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EFFECT OF CHEVRON-LIKE INJECTOR OUTLET ON VORTEX-DRIVEN COMBUSTION INSTABILITY

Abstract

Combustion instability (CI) is a major concern in liquid rocket engine (LRE) design. During the past few decades, coupling between unsteady heat release and combustion chamber acoustic has been studied as one of the major mechanism for combustion instability, and apparently, vortex shedding process enhancing fuel mixing process and corresponding heat release plays an indispensable role on this coupling in vortex-driven combustion instability. Although details of the interaction between vortex shedding and combustion chamber acoustic is still not interpreted completely, one point is definitely sure that only the vortex in its initiate state may have the same energy level with combustion chamber acoustic wave. It has been known that at certain flow velocity the shear layer near injector outlet becomes unstable, and vortex formation occurs. That means if we want to weaken or cut off the feedback loop between combustion chamber acoustic and combustion heat release involving vortex shedding, we need control the outlet structure of injector or any other region related to vortex production. In this paper, injector with chevron-like outlet will be studied and proposed as a new passive way to suppress combustion instability driven by vortex shedding for the first time. A reasonable speculation for it is that chevron-like outlet will undoubtedly strengthen the mixing process of fuel and oxidizer along circumferential direction, which may make shedding process more chaos and insensitive to acoustic wave. Besides, through introducing extra disturbance, frequency band of pressure wave produced by shedding process will tend to be widened, and also same to combustion heat release. If so, coupling between combustion heat release and combustion chamber acoustic maybe disappear or weakened and concentration of oscillation energy to acoustic mode should be prevented and combustion instability will then be suppressed.