SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Technology (3)

Author: Prof. Sergey Rebrov
Keldysh Research Center, Russian Federation, rebrov_sergey@mail.ru

Mr. A. Golikov
Keldysh Research Center, Russian Federation, andgolikov@mail.ru
Mr. Victor Golubev
Keldysh Research Center, Russian Federation, golubev.va@mail.ru
Mr. S. Nosach
Keldysh Research Center, Russian Federation, cornage-da@mail.ru

LASER IGNITION OF ROCKET PROPELLANTS

Abstract

In recent years the interest to rocket engines ignition technologies increased significantly. Firstly it is related with the development of the ability to launch multiple payloads into orbit in one flight which consequently will increase payload /costs ratio. The multiple payload capability requires igniter systems guarantying reliable multiple ignitions under vacuum conditions. Laser ignition with a number of advantages over the existing ignition systems will perform better in this task. A several important advantages of laser ignition in compare with classical ignition methods are following: ability of choosing ignition area, ability to operate in a wider range of propellant mixture ratios in compare with electrical spark ignition, a better performance as compared to spark ignition at elevated pressures (electrical spark systems can function only in limited pressure range), ability of repeated ignitions avoiding of creation of any toxic by-products (as compared to hypergolic igniters) and production of unwanted and potentially dangerous electrical noise (as compared to electrical spark systems). Nowadays there is number of laser ignition systems for different applications have been developed, manufactured and successfully tested in Keldysh Research Centre (KeRc), Russia. The conducted researches allowed creating ignition systems on base of a miniature laser system with weight up to 800g. These systems demonstrate reliable ignition of O2/kerosene, O2/ethanol, O2/H2, O2/methane fuels and were successfully used for following applications: ignition of laser igniters, ignition of a low-trust rocket engine (and also of non-prechamber low-trust rocket engine invented by KeRc), direct in-chamber laser ignition of a research combustion chamber. There are two principles of laser ignition that realized in the created systems. The first is based on initiation of laser spark by focusing laser radiation of pulsed solid state laser near a metal surface inside a fuel media. The laser used for this method generates impulses with energy Ei=7mJ and duration ti=8ns. The second method is initiation of laser spark by focusing laser radiation in a volume of fuel media with parameters of laser: Ei=25mJ and ti=8ns. The created ignition systems have demonstrated reliable operating in experiments with following ranges of variation of the oxidizer-to-fuel ratio: from 0.1 up to 12 for operating on O2/H2, from 0.2 up to 1.07 for O2/methane, from 0.3 up to 0.84 for O2/ethanol and from 0.25 up to 1.15 for O2/kerosene.