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HIGH FLUX HYBRID MOTOR DEVELOPMENT WITH DISTRIBUTED TUBE INJECTOR

Abstract

Regression rate enhancement is one of the mostly investigated areas of the hybrid rocket motors. Due to nature of hybrid propulsion (i.e. diffusion limited combustion), regression rate of the fuel remains limited while it is compared with solid rocket motors. Limited regression speeds of the fuel causes low thrust density motors for hybrid rocket motors. In order to overcome this drawback, many solutions were presented in the literature. Most of them were performed in lab-scale, and they were not suitable for the high-scale motor. For well-known scalable solution (i.e. multi-port fuel design), it could be accepted for solution of the regression rate enhancement; but residual web structure was the disadvantages of this solution. Another scalable well-known solution is to use the liquified (i.e. paraffin-based) fuels in hybrid motors. Regression rate of the fuel increases up to 4 times with paraffinic fuel when it is compared with classical polymeric fuels. Single circular port design with paraffinic fuel is quite promising especially for in-space applications. Enhancement gained with utilizing paraffinic fuel in hybrids is very high; however it is still lower than the solid charge's regression rates. Regression rate of paraffinic fuel is nearly one order of lower than solid charge's. Mass flux dependent regression rate of hybrids could limit the designer under specific geometric limits for fuel (b/a¡2) due to the OF shift causing performance decay in hybrids. Further increment in regression rate could be beneficial to broad the utilization of hybrids not only for in-space application but also for high thrust density required applications. Relatively new developed, scalable injector design (i.e. Distributed Tube Injector) promises further regression rate enhancement for paraffinic-fuel. In the literature, it was revealed that up to 4 times higher regression rates could be achieved when they are compared with same motor with classical fore-end injector which means regression speed reached with DTI is nearly about solid motor's regression speed. In this paper, further oxidizer loading capability will be tested with DTI. It is planning to run the motors up to the 3 times higher mass flux in order to achieve the very high thrust density with hybrid motors. Combustion stability of motor is other critical issue that will be investigated especially for increased mass flux environment. As mentioned paraffinic fuel will be used with storable, self pressurized nitrous oxide (N2O (L)). Chubby fuel geometry will be used in this investigation.