LES investigation of flame acceleration and DDT of methane-air mixture in rectangular channel

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Abstract

Large eddy simulation (LES) is used to simulate flame acceleration (FA) and deflagration to detonation transition (DDT) of methane–air mixtures in a small-scale 3D channel. The simulation results show that, in the early stages, the flame velocity increases exponentially because of the expansion of combustion products and the wrinkle of flame surface. In the next stage, the interaction between flame and pressure wave makes flame accelerate continuously, and the acceleration rate of the flame velocity decreases first and then increases. As the pressure of the leading shock increases, the boundary layer is heated by the preheating area in front of the flame surface which causes the ultrafast flame propagates in the boundary layer. The ultrafast flame generates oblique shock waves continuously moving to the center of the channel and colliding with each other, which promote the occurrence of local explosion and the coupling of flame surface and leading shock wave.

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