

## 【Grant-in-Aid for Scientific Research (S)】

### Science and Engineering (Engineering)



#### Title of Project : All-round Micro-propulsion System for Multipurpose Utilization of Microsatellites

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Research Area : Integrated Engineering

Keyword : Aerospace Engineering, Propulsion/Engine, Microsatellite, Electric Propulsion, Plasma

#### 【Purpose and Background of the Research】

Recently, practical usages of microsatellites have progressed considerably worldwide. In 2015, 10% of risk money in USA was invested to new space business represented by microsatellites and NASA is planning to use them as pathfinders for innovative technologies in deep space explorations. One of the key technologies is micro-propulsions, propulsion systems for microsatellites. Increasing mission varieties are requiring various propulsive functions to a propulsion system. Moreover, microsatellites' rideshare launches and agile development adapting for them require ultra-green propulsion system which does not use any high pressure gas and toxic materials. Purposes of this research are realizing high-capability propulsion systems using ultra-green propellant for microsatellites.

#### 【Research Methods】

The research consists of performance improvement of the ion thruster using water propellant, development of reaction control systems using green propellant, and collaborative development with microsatellite system.

Water has been regarded as an ideal propellant due to its safety, availability, and future procurement on the Moon and Mars. However, conventional ion thrusters have plasma sources significantly vulnerable for oxidization and they could not use water as its propellant. On the other hand, the ion thruster addressed here has plasma sources driven by microwave discharge which are tolerant for oxidization and usage of water.

Development of microsatellites has different features from conventional ones by strong interactions between components and considerably short development period. Hence their development style is different also from conventional ones. Key is

a collaboration of propulsion system and satellite system from their initial phases of research and development. In this research, they are jointly conducted sharing all features of the propulsion and satellite system each other.

#### 【Expected Research Achievements and Scientific Significance】

This research will generate micro-propulsion systems having various propulsive capabilities and high safety/handling-ability, which will expand the mission varieties by microsatellites. In particular, research of the ion thruster using water will provide effective tools understanding complicated molecular plasma which has wide applications in industry. Moreover, collaboration of a propulsion system with satellite system since their initial phase will suggest a new and effective style of microsatellite research and development.

#### 【Publications Relevant to the Project】

- Koizumi, H., Kawahara, H., Yaginuma, K., Asakawa, J., Nakagawa, Y., Nakamura, Y., Kojima, S., Matsuguma, T., Funase, R., Nakatsuka, J., and Komurasaki, K., Initial Flight Operations of the Miniature Propulsion System installed on Small Space Probe: PROCYON, Transactions of Japan Soc. for Aeronautical and Space Sci., Aerospace Technology Japan, 2016, to be published.
- Takao, Y., Hiramoto, K., Nakagawa, Y., Kasagi, Y., Koizumi, H., and Komurasaki, K., "Electron extraction mechanisms of a micro-ECR neutralizer," Japanese Journal of Applied Physics, Volume 55, Number 7S2, 2016

【Term of Project】 FY2016-2020

【Budget Allocation】 128,800 Thousand Yen

#### 【Homepage Address and Other Contact Information】

<http://www.al.t.u-tokyo.ac.jp/koizumi/html/htdocs/>



Figure 1 Ion thruster using water as the propellant