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A TRADE STUDY OF GREEN PROPELLANT OPTIONS FOR FUTURE LUNAR MISSION

**Abstract**

After the project Apollo's first successful human landing on the Moon in 1969, whole lunar exploration programs of the United States have been suspended over 20 years due to enormous financial expense and a rapid decrease of interest in Moon. But since two low cost lunar orbiters, the Clementine and the Lunar Prospector, were launched by US again from mid of 1990s, an interest in Moon revived, and thus the lunar exploration programs have been restarted though related activities were low-key compared to the frantic efforts over the past decades. Recently, several nations progress their own lunar exploration program successfully, such as SMART-1 from ESA, Chinese Chang'E-1 and -2, Japanese SELENE-Kaguya, Indian Chandrayaan-1, US Lunar Reconnaissance Orbiter, GRAIL and LADEE missions.

But rocket propellants commonly used in a propulsion system for the most lunar orbiters are toxic and carcinogenic, which can cause severe harmful effect to human health. Thus, the significance of more environmental friendly "green propellant" is gaining a greater interest in recent years with an increasing level of future space missions and applications. Although the current research status remains mostly at a development level and shows many technical challenges to overcome, the green propellant has a strong possibility to be employed as a major propulsion system for the future space exploration missions due to its various performance benefits with minimal environmental impact.

The major objective of the present study is to set up a principal guide to examine benefits of the green propellant for a future lunar mission. To do this, the mission requirements and onboard propulsion types of various small lunar orbiters launched since 1990 will be surveyed first. Then the characteristics of the some green propellants are considered for a given lunar mission to estimate the required propellant mass, the tank size as well as the delta-V.