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Hypersonic and Combined Cycle Propulsion (9)

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# STUDY ON THE THERMODYNAMIC CYCLE CHARACTERISTICS OF THE SCRAMJET FUEL FEED SYSTEM

**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 thermodynamic cycle characteristics of the Scramjet fuel feed system have 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. Considering heat releasing process, the scramjet combustor heat releasing analysis model and the regenerative cooling back-heating model have been established. The system balance parameters, turbo-pump power matching characteristics and cycle performance parameters are analyzed. The analysis results show that the coolant flow during expansion cycle needs to meet the two conditions, that's to say, the fuel flow rate of the cooling channel needs to meet the cooling needs of the scramjet, while the supercritical cracked fuel at cooling passage outlet needs to meet turbo expander acting requirements. Finally, thermodynamic cycle characteristics of the scramjet fuel feed system have been analyzed, the following conclusion is drawn that the performance of the cracked state kerosene turbine is mainly determined by the turbo expansion ratio and the outlet temperature of the cooling channel. This work has a benefit to develop the integration design technology of the scramjet system and to study the dynamical and thermal coupling problem thoroughly.