

分子・物質合成プラットフォームにおける利用成果

Application of XANES to the analysis of carbonaceous materials in Hayabusa-returned samples for determination of their origin

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Carbonaceous particles, those have been found in the sample catcher of Hayabusa spacecraft together with silicate particles, were still under the investigations, including precise determination of their origin. Results of isotopic analysis of H, C and N of the carbonaceous materials by NanoSIMS did not show any signatures of their extraterrestrial origin, e.g. isotopic anomalies against the terrestrial composition [1]. Some of the results of analyses by Transmission Electron Microscopy (TEM, [2]) and X-ray absorption near edge structure (XANES, [3]) indicated relation to the terrestrial material. Thus, those particles might indicate the contamination of terrestrial material into the sample catcher before, during and/or after the operation of Hayabusa spacecraft.

In previous study, a particle from the witness plate exposed to the clean room of Hayabusa2 spacecraft construction, where Hayabusa1 spacecraft was constructed, was investigated by XANES/STXM installed in ALS/LBNL, Berkeley. The shape of XANES spectrum of the particle (green, WP1 in Fig. 2) closely relates to that of a Hayabusa-returned sample, RA-QD02-0180-03 (blue line in Fig. 2), and indicate the relation of them.

In this work, we investigated a particle newly picked up from the same witness plate using XANES/STXM installed in UVSOR, in order to confirm the result of previous study.

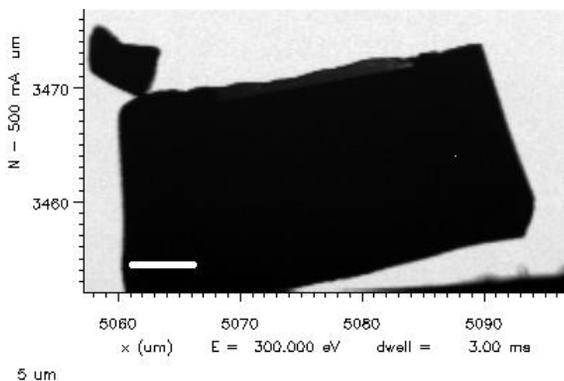


Fig. 1. STXM image of the ultrathin section of WP2 in Fig. 2. The particle was pressed on a gold plate and cut by Focused ion beam to extract ultrathin sections.

Figure 2 shows C-XANES spectra of the new particle (red, WP2) and Hayabusa-returned samples (blue, RA-QD02-0180-03). The shape of the spectra was similar, but position of the peaks of WP2 were different from others.

N-XANES spectrum of the WP2 was also largely different from other two samples. Though particles were picked up from the same witness plate and chemical composition of them was similar, those difference of XANES spectrum indicate the different origin of WP1 and WP2. The fact indicate several paths of the contamination to the sample catcher were possible, and should be considered for the precise determination of the origin of the contaminant.

In future work, we will apply the XANES/STXM analysis to further possible contaminants such as particles of biological materials.

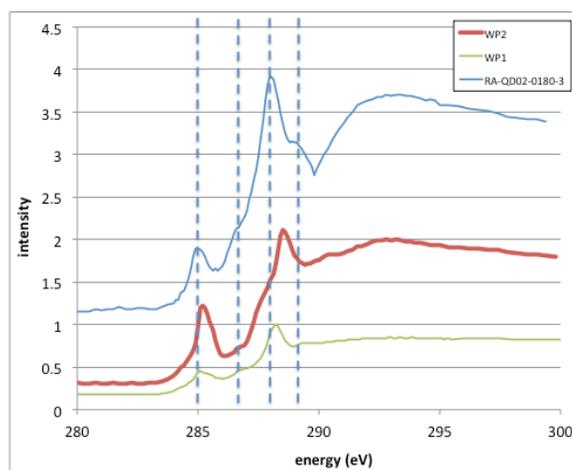


Fig. 2. C-XANES spectra of the particles from the witness plate of clean room of the Hayabusa2 spacecraft construction (green and red), and Hayabusa-returned sample (blue). Peak positions of WP2 were different from those other two samples.

[1] M. Ito *et al.*, *Earth planet. Space*, **66** (2014) 91.

[2] M. Uesugi *et al.*, *Earth planet. Space*, **66** (2014) 102.

[3] H. Yabuta *et al.*, *Earth planet. Space*, **66** (2014) 156.