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STUDY OF LASER PROPULSION EFFICIENCY FROM SOLID STATE LASER TO SHOCK WAVE ENERGY IN REDUCED AMBIENT PRESSURE

Abstract

Repetitively Pulsed Laser Propulsion is a potential candidate of lunching concept with the advantages like remote power supply, high payload ratio and affordable lunching cost. Besides of CO2 laser, the development of high power solid laser technology made it become another possible power source for laser propulsion mission. In this study, a high power pulsed Nd:Glass laser is used to generate breakdown in atmosphere air with the pressure range from 10 kPa to 100 kPa. Shadowgraph experiment and plasma emission photograph experiment were conducted to study the evolution of the laser absorption structure. From the shock wave expansion history, the energy conversion efficiency from laser energy to shock wave energy was obtained. The result shows that higher than 40% of efficiency could be achieved in 100 kPa under certain laser pulse energy. A saturation of laser energy absorption is appeared with the increase of the laser pulse energy. At last, optimization of the propulsion efficiency of Repetitively Pulsed Laser Propulsion using Solid state laser is discussed with the consideration of this saturation phenomena.