation. Typical size of the sample is less than 100 µm, so handling of the sample is performed with a micro-manipulation system in the clean chamber of JAXA's curation facility detailed in [4]. The operation of sealing the container is also performed in the clean chamber.

Structure of the sample transportation container. The container consists of a pair of outside flanges and a pair of quartz glass plates. The flanges are made by stainless steel, the same material of the clean chamber. The base flange has been machined to be able to hold a pair of glass plates with clips and screws. A cupper gasket coated with gold is set between a cover flange and the base flange. The pair of flange is then enclosed with six screw bolts to seal the pair of glass plate inside.

Inside the pair of flanges, the base plate made of quartz glass is set to contain a sample particle. It has three to five dimples whose aperture is about 1mm and depth is less than 0.5mm. The samples are putted in those dimples one by one with the micro manipulator electrostatically controlled in the cleam chamber. The metal plate is set under the base glass plate in order to increase the ability of the control the handling of the sample with the micro manipulation system. As the sample is set inside the dimple, a cover plate made of quartz glass is put upon the base plate though which the sample can be observed. The base plate is held with a metal clip and a screw and the cover plate is held with with two pairs of a clip and a screw.

Preparation and Contamination Control: Contamination control of the container is the key of the preparation, and that is focused on three topics as follows.

1. Materials of the parts of the container
2. Cleaning the parts of the container
3. Setting the sample to the container.

Materials. It is important to choose the materials of all parts of the container in order not to contaminant the sample. They are choosen on the basis of two ideas. The former is the same material used for Hayabusa spacecraft, especially the sample collecting device, such as pure alminum. The latter is distinguishable from the expected sample material, ferromagnesian silicates component of meteorites. The clean chamber is made by the stainless steel "SUS 304" categorized in Japanese Industrial Standards. Synthesized quartz is choosen for the material of the sample preservation plate since the amount of its impurities are low, around ppb for several metals.

Cleaning. Cleaning is the important process to remove contamination such as dust particles and impurities from the surface of the material. The removable impurities are particles, ions and various organics such as machine oil, grease, and human sebum.

At first, all parts are cleaned before bringing in the clean room as usual by careful wipe with ultrapure water or organic solvents. After bringing them to clean room, ultrasonic cleanings are performed. The first step of ultrasonic cleaning is to remove mainly organic impurities. Its solvent is typically 2-propanol, but some other solvents are chosen by necessity. The cleaning is repeated more than twice with the frequency of usually 40kHz. The next step of ultrasonic cleaning is to remove ions and particles. Its solvent is ultrapure water, overflowing from the ultrasonic bath in order to keep providing fresh water. The frequencies for the cleaning are 40, 100 and 950kHz. The cleaning is repeated twice at each frequency and the duration ranges from 20 to 30 minutes. After the series of ultrasonic cleanings, all metallic parts are dried in a desk top clean booth or purified nitrogen gas blow. Dried parts are assembled with tools cleaned by the same manner, and placed in a desiccator with purified nitrogen flow.

Additional cleaning is performed for quartz plates since they should contact the sample directly. They are washed by heated alkali and acid solutions to remove organics, ions, and particles again, since quartz is resistant to strong acid and alkali. The washing method is a batch cleaning refered from the RCA method for washing semiconductor wafer. The alkali and acid solutions are used twice respectively with ultrapure water rinse. After the cleaning and drying, the pair of quartz plates is assembled to the base flange of the container with cleaned tools.

After the cleaning the quartz glass plate are examined with microscopes to confirm whether the contaminant particles exist on them or not. The amount of ions and organics are evaluated with the decocted solution of test quartz pieces in ultrapure water, after the alkali and acid washing. Twenty of cations (Al, B, Ba, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Na, Ni, Pb, Si, Sr, Ti, and Zn) are examined with ICP-MS and AAS in a solvent maker and most of them are less than 1ppt. Six of anions (F, Cl, NO_2, NO_3, PO_4, and SO_4) are also evaluated with IC in the maker. Total organic carbon (TOC) is comparable to that of the ultrapure water.

Handling. Handling of the sample and sealing the container is performed in the clean chamber, so the inside of the container is filled with purified nitrogen gas whose purity should be equivalent to that in the clean chamber.

References: [1] Fujiwara A. et al. (2006) *Science, 312,* 1330-1334. [2] Abe M. et al. (2011) *LPS XXXXII,* Abstract #1638. [3] Fujimura A. et al. (2011) *LPS XXXXII*, Abstract #1829. [4] Abe M. et al. (2012) *LPS in this volume*.