

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

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STUDY OF THE THERMAL ADJUSTMENT OF RBCC BASED ON TWO-STAGE INJECTIONS

Abstract

To further improve the performance of Rocket Based Combined Cycle (RBCC) combustor in ramjet mode, one-dimensional analysis model and three-dimensional numerical simulation have been carried out to study the variation law of thermal throat and the scheme of thermal adjustment based on two-stage injections. The different position of thermal throat calculated by one-dimensional model shows that the more after of thermal throat position is, the bigger of integral thrust can be obtained when the expansion ratio of combustor and total exothermic quantity are the same. Through adjusting the injection proportion of two-stage, the wide move range of thermal throat has been realized. The move range can reach the 20% of combustor length under the premise of guaranteeing a certain performance. Compared to single-stage injection, the combustor area can be better used by two-stage injections and the bigger equivalence ratio of fuel can be injected for combustion especially in the flow condition of lower total pressure. Moreover, two-stage injections have wider and more flexible ways to adapt to the different flow condition. The combustion of primary fuel is mainly to achieve pre-combustion shock wave in isolator to ensure the subsonic incoming flow and the second fuel is mainly to adjust the position of thermal throat. The thrust performance of RBCC combustor can achieve at least 15% improvement at fly condition of Ma3-5 by using the thermal adjustment method based on two-stage injections.