AMINO ACID ANALYSIS OF WITNESS COUPONS COLLECTED FROM ISAS CURATION ROOM FOR THE QUALITY CONTROL OF HAYABUSA2 RETURN SAMPLE PROCEDURE

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One of the scientific goals of Hayabusa2 mission is to understand the origin and evolution of organic materials through interactions with water and minerals in the early solar system [1]. The characterization of organic materials (i.e. chemical composition, isotopic signature, abundance, morphology of complex organic molecules, etc.) in the returned sample has great importance for this purpose. The small-scale analysis of organic materials in extraterrestrial samples needs great care with regards to terrestrial contamination including any artifact materials. Therefore, comprehensive and specific managements to minimize the terrestrial contamination throughout the mission are required. The assessment of the terrestrial contamination in the extraterrestrial samples has been performed in the past sample return missions. The Stardust mission is the first sample return mission lead by NASA, in which cometary grains were captured using aerogel from comet 81P/Wild 2 and successfully returned to the Earth. For the assessment of the organic contamination throughout the mission, "witness coupons", which consist of aluminum or sapphire plates and aerogel tile, were used to track the origin and the incorporating routs of the contaminants in each process (e.g., construction of spacecraft, flight, recovery of the sample, etc.) [2]. The analysis of the witness coupons showed that the contaminations during those processes were not significant, but the aerogel used to capture the cometary grains contains carbon in a few simple forms (mostly as $-CH_3$ groups), and Nylon-6 from a shipping bag could be a source of ε-amino-*n*-caproic acid (EACA, $NH_2(CH_2)_5COOH$, the hydrolysis product of Nylon-6) [2, 3]. In the first Hayabusa mission, the spacecraft successfully landed on the asteroid Itokawa and directly sampled the surface particles using the sample catcher [4]. More than 450 particles (in ~μm scale) of the returned samples were classified into four categories based on their chemical composition. The category 1 and 2 particles are indigenous to the asteroid, but the category 3 particles comprising carbonaceous materials are suggested to be terrestrial or artifact materials of multiple origins [5,6].

The purpose of the study is to assess the possible terrestrial organic contamination in the curation room for the Hayabusa2 mission (cf. Design for Hayabusa2 sample container [7]). There are several working flow processes by the way of curation facility. We examined witness coupons, which are 4 cm^2 (2 cm × 2 cm) aluminum foils. They were placed in the curation room in ISAS /JAXA for 1 day, 2 day, 1 week, and 1 month. We performed amino acid analysis of the witness coupons because amino acid is one of the target molecules in the Hayabusa2 mission, but also concerned about the possible terrestrial contaminants. Briefly, amino acids were extracted in hot water for 12 hours at 110°C, and then HCl hydrolyzed for 12 hour at 110°C. They were converted to *N*-pivaloyl isopropyl (Pv/iPr) ester derivatives for gas chromatographic (GC) analysis [8]. The entire procedure through the extraction, hydrolysis, and derivatization were conducted in sealed glass ampules to minimize the analytical background. As a reference of the amino acid assessment above, we also evaluated the volatile organics in the curation room (class 1000 chamber) by using a thermal desorption-gas chromatography/mass spectrometry (TD-GC/MS) [9]. We focused on aliphatic, aromatic (also, their isomer ratios), heterocyclic, and sulfur compounds (e.g., alkyl chain and aromatics with -thiol, -sulfide, -thiophene groups and elemental sulfur). The organic concentration was very small but the most abundant species were 1-Rings of benzene, toluene and phenol. Here we discuss the present results and the procedure blank of the analysis in comparison with similar report by OSIRIS-REX team [10].

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