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# THE EFFECT OF THE REGENERATIVE COOLING PROCESS ON THE SUPERSONIC COMBUSTION INSIDE A STRUT-BASED SUPERSONIC COMBUSTOR

**Abstract**

The supersonic combustion is one of the most fundamental problems within scramjets which have shown great potential to provide essential thrust for air-breathing propulsion system. Recently, in order to operate in a wider range of flight velocity and altitude, scramjets are required to work under lower flight dynamic pressure, bringing a great challenge for robust flame stabilization in supersonic combustor. Normally, promoting fuel mixing, supplementing oxygen and various flame holders have been used to improve supersonic combustion. For scramjets, regenerative cooling process will have significant effect on the supersonic combustion by preheating fuel combined with pyrolysis reactions. In this paper, to investigate the effect of regenerative cooling process on the supersonic combustion inside a strut-based supersonic combustor fueled by liquid kerosene at Ma 5/6, a numerical model was established and validated with experimental results. In order to analyze flame properties, the eddy dissipation concept (EDC) coupled with a detail kinetic model of n-decane containing 40 species and 141 reactions was used. The configuration is similar to a laboratory scramjet at the Institute for Chemical Propulsion of the German Aerospace Center (DLR) with a wedge-shaped flame holder, which is also employed to validate the numerical model through comparing the numerical results qualitatively and quantitatively with shadow-pictures. Firstly, the numerical study of the impact of regenerative cooling process on supersonic combustion under normal flight dynamic pressure was carried out. Further, the influence of regenerative cooling process on the supersonic combustion under the lower flight dynamic presses was discussed. The results indicate that the regenerative cooling process can make a positive difference to the supersonic combustion through changing the state of injected hydrocarbons. This result improves the understanding of the effect of regenerative cooling process on the flame properties, which can be imperative for the development of supersonic combustion technology.