

たんぽぽ：国際宇宙ステーション曝露部での宇宙塵と微生物の曝露および捕集実験の初年度結果報告

First year report of the Tanpopo: Capture and Exposure Experiment of Micrometeorite and Microbes on Exposure Facility of International Space Station

*山岸 明彦¹、橋本 博文²、矢野 創²、横堀 伸一¹、小林 憲正³、三田 肇⁴、藪田 ひかる⁵、東出 真澄⁶、田端 誠⁷、河合 秀幸⁷、今井 栄一⁸

*Akihiko Yamagishi¹, Hirofumi Hashimoto², Hajime Yano², Shin-ichi Yokobori¹, Kensei Kobayashi³, Hajime Mita⁴, Hikaru Yabuta⁵, Masumi Higashide⁶, Makoto Tabata⁷, Hideyuki Kawai⁷, Eiichi Imai⁸

1. 東京薬科大学生命科学部、2. 宇宙科学研究所、3. 横浜国立大学、4. 福岡工業大学、5. 広島大学、6. 宇宙航空研究開発機構、7. 千葉大学、8. 長岡技術科学大学

1. Tokyo University of Pharmacy and Life Science, Department of Molecular Biology, 2. ISAS/JAXA, 3. Yokohama National University, 4. Fukuoka Institute of Technology, 5. Hiroshima University, 6. Japan Aerospace Exploration Agency (JAXA), 7. Chiba University, 8. Nagaoka University of Technology

Purpose of Tanpopo mission

Tanpopo, a dandelion in Japanese, is a plant species whose seeds with floss are spread by wind. We proposed this mission to examine possible interplanetary migration of microbes, and organic compounds at the Exposure Facility of Japan Experimental Module (JEM: KIBO) of the International Space Station (ISS).

We are testing the panspermia hypothesis, which proposes the interplanetary transfer of life. We are also testing if the organic compound may be transferred from space before the origin of life on the earth. The Tanpopo mission consists of six subthemes: Capture of microbes in space (Subtheme 1), exposure of microbes in space (Subtheme 2), analysis of organic compounds in interplanetary dust (Subtheme 3), exposure of organic compounds in space (Subtheme 4), measurement of space debris at the ISS orbit (Subtheme 5), and evaluation of ultra low-density aerogel developed for the Tanpopo mission (Subtheme 6).

Apparatus developed for Tanpopo mission

We have developed two types of apparatus used for Tanpopo mission: Capture Panels for aerogel to capture micro-particles and Exposure Panels for exposure of microbes and organic materials. Each Capture Panel contains a silica aerogel block in an aluminum mesh container. Silica aerogel, which is the lowest density solid material, is used to capture micro particles, which may include, micrometeorite, artificial space debris and earth-originated natural particles. We are going to analyze if the particles contain terrestrial microbial cells or not.

Exposure Panels have been developed to expose microbes and organic compounds to the space environment. Several microbial species including, *Deinococcus radiodurans*, *Deinococcus aerius*, *Deinococcus aetherius*, *Nostoc sp.*, *Schizosaccharomyces pombe*, have been exposed to the space environment. These species are expected to be resistant against space environment, vacuum, desiccation, temperature-cycle, UV and ionization radiation. We are testing the survival of these species after one-, two- and three-year exposure in space. Organic compound such as amino acids and the precursors have also been exposed.

Schedule of Tanpopo mission

Tanpopo apparatus was launched on April 2015. The Panels were placed on the Exposed Experiment Handrail Attachment Mechanism (ExHAM) in the ISS. The ExHAM with Panels were placed on the Exposure Facility of KIBO (JEM) with the Japanese robotic arms through the airlock of KIBO on May 2015. The first set of Capture Panels and an Exposure Panel were retrieved on June 2016, contained in plastic bags, and stored in the pressurized area of the International Space Station. They have returned to the ground in the space capsule, and returned to JAXA, September 2016.

Exposure Panel was separated into each Exposure Unit, each harboring either microbe or organic compound was handed over to the scientist in charge of each microbe or organic compound. Some of the Units are dedicated to the UV or radiation dose measurement.

Each aerogel block of each Capture Panel was examined for the particles captured and the tracks made upon the impact, which were extracted from the aerogel block and handed over to the scientists. The analysis includes, fluorescence microscopic inspection to test if there are microbial cells or not. Particles and tracks will be used for the mineral analysis as well as the analysis of organic compounds.

References:

- 1) A. Yamagishi, H. Yano, K. Kobayashi, S. Yokobori, M. Tabata, H. Kawai, M. Yamashita, H. Hashimoto, H. Naraoka and H. Mita, "TANPOPO: astrobiology exposure and micrometeoroid capture experiments." International Symposium on Space Technology and Science (ISTS) Web Paper Archives. 2008-k-05 , 2008.
- 2) Y. Kawaguchi, S. Yokobori, H. Hashimoto, H. Yano, M. Tabata, H. Kawai H, and A. Yamagishi, "Investigation of the interplanetary transfer of microbes in the Tanpopo mission at the Exposed Facility of the International Space Station," *Astrobiology* Vol. 16, pp. 1-14, 2016

キーワード：国際宇宙ステーション、曝露実験、微生物、有機物、エアロゲル、宇宙塵

Keywords: International Space Station, Exposure Experiment, Microbes, Organic compounds, Aerogel, Micrometeorite