IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 1 (2A)

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DEVELOPMENT OF CUBESAT MOON LANDER OMOTENASHI

Abstract

OMOTENASHI (Outstanding MOon exploration TEchnologies demonstrated by NAno Semi-Hard Impactor) will be the world's smallest moon lander. It will be launched by NASA's Space Launch System (SLS) Artemis-1 with Orion spaceship in 2020 or later. The missions objectives of OMOTENASHI are (1) demonstration of nano-lander technology and (2) observation of radiation environment in Cis-lunar region. In the near future, industry, academia, and even individuals will be able to easily participate in space exploration. In the presentation, the system design of the spacecraft and current development status including some test results are shown.

Since it must be within 14 kg mass and 6U CubeSat size, some new technologies have to be developed. To decelerate the orbital velocity from 2500 m/s, a small solid rocket motor is employed. However, because it cannot decelerate whole 14 kg spacecraft, unnecessary part of the spacecraft should be separated before deceleration. That is, the spacecraft consists of Orbiting Module (OM), Rocket Motor (RM), and Surface Probe (SP). After the OM will be separated, only the SP whose mass is 715g will arrive to the moon surface.

Since deceleration maneuver is conducted by the solid rocket motor, roughly 50 m/s velocity error at the impact on the moon surface will remain. To withstand the high speed impact, three types of shock absorption are used. First one is a crushable material which is sandwiched between the SP and the RM and impact shock from RM side will be reduced by the material. In case of impact from the other side, an air-bag will be used. The air-bag will be inflated in orbit. Finally, epoxy filling of the instrument box of the SP will cope with the shock which will be decreased to roughly 8500 G by the crushable material or the air-bag.

We have already completed spacecraft hardware development and environment tests and are currently conducting software tests considering in-orbit operation. In the presentation, after the brief explanation of the mission and the spacecraft design, test results including the development of the Attitude and Orbit Control simulator are shown.