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Investigations on the influence of swirl intensity on solid-fuel ramjet engine. (English)
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Comput. Fluids 167, 82-99 (2018).

Summary: In this paper, the influence of swirl intensity on solid fuel regression rate and combustion phenomena in a solid fuel ramjet has been investigated numerically and experimentally. First, an in-house code has been developed to solve axisymmetric Reynolds-averaged Navier-Stokes equations of unsteady turbulent swirling compressible flow field with chemical reactions. Second, experiments have been conducted in a solid fuel ramjet without swirl to validate the developed code for solid fuel decomposition; then the predictive capability of the code is validated by using; swirling flow passes through sudden expansion combustor, shock-induced combustion case, and a semi-infinite plate. Third, unsteady simulations are carried out for reacting turbulent flows with and without swirl in a solid fuel ramjet using high-density polyethylene (HDPE) solid fuel. Then, the computational results are analyzed and discussed. The results show that, the presence of swirl is more effective in enhancing the regression rate and the turbulent mixing throughout the ramjet. Increase swirl number increases the heat and mass transport at the fuel surface and hence increases the regression rate.

MSC:

80M12 Finite volume methods applied to problems in thermodynamics and heat transfer
65M08 Finite volume methods for initial value and initial-boundary value problems involving PDEs
80A25 Combustion

Keywords:

regression rate; swirl flow; solid fuel ramjet; SST turbulence model; finite rate

Software:

AUSMPW+; CHEMKIN

Full Text: DOI

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paper as accurately as possible without claiming the completeness or perfect precision of the matching.