Tests and rehearsals for curation of samples returned from asteroid Ryugu by Hayabusa2 spacecraft

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Hayabusa2 spacecraft had accomplished the 1st and 2nd touchdown sampling onto C-type near-Earth asteroid Ryugu in Feb. and Jul. 2019 [1]. The spacecraft left the asteroid in last Nov. to return its reentry capsule including recovered asteroidal samples in this Dec. We have been preparing for receiving the samples and performing their initial description at the Extraterrestrial Sample Curation Center (ESCuC) of Japan Aerospace Exploration Agency (JAXA). The recovered samples will be the first C-type asteroid samples never experienced terrestrial atmosphere. Thus we have developed clean chambers for handling the Hayabusa2-returned samples without exposing to terrestrial air and installed them into the newly developed clean room in the ESCuC [2]. The clean chambers consist of five components; CC3-1 and CC3-2 for vacuum procedures, CC3-3 for changing environment from vacuum to nitrogen condition, CC4-1 and CC4-2 for procedures in nitrogen condition.

The procedures after the recovery of reentry capsule at the landing site will be mainly done by Hayabusa2 Sampler developing team, securing the capsule, removing support frame to extract the sample container, cleaning its surface and setting it into the gas sampling system to recover gaseous sample inside the sample container. Then the condition inside the container will be kept in vacuum to be enclosed into its transportation box in which will be sealed in nitrogen condition and sent back to Japan by air. After it will arrive to Japan, it will be instantly transported to ESCuC in the JAXA Sagamihara campus, to be introduced into the class 10,000 clean room for further procedures. Subsequently, procedures for the sample container after then are planned as follows; (1) opening the transportation box to extract the container, (2) removing the heat shield using the milling machine, (3) cleaning the outer surface of the container and checking its cleanliness, (4) fixing the container into the container opening system and removing parts of container which must not be introduced to the clean chamber, (5) introducing the container to the CC3-1, (6) evacuating the CC3-1 to reach high vacuum condition, (7) opening the container, (8) extracting a sample catcher from the container, (9) transferring the catcher to the CC3-2, (10) removing the cover of the chamber A of the catcher, (11) recovering small amount of samples from the chamber A under the vacuum condition, (12) setting a temporal cover to the chamber A of the catcher, (13) transferring the catcher to the CC3-3, (14) changing the environment of the CC3-3 from vacuum to purified nitrogen condition, (15) setting the handling jig to the catcher, (16) transferring the catcher to CC4-2 via CC4-1, (17) measuring bulk weight of the samples including the catcher and the jigs and observing the interior of the chamber A of the catcher, (18) transferring the catcher to CC4-1, (19) dismantling the catcher, (20) recovering samples inside each of the chambers of the catcher, (21) transferring the samples to CC4-2, (22) measuring the weight of the samples from of the chambers of the catcher and observing them with the optical microscope, (23) picking up individual samples, (24) performing their weight measurements, optical observations, FT-IR analyses and MicrOmega analyses, and (25) enclosing them into their containers for transportation or preservation.

So far, we have done rehearsals for the procedures (4) and (9) to (14) two times for each, and will continue tests and rehearsals for each of the procedures as those necessary for them will be ready to use

until this Sep. Then we will refresh the clean chambers, instruments, jigs and tools for the procedures to be ready for receiving samples returned by Hayabusa2 in this Dec.

References:

[1] Tachibana S. et al. (2020) LPS XXXXXI, abstract #2027.

[2] Yada T. et al. (2019) LPS XXXXX, abstract #1795.

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