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Combustion Studies of MMA/ GO_x for a Hybrid Rocket Motor

CHANDRU DHANDAPANI, Caltech, JASON RABINOVITCH, Jet Propulsion Laboratory, California Institute of Technology, GUILLAUME BLANQUART, Caltech — Poly(methyl methacrylate) (PMMA) is the synthetic polymer of methyl methacrylate (MMA), used as a solid fuel in hybrid rockets. PMMA undergoes pyrolysis into predominantly gaseous MMA ($C_5H_8O_2$), which then undergoes combustion with an oxygen stream in the combustion chamber. Experimental studies of this combustion chamber have been performed in literature, and the current study performs simulations, which can access more data in the combustion chamber. Simulations of laminar and turbulent non-premixed flames are performed using NGA, in a cylindrical domain, with gaseous MMA introduced through the cylinder walls. The rate of inflow of MMA is controlled by the temperature field in the combustion chamber, and the results from the 3D simulation are compared with that of experimental setups of hybrid rocket motors. The fuel regression rate and the chemical composition in the combustion chamber are calculated and compared, between simulations and experiments. Different models are used for the chemistry and combustion, and the results from these different simulations are compared and contrasted.

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