SPACE PROPULSION SYMPOSIUM (C4)
Advanced and Combined Propulsion Systems (8)

Author: Mr. Daixian Zhang
College of Aerospace Science and Engineering, National University of Defense Technology, China, zhangdaixian@163.com

Dr. Jianjun Wu
National University of Defense Technology, China, jjwu@nudt.edu.cn
Dr. Rui Zhang
College of Aerospace and Materials Engineering, National University of Defense Technology, China, nudtzhang@163.com
Dr. Zhen He
College of Aerospace and Materials Engineering, National University of Defense Technology, China, hezhen_2012@sina.com
Mr. Fan Zhang
China, fallinfall1024@gmail.com

DESIGN AND PERFORMANCE STUDY OF A NEW LASER-ELECTROMAGNETIC COUPLING PLASMA THRUSTER

Abstract

An experimental study on rectangular laser-electromagnetic coupling thrusters was conducted. The laser-electromagnetic coupling thruster was consisting of a ceramic combustor and a rectangular eletrode configuration. The propellant (Teflon in the test) placed in the ceramic was irradiated by a nanosecond pulsed Nd:YAG laser with wavelength of 1064nm, pulse width of 7ns and single pulse energy of 0-600mJ. And the plasma plume formed and expanded through a isolated ceramic cube to the rectangular eletrode with voltage of 0-3000V. Once the plasma arrived the field between the electrodes, the discharge process was induced to enhance the ionization and accelerate the plasma. In the discharge process, the netrual gaseous or large particles produced by laser ablation were further heated and ionized. Therefore the thrust performance may be improved. Besides, the consumption and ablation rate of propellants was controllable as the mass shot was decided by the laser ablation conveniently. Experimental measurement of discharge characteristics, impulse bit and mass shot was conducted. From the measurement, thrust performance showed impulse bit of 480-590μNs, mass shot of 46μg, specific impulse of 1100-1300 seconds and thrust efficiency of 3-5% for charge energy of 0-90J and a laser pulse energy of 600mJ. In the test, we found that the voltage between eletrodes, discharge energy and specific impulse became lower or higher as adding or decreasing the laser repetetive output frequency. Therefore, the thrust performance could be changing by adapting the single energy and laser repetetive output frequency. In addition, it was shown that by matching the parameters of laser and discharge circuit, the thrust performance of the thruste may be improved.