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Detonation Initiation on the Microsecond Time Scale: DDT's

DAVID R. KASSOY, MATTHEW NABITY, University of Colorado — Numerical solutions to the planar, reactive Euler equations, with one-step exothermic kinetics, describe deflagration-to-detonation transition (DDT) subsequent to thermal power deposition into a finite volume of perfect gas mixture. A parametric study is carried out for deposition location relative to the bounding wall, for power deposition level and for activation energy values. Results are given for the transient, spatial distributions of temperature, pressure, reactant concentration and local chemical heat release as well as for the time variation of the global heat release and the maximum pressure (lead shock) in the flow field. All solutions are characterized by a complex sequence of reactive gasdynamic events, featuring the spontaneous generation of numerous, isolated reaction centers. Compression waves generated by sequential explosions of reaction centers strengthen the lead shock sufficiently to facilitate the sudden appearance of a coupled reaction zone. The distance from the confining boundary to the initial location of the overdriven detonation varies with the magnitude and location of the power deposition and the value of the activation energy. Subsequent reactive gasdynamic transients enable detonation relaxation to a CJ wave.

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