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SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic Air-breathing and Combined Cycle Propulsion (9)

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THERMODYNAMIC ANALYSIS OF HELIUM SYSTEM CYCLE FOR THE PRECOOLED AIR-BREATHING COMBINED ENGINE

Abstract

Precooled air-breathing combined engine is a typical scheme for the reusable hypersonic vehicle, a helium cycle is introduced between the air cycle and fuel cycle as the intermediate medium in order to improve the engine performance and reliability, and it has become an important research filed of such precooled engine. Based on the features of engine system, a mathematical model of helium cycle system including the main components was established in this paper. Through the calculation and analysis of its working process, the system charateristics and the variation law and thermodynamic cycle efficiency are obtained during the for the whole operating envelope. The analysis of thermodynamic loss shows that the energy loss of helium cycle system is from the internal irreversible factors which are non-isentropic compression and expansion, heat leakage and friction loss, and the magnitudes of all kinds losses have the same magnitude. The results indicate that increasing the maximum temperature and the lowest temperature ratio of the helium cycle will increase the external output power of the system. Since the heat dissipation is effectively utilized during the cycle, the cycle efficiency can still be maintained above 90% in overall working conditions.