DYNAMICS AND MECHANISM OF ENERGY RELEASE IN DETONATION STRUCTURE

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The fundamental feature of the propagation of a detonation wave is cell generation. The size of the detonation cell defines the characteristic length scale at which the detonation front recovers peak flow parameters, i.e., pressure, temperature, and energy release, and in this way self-sustains the non-decaying propagation. Because of this process, the cell size is an important scale factor characterizing the structure and macroscopic behavior of detonation wave under stable and transient conditions [1-3]. In this study, we are discussing mechanism of energy release in detonation structure and evolution properties of detonation front along the finite length tube.

A new emission technique has been applied to measure the evolution of the detonation structure along the round tube and characterized it as a function of initial pressure. The method is based on the detection of an emission spectrum behind the detonation front in the spectral range corresponding to local gas temperatures that are much higher than those for the Chapman-Jouguet equilibrium condition. This technique provides quasi-continuous cell-length measurements along the normal to the detonation front over the long distance. Our study has experimentally identified the steady states of detonation structure in round tubes, referred to here as the single detonation modes. When the state of a single mode is fully established, then both the flow structure and the energy release at detonation front develop strictly periodically along the tube at a constant frequency inversely proportional to the cell length of the mixture.

Outside of the pressure range where a detonation mode was most likely to occur, the detonation front is unstable and may exhibit an irregular cellular pattern. At these conditions, the evolution of local gas emissivity, which is time dependent and corresponds to axial pulsations of the detonation structure, has the appearance of a superposition of separate harmonics describing the states of emissivity oscillations and cell structure of single detonation modes.

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References

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