SPACE EXPOSURE EXPERIMENTS OF CARBONACEOUS CHONDRITES, CHONDRITIC ORGANIC MATTER AND ITS ANALOGUES IN TANPOPO2, ASTROBIOLOGY SPACE MISSION ON ISS.

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Organic matter (OM) is susceptible to environmental conditions and changes its structures relatively easy. UV irradiation and high-energy particle bombardment in space environments are likely to alter OM. Therefore, it is important to evaluate modifications of OM in space environments to understand dust surface processes and asteroidal surface processes. Many laboratory experiments have been performed simulating space environments to evaluate the effects of high-energy particles and UV irradiations [e.g., 1], as well as space exposure experiments [e.g., 2]. However, the experiments focusing on chondritic organic matter are limited.

The Tanpopo mission is an astrobiology space experiment using the ExHAM facility of the Japanese Experiment Module (JEM) 'Kibo' on the International Space Station (ISS) to understand the delivery of extraterrestrial organic compounds to the Earth and potential interplanetary transfer of life [3]. The Tanpopo2 is the successor of the Tanpopo mission, and will be launched in the summer of 2019. One of the Tanpopo2 exposure panels, the Tanpopo2-QCC exposure panel (TNP2QCC, Fig. 1) [4] features the direct exposure to solar radiation without MgF_2 or SiO_2 windows that were used in the exposure experiments of Tanpopo. The TNP2QCC is dedicated for exposure experiments to understand the organic evolution from circumstellar medium, molecular clouds and the Solar System small bodies, including the exposure of quenched carbonaceous composite (QCC) [5], nitrogen-included QCC [6] and simulated interstellar organics [7]. The exposure experiments of carbonaceous chondrites, chondritic IOM, and analog material of chondritic organic matter are one of subthemes of the TNP2QCC.

We prepared the Murchison meteorite powder, the Tagish Lake meteorite powder, insoluble organic matter (IOM) from Murchison, Leonardite humic acid standard (obtained from International Humic Substances Society), organic solid prepared by the method described in Kebukawa et al. [8] (250ºC, 72h). The powdered samples are pressed on gold substrates and indium substrates (10 mm diameter, Fig. 2A), with and without MgF_2 windows. These samples will be analyzed with attenuated total reflection Fourier-transform infrared spectroscopy (ATR-FTIR) and nanoscale secondary ion mass spectrometry (NanoSIMS). 100-nm thick sections were prepared with focused ion beam (FIB), and covered with MgF_2 windows to avoid destruction by reactive oxygen species at lower Earth orbit. The FIBed sections will be analyzed with scanning transmission X-ray microscopy (STXM) and NanoSIMS. In addition, special holders (Fig. 2B) were made for visible-infrared (VIR) diffuse reflectance spectroscopy for selected samples (Murchison and humic acid).

We will present the current status of the exposure experiments, as well as ongoing laboratory UV irradiation experiments using the equivalent flight samples.

Fig. 1: The sample exposure pael equivalent to the flight model (99.5 mm × 19 mm). (A) Exposure surface and (B) back side for dark controls.

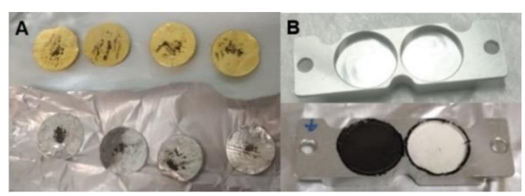

Fig. 2: (A) the Murchison mteorite powderes pressed onto Au (upper) and In (lower) substrates (the flight samples). (B) The sample holders for VIR diffuse reflectance spectroscopy equivalent to the flight model without samples (upper) and with dummy powderes (lower). The inner diameter is 10 mm.

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