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ANALYSIS OF HEAT RELEASE DISTRIBUTION IN SCRAMJET COMBUSTOR USING WALL PRESSURE BASED ONE DIMENSIONAL MODEL

Abstract

Heat release distribution in scramjet combustor is dominant yet complicated for its critical effects on flow field, combustion mode and its transition, and thus the propulsion performance. As CFD is time consuming and experimental measurements are limited on only certain location, in the present study, a one dimensional model based on measured wall pressure was developed and studied in series of direct connected combustion tests. The measured wall pressure, combustor geometry configuration and initial flow parameters were used as input of the model, and the obtained results included the the flow field distribution, such as velocity, temperature, density and the heat release distribution. The obtained results of the model showed that as the fuel/air ratio increased, the combustion mode turned from scram to ram mode, and the area of heat release changed. In the scram mode, the area of heat release was distributed in the cavities and the side close to the wall downstream the cavities, according to the heat release rate distribution. In the ram mode, the area of heat release was mainly concentrated in the cavity, and heat release in the area downstream the cavity was relatively fewer. The area of heat release compared well with the experimental pictures. It was also seen that, the combustion efficiency was about 0.85 in the scram mode, and about 0.65 in the ram mode. It was observed from the experiment that the velocity in the area of heat release was mainly subsonic and the velocity in the core flow depends on the fuel/air ratio. To study the core flow and averaged flow parameters, the obtained heat release distribution used as input of another modified model was also developed and the results showed the combination of the two models was of more advantage.