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MULTISTAGE LOW POWER HALL THRUSTER WITH A CYLINDRICAL METAL DISCHARGE CHANNEL

Abstract

Small spacecraft with low onboard power are becoming more and more in demand. To control the movement of such spacecraft, efficient propulsion systems with a power consumption of less than 100 W are required. Hall thrusters are known for their energy efficiency, however, traditional schemes of such thrusters with power consumption of less than 300 W do not allow creating devices with acceptable efficiency and lifetime, since there is not enough space to accommodate an appropriate magnetic system. However, there is a type of Hall thrusters known as HEMPT (High Efficiency Multistage Plasma Thruster), in which the magnetic field is applied in the form of several arched rings located along an extended cylindrical discharge channel. As a result, several Hall current regions are created. The magnetic field of each of the stages is adjustable, and their ratio can be optimized for the selected mode. Known models of such thrusters have good performance. Several attempts to create low-power devices have been made, but at the moment the threshold of 100 W has not been overcome. Also, in known models, the discharge channel is always dielectric, which makes it expensive to manufacture and fragile. Therefore, a scheme of a HEMPT type thruster with a metal discharge channel is proposed. The channel is isolated from the rest of the thruster components and acquires a floating potential during operation. In this work, a laboratory model of such a thruster with the following parameters was created and tested: a discharge channel diameter of 10 mm, a discharge channel length of 32 mm, three stages of electromagnetic coils, and a maximum induction in a stage on the channel wall of 0.04 T. The device showed operability with argon, krypton and xenon. The most interesting primary results were obtained with krypton: at a propellant flow rate of 0.5 mg/s, a discharge current of 0.5 A was achieved at a voltage of 128 V. Further tests are planned in order to optimize the operating modes and to obtain full performance characteristics of the proposed thruster model.