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Effect of the micro vortex generator on the characteristics of vaporized RP-3 kerosene combustion in supersonic flows

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Contents

The combustion characteristics of vaporized RP-3 kerosene with MVGs in supersonic flows simulated under Mach 5.5 flight conditions are experimentally investigated in this paper. MVGs are installed downstream of the injection position and upstream of the cavity to evaluate the mixing effect of the incoming flow and fuel. This paper mainly investigates the effect of MVG on the combustion characteristics of vaporized RP-3 kerosene, with the aim of better understanding the role of the position and quantity of MVG in a supersonic combustor.

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- The cavity-stabilized flame distribution during stable combustion



Fig. 1. Profiles of the cavity-stabilized flame: (a) without a micro vortex generator and (b) with a micro vortex generator at Loc3.

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- The cavity-stabilized flame distribution with different numbers of micro vortex generators

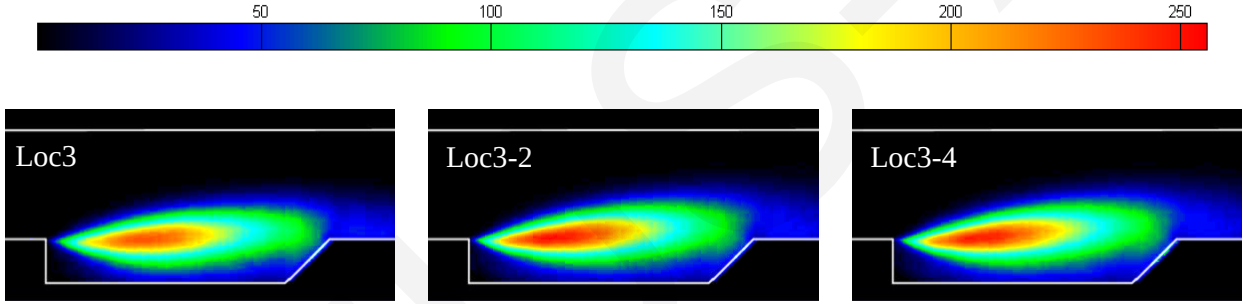


Fig. 2. Pseudo-color images of the cavity-stabilized flame with different numbers of micro vortex generators at the same position.

Conclusions

1. Though the ignition processes with and without an MVG show a similar tendency, a MVG can effectively improve the combustion intensity after stable combustion has been achieved. The local high pressure induced by chemical heat release with the MVG can lift the shear layer and promote the penetration of the flame region deeper into the mainstream.
2. By shortening the distance between the MVG and the injection position, the interaction between it and the fuel jet is enhanced, facilitating the mixing effect and subsequent combustion. The light intensity can be increased by 15.6% by decreasing the distance between the injection position and the MVG in this paper. The position of the MVG mainly affects the pressure between the injection position and the cavity, but has a little effect on the cavity itself.
3. An increase in the number of MVGs is also beneficial in improving the premixed degree of fuel and air before combustion, as it results in more violent chemical reactions in the downstream region. However, the position of the MVGs may play a more important role in the combustion performance.

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