

Development of evaluation technology by numerical analysis and short duration microgravity experiment for propellant management device in propellant tank

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Biography

Dr. Ryoji Imai is a professor at Department of Mechanical, Aerospace and Material Engineering, Muroran Institute of Technology Japan. He received a Doctorate in Faculty of Engineering Science at Osaka University in 1995. He had been belonging to research institute in IHI Corporation from 1989 until 2014. During carrier in IHI, he was in charge of research and development on fluid management technology in microgravity condition, thermal problem on propulsion system, and solving some thermal problems related to nuclear power plant, LNG plant, and so on. His current research interests are dynamic wetting behavior, propellant management technology under microgravity condition, and propulsion system for unmanned supersonic airplane

Abstract

In propellant tanks equipped on artificial satellites, Propellant Management Devices (PMDs) which acquire a liquid propellant at its exit and separates a gas in microgravity condition are installed. In this lecture, hydraulic design of vane type PMD utilizing capillary force, development of numerical analysis technology of fluid behaviors under microgravity condition, in which surface tension and wettability are dominant, and evaluation test by short duration microgravity experiment using drop shaft facility are introduced. As an example for these activities, Figure 1 shows liquid behavior in water tank with vane type PMD under microgravity condition. This water tank will be applied in our developing propulsion system utilizing hydrogen production reaction by aluminum powder and pure water. Figure 2 show general description of this propulsion system. Hydrophilicity coating of silica was covered on tank wall and vane surface to improve wettability and strengthen the effect of capillary force, and it was verified that liquid acquisition was successfully achieved by present vane type PMD (see Fig.1). In addition of this, evaluation tests for performance of PMD in long duration test by artificial satellite and numerical analysis of dynamic wetting behaviors and their evaluations by short duration microgravity experiments will be introduced.

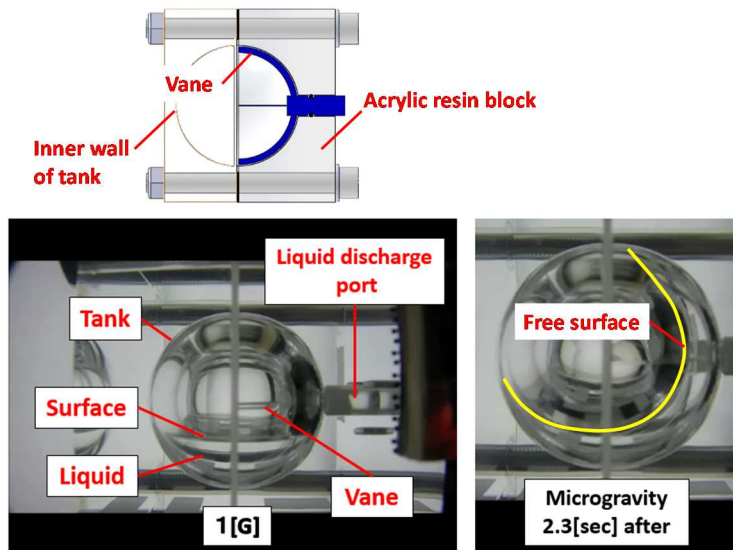


Fig.1 Behavior of water in tank with vane type PMD
Silica coating is covered on tank wall and vane surface.

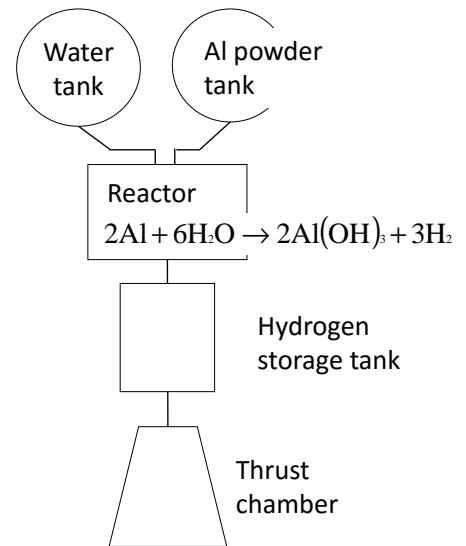


Fig.2 Propulsion system utilizing hydrogen production reaction by aluminum powder and pure water