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DEVELOPING AND TESTING NEW COMPOSITE CATALYTIC BED FOR DECOMPOSITION OF 98% HTP

Abstract

Highly concentrated (98%+) aqua solution of hydrogen peroxide of HTP class (High Test Peroxide) is undoubtedly the most attractive replacement for currently used highly toxic and inherently dangerous propellants for variety of spacecraft and satellites. The compound is being under experimental research for its near-future practical utilisation within space propulsion applications. This liquid rocket propellant has great potential to be successfully used in thrusters and engines in RCS's. It does not suffer from many disadvantages typical for currently used rocket propellants and is now being extensively tested in many other space propulsion research centres around the world. The medium (98% HTP) is non-toxic, non-carcinogenic non-volatile and almost non-corrosive transparent liquid. It is also characterized by relatively high density, low viscosity, high oxidative potential (second after LOX), monopropellant properties and rather low cost. The development of the effective, reliable and long-lasting catalyst bed for the 98% HTP decomposition is the most significant task to be solved in order to enable the medium to be used in variety space propulsion applications. Such catalyst bed must be characterised by high repeatability and performance, insensitivity to poisoning, ability to start without preheating and be able to withstand relatively large number of hot runs. The paper presents a comprehensive experimental approach towards the identification of high-value structural catalyst bed (composite catalyst) for the efficient decomposition of 98% hydrogen peroxide of HTP class. The following aspects of the design process and experimental testing of the new composite catalyst bed are presented: designing, developing and laboratory testing of new composite (structural) catalyst bed. The catalyst bed has been built through the combination of the pellet MnxOy alumina catalysts with metal-ceramic grid platinum catalyst integrated into a small, compact structure. The hot tests have enabled characterisation of both catalytic and propulsive performance in terms of: decomposition temperature, number of short hot runs (about 15 s), resistance to poisoning, efficiency, repeatability and thermal and mechanical hardness. A kind of demonstrator monopropellant thruster utilising this new catalyst bed has also been tested towards its thrust and specific impulse. Key words: HTP, hydrogen peroxide, catalyst bed, decomposition, monopropellant, oxidizer, propulsion, thruster