M-flame under external high-frequency acoustic field

Krikunova A I

Joint Institute for High Temperatures of the Russian Academy of Sciences, Izhorskaya 13 Bldg 2, Moscow 125412, Russia

utro-2007@mail.ru

The trend for the most accessible improvement and maximum efficiency of modern systems and devices of power engineering leads to the need for their operation at the boundaries of possible ranges. The implementation of such extreme modes during the operation of power plants is associated with an increased probability of the occurrence of off-design thermoacoustic instabilities, including those developing as a result of external acoustic excitation from other processes or units. Predicting the exact values of the criteria that determine the development of such processes is most difficult when working in various gravity conditions. In this work, the conditions of M-V and V-M transformations of the shape of a premixed methane–air flame were investigated under conditions of external acoustic excitation of high frequencies under conditions of normal and reverse gravity. An excitation frequency was in range 420–820 Hz. An amplitude of longitudinal velocity pulsations up to 10% of the mean flow velocity was applied. As was shown earlier, M-V and V-M flame shape transition under acoustic excitation, as without external disturbance, exhibit hysteresis effects. The acoustic impact above the first critical frequency (160 Hz) for rich flames brings to the hysteresis deterioration [1]. In this work it was shown that under conditions of normal gravity, with an increase in frequencies above 400 Hz, there is a tendency towards degeneration of the hysteresis too, however, the degeneration itself occurs only (among those studied) at an excitation frequency of 500 Hz. At high frequencies, degeneration probably occurs under conditions close to a diffusion flame. Under reverse gravity conditions, the high-frequency acoustics excitation did not change the stability of the flame.

[1] Krikunova A, Arefyev K, Saveliev A, Kossov G and Cheshko A 2021 *Phys. Fluids* **33** 053610