Discovery of Micrometeoroid Impact Signatures on the Tanpopo Aerogel Panels: Early Report of the Initial Sample Analysis of Its First Year Samples Retrieved back to the Earth

*Hajime Yano[1], Satoshi Sasaki[2], Junya Imani[2], Daiki Horikawa[3], Yuko Kawaguchi[4], Yoko Kebukawa[5], Kyoko Okudaira[8], Hajime Mita[6], Takashi Ozawa[7,1], Kazuyoshi Arai[3], Masaru Tomita[3], Eiichi Imai[9], Makoto Tabata[10], Shin-ichi Yokobori[4], Hirofumi Hashimoto[1], Akihiko Yamagishi[4]

1. Japan Aerospace Exploration Agency, 2. Tokyo University of Technology, 3. Keio University, 4. Tokyo University of Phermacy and Life Sciences, 5. Yokohama National University, 6. Fukuoka Institute of Technology, 7. Hosei University, 8. University of Aizu, 9. Nagaoka University of Technology and Science, 10. Chiba University

The “TANPOPO” mission, named after dandelion, has been Japan’s first astrobiology space experiment onboard the International Space Station-Kibo Exposed facility since May 2015, in order to test various aspects of the “quasi-panspermia” hypothesis for exogenesis origin of life precursors and their interplanetary transport. In May and November 2015, the first year samples were installed on a small pallet called “ExHAM” on the handrail of the ISS-Japan Experiment Module (JEM), or Kibo, Exposed Facility (EF) in the duration of 1-3 years. The first year exposed samples were successfully retrieved back to the Earth in August 2016; then the initial sample analysis and curation (ISAC) activity at ISAS had started since late September 2016, by a team of scientists gathered from planetary science to microbiology fields.

By analyzing captured micrometeoroids in the aerogels, one can learn what kinds of extra-terrestrial organic compounds inside micrometeoroids can be transported from parent bodies and how they may be altered in outer space. Also by evaluating retrieved samples of exposed terrestrial microbes and astronomical organic analogs on the exposure panels, one can investigate their survivals and alterations in the duration of interplanetary transport. These samples continue to be returned to ground laboratories after retrieval to the Earth in 2017, 2018 and finally 2019.

The TANPOPO employs blocks of ultra-low dense aerogels on the Capture Panels (CP) that are exposed and retrieved to capture impacting solid microparticles such as organic-bearing micrometeoroids and possible terrestrial particles in the low Earth orbit. In case of microparticles of terrestrial origin impacted into the CPs, one can test if terrestrial microbes (e.g., aerosols embedding microbial colonies) may be present, even temporarily and in “freeze dry” form in the low earth orbit altitudes. Also by evaluating retrieved samples of exposed terrestrial microbes and astronomical organic analogs on the Exposure Panels (EP), one can investigate their survivals and alterations in the duration of interplanetary transport.

The TANPOPO experiment consists of following six sub-themes: 1) capture of microbes in space, 2) exposure of microbes in space, 3) exposure of organic compounds in space, 4) capture of organic compounds in micrometeoroids in space, 5) evaluation of ultra low-density aerogel developed for the Tanpopo mission, and 6) capture of space debris at the ISS orbit. Each will utilize one or more CP and EP samples from various pointing faces onboard the ExHAM as the ISS is a earth gravity gradient three-axis stabilized satellite.

The ISAC procedure has covered from the receipt of retrieved samples, their initial inspection and documentation, processing and distribution of the samples for detailed analyses of each sub-theme,

cataloging for data archiving and to sample storage. For initial inspection and documentation, the Captured Particles Location, Observation and Extraction System (CLOXS) mapped and measured more than 60 hypervelocity penetration tracks and captured particles (e.g., incoming angle, track depth and track volume) on 8 of the first year tanpopo aerogel panels at the ISO-1 level clean environment achieved at the ISAS clean room. Then the CLOXS then processed keystones containing microparticles to be inspected and their penetration tracks for allocation to respective sub-theme researchers, in accordance with their requests for the subsequent detailed analyses within the first 100 days after the Earth sample return, i.e., by January 2017.

Keywords: Microbes, Panspermia, Sample Analysis and Curation

