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

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# CUBESAT SEMI-HARD MOON IMPACTOR: 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 SLS (Space Launch System) EM-1 (Exploration Mission-1) with Orion spaceship in 2018. The missions 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. To realize such a world, technologies demonstrated by OMOTENASHI will contribute very much. The observation of radiation will be helpful for future human exploration.

To realize the spacecraft within 14 kg mass and 6U CubeSat size, some new technologies have to be developed. The smaller the spacecraft is, the more mass of structure and bus components become dominant. For example, the propulsion system by which whole 14 kg spacecraft can land on the moon surface could not be realized. Therefore, minimization of the Surface Probe is essential. (current mass allocation is 400 g) To decelerate the orbital velocity of about 2500 m/s, a solid motor is used, considering Isp (specific impulse) and dry mass of the propulsion system. Moreover, even the ignitor for the solid motor should be separated just after ignition in order to reduce deceleration mass. To realize this concept, a laser ignitor is introduced.

Though precise and robust trajectory control is indispensable, a few tens m/s error at the impact on the moon surface should be considered. To stand high speed impact, a shock absorption mechanism is needed. Currently, two options are studied. One is the use of an air-bag. The other is covered with crashable material.

Microminiaturization of the communication system is another important development. For the link between Earth and Moon, 1 W radiation power is needed, but size, mass, and power consumption should be minimized. Based on the transponder for the PROCYON spacecraft (launched in 2014), a new transponder is under development that will have a mass of a few hundred grams and will consume 10 W.

In this paper, mission outline, spacecraft configuration, and some newly developed technologies are shown.