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EFFECT OF ALUMINUM CONTENT ON NOZZLE EROSION IN A HYBRID ROCKET MOTOR

Abstract

Nozzle erosion is a key problem that restricts the application of hybrid rocket motors. In this paper, numerical simulations and a firing test are performed to investigate the nozzle erosion of a hybrid rocket motor. The motor adopts 98% hydrogen peroxide and HTPB based fuel with aluminum additives. The ablation layer of nozzle consists of carbon ceramic composite and copper infiltrated tungsten. A thermo-chemical erosion model of carbon ceramic and copper infiltrated tungsten is established, and numerical simulations of gas-liquid two-phase combustion flow field on nozzle ablation characteristics under different aluminum content are conducted. A firing test of the hybrid rocket motor is carried out, and the erosion rate of nozzle throat is 0.021 mm/s. The error between the simulation result and experimental data is about 2.38%, which verifies the accuracy of simulation models. Simulation results show that with the increase of aluminum content, the fuel regression rate increases gradually, and oxidizer to fuel ratio decreases. The flame layer thickness in the combustion chamber increases, and nozzle inlet temperature gradually increases from 2870 K to 3260 K. When the aluminum content increases from 10% to 60%, the nozzle throat erosion rate improves from 0.0123 mm/s to 0.0221 mm/s. The increase of aluminum content makes very little effect on the axial distribution of nozzle erosion rate.