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A Cleaning Method for Extraterrestrial Sample Holder

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The Hayabusa spacecraft captured particles at the surface of a near-Earth asteroid (25143)Itokawa [1]. The samples were stored in the reentry capsule of Hayabusa, and successfully brought to the Planetary Material Sample Curation Facility (PMSCF) of JAXA in 2010 [2,3,4]. They were extracted from the capsule and have been preserved in PMSCF[3,4]. Typical size of the sample is less than 100 micron, so handling of them is performed with a micro-manipulation system in the clean chamber filled with purified nitrogen [4]. Picked up samples are identified by FESEM-EDS observation, then each of them is placed on the gridded quartz glass plate in the sample holder for preservation.

Contamination control of extraterrestrial samples is essential matter, and it is important to handle and preserve samples without terrestrial contamination and alteration as possible. We hereby report the cleaning of quartz glass plates which contacts with samples directly.

The cleaning processes are performed in the clean room of PMSCF. A series of ultra sonic cleanings is a typical procedure for all materials such as metals and glasses. The first step of ultra sonic cleaning is to remove mainly organic impurities. Its solvent is typically 2-propanol. The cleaning in the solvent is repeated more than twice with 40 kHz frequency band for 20min, changing the solvent each time. The next step is to remove particles and ions. Its solvent is ultrapure water, overflowing from the ultrasonic bath to keep providing fresh water. The frequencies for the cleaning are 40, 100, and 1000 kHz bands. The cleaning is repeated twice at each frequency for 20 to 30 min. After the series of ultrasonic cleanings, water on the cleaned parts are removed by the purified nitrogen gas blow or air in clean booth.

For quartz glass, an additional acid and alkali treatment is performed after the series of ultra sonic cleanings. They are washed by heated alkali and acid solutions to remove organics, ions, and particles again. The washing method is a batch cleaning, and its procedure is our modified RCA method, originally for washing semiconductor wafer. The alkali and acid solutions are used twice respectively with ultrapure water rinse. After the cleaning and drying, the quartz glass plates is assembled to the cleaned holder or case with a cover, and stored in a desiccator filled with purified nitrogen.

The cleanness of washed quartz glass plate was evaluated with 4 methods. After our previous study [5], the detection limit was improved for metals and ions, and the analysis method was changed for organics.

1. Contaminant metals remained on the plate were extracted with 3 ml of HCl (0.35%) with H_2O_2 (0.3%), then 32 elements (B, Na, Mg, Al, K, Ca, Ti, Cr, Mn, Fe, Ni, Co, Cu, Zn, Ga, Sr, Y, Zr, Mo, Pd, Ag, Cd, In, Sn, Ba, La, Hf, Ta, W, Pt, Au, and Pb) were examined with inductively coupled plasma mass spectrometry. They were $1x10^{7}$ to $1x10^{14}$ atoms/cm^2 on the plate. Some contaminated elements are detected, but the amount of most of the elements does not affect the scientific analysis such as ion-probe measurement.

2. Contaminant ions were extracted with 60 ml of purified water, then 8 of ions (F^-, Cl^-, Br^-, $NO_2{}^-$, $NO_3{}^-$, $SO_4{}^{2-}$, $PO_4{}^{3-}$ and $NH_4{}^+$), lactic acid, acetic acid, formic acid and a few amines are examined with ion chromatography. They were less than $1x10^{-9}$ g/cm^2 on the plate.

3. Organics released by thermal desorption from the surface of the plate was collected to Tenax$^{(R)}$ adsorbent resin. The collected organics are measured with gas chromatography mass spectrometer. Total amount of the organic carbon was less than $1x10^{-8}$ g/cm^2 on the plate.

4. Contaminant particles, larger than a few micron, were not observed by microscopes.

References

[1] Fujiwara, A. *et al.* (2006) *Science* **312**, 1330. [2] Abe, M. *et al.* (2011) *LPS* **42**, #1638. [3] Fujimura, A. *et al.* (2011) *LPS* **42**, #1829. [4] Yada, T. *et al.* (2012) *MAPS* in press. [5] Ishibashi, Y. *et al.* (2012) *LPS* **43**, #2887.

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