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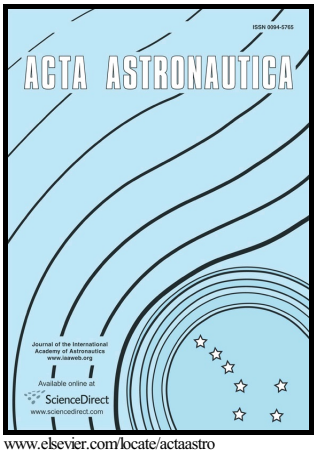

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Abstract: As a promising candidate for future air-breathing systems, the viability and efficiency of scramjet propulsion is challenged by a variety of factors including the combustion oscillation in scramjet combustor. A series of comparative experiments focusing on the combustion oscillation issue has been carried out in the present work. The obtained experimental results show that as the global equivalence ratio increases, the combustion oscillation becomes more regular and frequent which is the most intensive in the vicinity of the fuel jet and the periodic combustion oscillation is more possible when the injectors and flame-holding cavity are mounted on the expansion-side wall. In order to avoid the combustion oscillation in scramjet combustor, distributed injection scheme is an effective method which can induce two parts interacting stable flame. In addition, the results reveal that the varying fuel including hydrogen, ethylene and kerosene with different chemical kinetics has a significant effect on the reaction process in scramjet combustor, which can result in stable combustion, periodic oscillation and failed ignition respectively on the same operating condition of this paper. We believe that the present work is helpful to the designing of scramjet propulsion device.

Keywords: scramjet combustor, combustion oscillation, equivalence ratio, injection scheme, varying fuel

1 Introduction

Combustion instabilities were discovered in the late 1930s as anomalies in firings of solid and liquid rockets and were identified at the start of the 1950s and then became the subject of research[1]. Although a lot of numerical and experimental investigation has been carried out aimed at understanding the origins, explaining how they developed and predicting their levels, the problems continue to the present time and will always be found in combustion systems, particularly those intended to pursue high performance, such as scramjet. Unlike the combustion instabilities of rockets, gas turbines, and ramjets, which have received enough attention, the problem in scramjet combustor has been neglected for a time because of the general thought that acoustic waves cannot propagate upstream in a supersonic flow environment, any flow oscillations resulting from an unsteady combustion process will be simply exhausted from the engine exit and