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Formation of Reactivity Gradients for Detonation Initiation through Turbulent Flame Quenching VADIM N. GAMEZO, ELAINE S. ORAN, Laboratory for Computational Physics and Fluid Dynamics, Naval Research Laboratory, Washington, DC 20375 , TAKANOBU OGAWA, Department of Mechanical Engineering, Seikei University, 3-3-1 Kichijoji-Kitamachi, Musashino-shi, Tokyo, 180-8633, Japan — Deflagration-to-detonation transition (DDT) in gaseous reactive systems usually occurs through the Zeldovich's gradient mechanism that involves the propagation of a spontaneous reaction wave through a preconditioned region containing a gradient of reactivity. One of the many possible ways for creating this gradient is the flame quenching in the turbulent flow and subsequent mixing of burned and unburned materials. We study these phenomena using compressible reactive Navier-Stokes numerical simulations. The reactive system considered is a stiochiometric hydrogen-oxygen mixture with a simplified one-step Arrhenius kinetics of energy release. Two-dimensional simulations of a flame interacting with a diffracting shock and with a turbulent flow behind the shock show the local flame quenching. This leads to the mixing of burned and unburned materials and the formation of reactivity gradients. Because such flame-quenching phenomena can create conditions leading to DDT in unconfined systems, they are important for hydrogen safety issues and for Type Ia supernovae.

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