Paper ID: 77686
student

IAF SPACE PROPULSION SYMPOSIUM (C4)
Liquid Propulsion (2) (2)

Author: Mr. Damian Grabowski
Łukasiewicz Research Network – Institute of Aviation (ILOT), Poland

Mr. Mateusz Surma
Warsaw University of Technology (WUT), Poland

FEASIBILITY OF UV INDUCED DECOMPOSITION OF HIGH TEST PEROXIDE IN SPACECRAFT PROPULSION.

Abstract

Highly concentrated hydrogen peroxide (98%), also known as High Test Peroxide (HTP), is a green propellant finding its application in both monopropellant and bipropellant propulsion systems. HTP is a stable propellant, which decomposition to hot gas (oxygen and steam) can be caused by several conditions, such as exposition to a catalyst or high temperature. Those two methods are most widely used in current propulsion systems operating on condensed hydrogen peroxide. However, other possibilities might also be feasible. One of them is based on the fact, that hydrogen peroxide decomposition can be induced by exposition to ultraviolet light (wavelengths between 193 nm and 351 nm). UV photolysis is often used in other industries, such as biotechnology; however, applied methods might be duplicated for space propulsion applications.

This paper describes a general feasibility study of applying UV-induced decomposition of High Test Peroxide to spacecraft propulsion systems. Those include creating physical and mathematical models regarding the UV decomposition process, which were later used for scaling the light source and the whole propulsion system. Further analysis yields potentially useful systems with reasonable mass flow and light source power values. Obtained results could be used in the further development process, especially including creating the prototypes.

If propulsion systems utilizing UV proved feasible, those could become competitors with currently used HTP decomposition methods, especially compared to thermal decomposition thrusters, as similarly, they would not require physical, degradable catalysts. Preliminary studies revealed that resulting systems could deliver operational performance in the range of widely used electric propulsion. However, on the contrary to the typical electrical propulsion, proposed system would operate on much cheaper hydrogen peroxide than various noble gases.