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Author: Dr. Hongbo HU
Xian Aerospace Propulsion Institute, China, hhb_lrelab@sina.com

NUMERICAL INVESTIGATION ON DETONATION PROCESS OF PULSE DETONATION ENGINE WITH HYPERGOLIC PROPELLANTS

Abstract

The pulse detonation engine(PDE) is considered as a potential propeller with higher efficiency in future. However, the formation mechanics of the detonation wave with hypersonic propellants in the engine is not very clear. In this paper, the detonation combustion processes of monomethylhydrazine/nitrogen tetroxide(MMH/NTO) mixtures in PDE were investigated by numerical simulations. The simulations were accomplished based on FLUENT with UDF, in which a reduced chemical kinetic model including 20 reactions and 23 species devoted to the gas phase reaction of MMH/NTO was used. And the pressure dependent boundary conditions for liquid propellants were used for multi-cycle detonation processes simulations. The deflagration to detonation transition (DDT) processes were studied under different distributions of propellant liquid droplet radius, which were corresponding to the injection pressures. And the impacts of engine sizes on detonation processes were investigated also. It was discovered that the detonation wave formation was affected by liquid droplet radius evidently. For large droplets, a lot of propellants were consumed after detonation wave. The detonation frequency was decided by the injection pressure, and the peak pressure of the detonation wave was relevant to the engine size closely. The results show the temperature distributions in the engine also which could offer help to the design of pulse detonation rocket engine.