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RLC-CIRCUIT PARAMETERS INFLUENCE ON ABLATION PULSED PLASMA THRUSTER PERFORMANCE*

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Nowadays CubeSat nanosatellites are widespread technology in space industry. Due to the low manufacturing and launch price, CubeSat is an attractive option for testing new technologies, for observation and etc. Sometimes a low-thrust propulsion system is required on these satellites for increasing lifetime and number of satellite abilities. Electric propulsion systems (EPS), which can generate thrust about 1 μN…10 mN fit this requirement the best [1].

However there are a number of restrictions on power supply, propulsion system volume and mass for CubeSats due to their small dimensions. Some EPS (for example, GIT or Hall thrusters) suffer from performance decrease and manufacturing complication at low powers. This raises satellite's price [2].

In this regard ablation pulsed plasma thruster (APPT) is considered as a promising propulsion system for nanosatellites. APPT operation is stable at low power supplies; this thruster uses solid dielectric material as propellant. This makes propellant supply system simple and propulsion system's price low.

APPT operation principle is mass acceleration by electromagnetic and gas dynamic forces. Mass flow with thermal velocities makes specific impulse low. So processes in APPT have to occur under optimal conditions in order to make most amount of mass accelerated by electromagnetic forces [3, 4]. One of the promising ways to organize optimal mass acceleration is matching energy distribution during the impulse.

Experimental and theoretical studies of ablation and acceleration processes matching with thruster performance parameters were carried out. Electrical parameters variation in RLC-circuit allows managing the decay factor and natural angular frequency in current and voltage oscillations. This can lead to circuit released power changing during the same time.

Since the determining resistance value in the circuit is the plasma resistance, an increase in the other elements resistance will lead to power release on the element with the highest resistance value. This will lead to the fact that less energy will be delivered to the plasma so the efficiency will decrease.

In this regard, energy storage capacity and circuit inductivity were varied for studying the current oscillation influence on thruster performance parameters. In each case current waveform data and impulse bit were measured. Impulse bit was measured by shooting method.

Measured data allows estimating impulse bit of the plasma filament contribution to the total impulse bit measured by shooting method. Based on experimental data, an assumption was made. It is assumed that most amount of plasma filament, which takes part in electromagnetic acceleration, left discharge channel during the first period.

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