Development of analytical method of Haybusa2 returned samples by multi-agency collaboration.

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In recent, we are able to obtain samples of extraterrestrial bodies, such as comets and asteroids, through direct sampling. Although the amount of those samples are not so large, and samples are less around 100 μm, we can obtain knowledges about origin and evolution of extraterrestrial bodies in solar system from many aspects, by applying the analytical methods developed for the analyses of meteorites and cosmic dusts. However, organic materials and water, those will be included in the samples obtained by future sample return missions, are easily damaged by the terrestrial contamination during analysis or sample preparations. In such cases, knowledges and experiences of analysis of extraterrestrial materials found on the surface of Earth will not be sufficient for the analysis of future analysis of returned samples. Special team for the analysis of organic particles inside the Hayabusa returned samples, called Category 3 particles, investigated the particles with several analytical methods along with the development of devices and methods for the analysis. Though they successfully reported results of their analysis, it took around 4 years after the return of the Hayabusa spacecraft.

On the bases of the experiences of such previous issues, we started the development of techniques and devices for the handling, transfer and analysis of samples returned by Hayabusa2 spacecraft from 2015, by organizing a special team constituting of members of Japan Aerospace Exploration Agency (JAXA), Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Institute for Molecular Sciences (IMS), SPring-8 and National Institute of Polar Research (NIPR). Our activity includes development of sample container for distribution of samples with inter-facility transfer, atmosphere shielding sample holder, sample holder applicable for multiple analytical devices, and trial examinations of those developed devices through the analysis of extraterrestrial materials.

In this presentation, we report the results of sequential analysis of Antarctic micro-meteorites (AMMs) which simulated the small returned particles of Hayabusa2 returned samples, as the first step of a series of flow test. 10 Antarctic micrometeorites provided by NIPR were imaged by synchrotron radiation computed tomography (SR-CT) and x-ray diffraction (XRD) at SPring-8, and investigated by high resolution field emission scanning electron microscopy and energy dispersive spectroscopy (FE-SEM-EDS) system at IMS. Through the series of non-destructive analysis, we selected AMMs those having similar characteristics of carbonaceous chondrites, and formed thin sections by focused ion beam (FIB) for the characterization of organic materials by scanning transmitted x-ray microscopy and near edge x-ray absorption fine structure analysis (STXM-NEXAFS) at IMS, high resolution analysis by transmission electron microscopy (TEM), and isotopic analysis of light elements such as hydrogen, carbon, nitrogen and oxygen by secondary ion mass spectrometry (SIMS) at JAMSTEC.

We will also show the future plan of the developments and trial examinations. We will operate the rehearsals using mm-sized Antarctic meteorites simulating anlaysis of large particles of the Hayabusa2 returned samples, along with the development of sample fabrication methods and data sharing process of

sequential analysis.

Keywords: Hayabusa2, analysis of returned samples

