A MICRO-SPECTROSCOPIC APPROACH TO THE CARBONACEOUS MATTER IN THE PARTICLES RECOVERED BY THE HAYABUSA MISSION. F. Kitajima[1], M. Kotsugi[2], T. Ohkochi[2], H. Naraoka[1], Y. Ishibashi[3], M. Abe[3], A. Fujimura[3], R. Okazaki[1], T. Yada[3], T. Nakamura[4], T. Noguchi[5], K. Nagao[6], A. Tsuchiyama[7], T. Mukai[3], S. A. Sandford[8], T. Okada[3], K. Shirai[3], M. Ueno[3], M. Yoshikawa[3] and J. Kawaguchi[3]
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Introduction: The main target of the carbonaceous matter sub-team is the insoluble organic matter (IOM) in the returned sample by the HAYABUSA mission. We are planning to analyze the matter by micro-spectroscopic techniques, such as Raman, fluorescence, infrared (IR) spectroscopy. And in addition to these techniques, we are also planning to use photoemission electron microscopy (PEEM), although the insulation of such stony samples is not suitable for this technique.

IOM is the major fraction of the chondritic carbonaceous matter, and generally assumed to be completely indigenous due to their high molecular weight and immobility. It is characterized by condensed aromatic moieties cross-linked by aliphatic and ether linkages, with various functionality external to the aromatic structure [1]. It converts gradually to graphitic matter during thermal metamorphism, and suggests to what extent thermal metamorphism has proceeded [2]. Raman spectroscopy is a useful tool to evaluate the structural ordering of the matter and the degree of thermal metamorphism [3, 4, 5]. The 1s-σ^* exiton intensity shown in carbon X-ray Absorption Near Edge Structure (C-XANES) spectra [6] and infrared spectral band of aliphatic C-H stretching [7] are alternative methods to evaluate thermal process of IOM.

The asteroid Itokawa belongs to S-type and its surface is similar to that of LL5 or LL6 chondrite. However, it is a rubble-pile object and experienced collisional breakup and re-agglomeration, suggesting the possible fragments of carbonaceous materials in Itokawa samples. If such particles are found, it can be a clue to the thermal process involved in the formation history of Itokawa.

Methods: We hope to analyze the samples as intact as possible by non-destructive method without using organic resin or adhesives. And, because recovered samples by HAYABUSA mission are considered to be small grains, we designed a sample holder made from diamond plates for Raman, fluorescence, and IR spectroscopy (PEEM analysis will be performed using potted butt, as it is located at downstream of the examination flow). One diamond plate has some hollows and each individual sample particle shall be set in a hollow at the curation facilities. This plate can be covered by another flat diamond plate, and we can carry it without using organic adhesives. This sample holder can be set directly on the sample stages of micro-Raman or micro-IR spectrometers, and we can obtain the spectra without taking out the sample grains from the holder.

Discussion: The first question is whether some particles recovered by the HAYABUSA mission contain extraterrestrial carbonaceous matter. If such carbon-containing particle is found, characterization of IOM will be performed. Micro-Raman spectroscopy is sensitive to skeletal aromatic network and it gives maturity level of IOM. The G-band position of the chondritic carbonaceous matter shifts up with increasing metamorphic grade, and the FWHM-G (Full width at half maximum of G-band) decreases [3, 4, 5]. Fluorescent background reflects overall compositional differences of IOM [4]. External functional groups will be determined by IR spectroscopy, and element-selective analysis of functional groups can be performed by PEEM. These different analytical spectroscopic features also indicate the record of thermal evolution of IOM in individual grains. Such approach can be a clue to an asteroid formation history.

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