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Improvement on the Ionization Rate of Hall Thruster with High Voltage

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With the development of spaceflight mission, high special impulse becomes significant trend of Hall Thruster. Improving the discharge voltage is the most effective way to achieve high special impulse. Because of the limit of total power, the increase of voltage means the decrease of mass flow rate of neutral propellant, and ionization rate is significantly related to the neutral density. Decreasing the mass flow rate will decrease the neutral density, which leads to the decrease of collision frequency, and ionization rate. At the same time, when increasing the discharge voltage together with reducing the mass flow rate to maintain the constant discharge power, the acceleration layer widens mainly towards the anode, the ionization zone increases in both directions and shifts towards the anode. That means the overlap of ionization region and acceleration region, which also decreases the performance of thruster. To improve the ionization rate of Hall Thruster with high voltage, this article advances a gas distributor with azimuthal gas injection technique such that the propellant enters the discharge channel with azimuthal velocity, and thus longer neutral residence time. That increases the electron-neutral collision rate, and thus higher ionization rate. Experimental results show that a gas distributor with azimuthal gas injection technique can effectively improve the ionization rate at high voltage and low mass flow rate.

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