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SPACE PROPULSION SYMPOSIUM (C4)
Advanced Propulsion : Non Chemical, Non Electric (6)

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HEATING STRUCTURE AND ITS SUSTAINING CONDITION OF LASER SUPPORTED DETONATION WAVE

Abstract

Repetitively Pulsed (RP) Laser Propulsion is expected as a low cost launch system. Laser energy irradiated to a vehicle is converted to blast wave enthalpy through the Laser Supported Detonation (LSD) wave and generate thrust. Therefore, understanding the supporting structure and sustaining condition of the LSD wave is important. Ushio et al. had visualized the LSD wave by schlieren image before. However, internal structure of the LSD wave was still not clear. In this study, in order to investigate the internal structure of the LSD wave, distribution of its electron density was measured by 2-wave Mach-Zehnder interferometry. Its electron temperature distribution was measured by emission spectroscopy and calculated based on Saha's equation. As a result, It is found that electron number density and temperature distributions of LSD have peaks behind the shock wave. Based on the measured electron number density and electron temperature distributions, laser absorption coefficient was calculated, which gave us valuable information on the laser absorption structure: Electron density distribution of LSD has a peak behind shock wave, and because of its high electron density, incident laser energy can be entirely absorbed before reaching this peak. In this way, a new electron density peak is generated in front of the old one. So this electron density peak propagates together with the shock wave at the same velocity, and high laser heating near the shock front is sustained. However, as the incident laser power becomes lower, laser absorption layer will become thicker under a certain condition, then the electron density peak will no longer catching up with the shock wave. In this way, LSD terminates. These results show that for sustaining the LSD wave, absorption layer thickness should be kept thin sufficiently to the distribution of the electron number density.