

SPACE PROPULSION SYMPOSIUM (C4)

Joint Session between IAA and IAF for Small Satellite Propulsion Systems (8-B4.5A)

Author: Ms. Ayana Banno

Chiba Institute of Technology, Japan, s1671033kw@s.chibakoudai.jp

Dr. Yutaka Wada

Chiba Institute of Technology, Japan, yutaka.wada@p.chibakoudai.jp

Dr. Hiroshi Hasegawa

NOF CORPORATION, Japan, hiroshi_hasegawa@nof.co.jp

Mr. Motoyasu Kimura

NOF CORPORATION, Japan, motoyasu_kimura@nof.co.jp

Prof. Keiichi Hori

Japan Aerospace Exploration Agency (JAXA), Japan, hori@isas.jaxa.jp

DEVELOPMENT OF GAP/AP SOLID PROPULSION SYSTEM FOR ULTRA-SMALL SATELLITE

Abstract

This study is the development of small solid rocket motor with Glycidyl Azide Polymer (GAP) / Ammonium Perchlorate (AP) propellant for an ultra-small satellite.

GAP is one of the most prospective high energy materials. It has a high heat of formation, high density, and excellent hazard properties. Applications of GAP have been widely investigated for fuel binder of composite propellants, a solid fuel of hybrid rockets and ducted rockets. For its high-density property, GAP/AP propellant has higher density specific impulse than other solid propellants such as HTPB/AP. These characteristics enable to be miniaturization of the thruster and produce a small propulsion system. This system is expected as the motor for ultra-small space probes as the way to transfer from landing point to target point on an asteroid. This small propulsion system with GAP/AP which mass ratio are 20/80, was designed based on the results of the theoretical calculation. This system has 10 N of average thrust at 1.0 MPa of the chamber pressure. The motor case is 30 mm length, and a 24 mm outer diameter that contain solid propellant and nozzle. In these conditions, this system is estimated 184 s of specific impulse and 14.7 N-s of total impulse. The propellant weight is required 8.1 g, and it is possible to be 20.5 g of the total weight of this system that the components other than the propellant are made of Bakelite.

The various test is performed to obtain some properties. The linear burning rate is measured in the nitrogen gas ambient condition at various pressures. The adhesiveness on the Bakelite motor case is investigated by a tensile tester. Both of them is attempted to adhere to surface treatment using a primer containing a urethane bond. Thrust and combustion pressure is measured by combustion test, and ignitability of this propellant is measured by combustion test in vacuum environments. The characteristics of fundamental combustion and the performance evaluation of this propulsion are presented in this congress.