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SPACE DEBRIS SYMPOSIUM (A6)
Hypervelocity Impacts and Protection (3)

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MEASUREMENT OF MICRO-DEBRIS FLUX VIA TANPOPO CAPTURE PANEL ONBOARD THE ISS KIBO EXPOSED FACILITY

Abstract

Micron-sized space debris cannot be detected by ground-based observation network while it is important to better understand the debris flux in order to properly assess impact risk of spacecraft on the low earth orbit. The purpose of this study is to directly measure micro-debris flux in the orbit of the International Space Station (ISS) as a part of the TANPOPO mission. In this mission, the Capture Panel (CP), which is composed of ultra-low-density aerogel and Aluminum-alloy case will be exposed in the low earth orbit and retrieved back to ground laboratory after 1 year of exposure each. The CPs will be installed at 3 pointing faces (space East/ram and North/anti-PM) of the Exposed Experiment Handrail Attachment Mechanism (ExHAM) attached onto the Kibo Exposed Facility. This cycle is repeated up to three times. In order to estimate impact flux, a 3-D model of the ISS was generated by Turandot, a debris impact risk assessment tool developed by JAXA; then impact flux was quantitatively estimated by using the reference dataset of the MASTER-2009. As the result, the estimated impact number on the ram pointing face CPs was the highest among the three faces in 1 year-long exposure in the ISS orbit, and approximately 70.8 impacts by both orbital debris and meteoroids larger than 1 micron in diameter were expected on all the CPs on the ram face, which was 400 cm2 in total exposed area. Therefore, a sufficient amount of impact microparticles is expected to be captured for post-retrieval analysis on the ram face CPs. Also, correlation between crater morphology and impact energy must be evaluated to derive information regarding impactor's origin, such as debris vs. meteoroids, For the TANPOPO CPs, impact signatures will be formed only on the aerogel modules but also on the Al-alloy case surfaces. Since hypervelocity impact studies on Al alloys have been extensively conducted in the past, impactor properties can be reliably estimated from end-product craters on the CP case surfaces. In this regard, hypervelocity impact experiments to the same Al alloy plates (A7075-T651) as the TANPOPO CPs were conducted with the two-stage light gas gun at ISAS/JAXA. Projectiles of pure aluminum, alumina and steel were launched by the sabot-bulk shot technique at 6 to 6.5 km/s velocity. Morphology of the impact

craters was measured by a 3-D laser microscope. From this data, a relationship between impact condition of projectiles and the morphology was investigated.