SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (4)

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DEVELOPMENT OF NANOSATELLITE PROPULSION SYSTEMS

Abstract

Nanosatellites have evolved over the last years to powerful instruments not only for education purposes but also for test beds for new technology developments. However, the mission range of such small satellites is limited since autonomous propulsion and active attitude control was until now an unachievable goal due to their stringent mass, volume and power limitations.

The present paper summarizes the theoretical and experimental efforts to develop a miniaturized Pulsed Plasma Thruster (PPT) for attitude control and an advanced Field Emission Electric Propulsion (FEEP) for v control.

The Pulsed Plasma Thruster (PPT) recommends itself for such an application due to its structural simplicity and low power requirements. However, albeit several efforts worldwide were ongoing to develop such a system the generally lacked required miniaturization and lifetime. The present paper presents a system consisting of four miniaturized PPTs, installed on a single PCB. The system has a total power requirement of ¡ 2 W, and weights roughly 250 g. The lifetime of an individual PPT has been experimentally verified to be larger than 600,000 discharge cycles. The system of four PPTs can deliver an impulse bit of 7Ns on average and can deliver a total v of roughly 11 m/s to a CubeSat.

A rather unlikely candidate for nanosatellite propulsion system is the Field Emission Electric Propulsion system. However, recent advances have allowed to develop a miniaturized system with a power demand corresponding to the one available on a double CubeSat. While, e.g. the Mircopropulsion system developed for LISA Pathfinder (Indium Needle FEEP) requires roughly 7 W to generate 100N, the power demand of the present system is roughly 4 W and has a thrust range between 0.03 – 0.1 mN. The volume of the system, including the PPU is roughly 700 cm3 and its shape is such that is fits within a standardized CubeSat. The present paper summarizes the development of this system and its experimental investigation.