

SPACE PROPULSION SYMPOSIUM (C4)  
Hypersonic and Combined Cycle Propulsion (5)

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DESIGN AND OPTIMIZATION OF HYDROCARBON-FUELED SCRAMJET STAR-UP SCHEME  
WITH EXPANSION CYCLE**Abstract**

Scramjet is the ideal power system and the core component of hypersonic vehicle, and the critical technology of scramjet has been developed with a significant progress, but the starting progress has not caught enough attention. The turbo-pump feed system based on expansion cycle is a competitive scheme for the long-time working scramjet with hydrocarbon-fueled regeneration cooling. The hydrocarbon fuel has transition from cold liquid state to supercritical/cracking state after heated in cooling channels which can be used to drive turbine. The ethylene is adopted to assist ignition/start of scramjet. Considering heat releasing and unsteady heat transfer, the dynamic models of turbine, pump, pipes, valves, cooling channels and the combustor have been established. The baseline start-up scheme of scramjet is design, and then, the optimization of start-up scheme of scramjet is performed with goal of minimum start-up time and ethylene consumption under the restrictions of pressure pulsation in fuel pipeline and combustion stability in chamber. Finally, the coupling effects of working parameters of start-up process on scramjet performance are discussed in detail. This work has a benefit to improve scramjet start-up technology and to study the dynamical and thermal coupling problem thoroughly.