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Simulation of High-Pressure Methane Hydrate Combustion[1]
PAVEL POPOV, WILLIAM SIRIGNANO, University of California at Irvine, Mechanical and Aerospace Engineering — With its prevalence in ocean floor deposits, methane hydrate has recently attracted considerable attention in the combustion community. We present a new scheme for the simulation of methane hydrate combustion at high, near critical pressures. This process features a combination of solid, liquid and gas phases, wherein the solid methane hydrate melts into a bubbly liquid, which then evaporates into a gas phase; methane-air combustion occurs in the gas phase. In addition to its multiphase nature, this problem features the additional challenge of modelling the gas/liquid phase transition at near-critical pressures. A new computational procedure has been developed to simulate this problem, using a detailed chemical mechanism for the simulation of reaction in the gas phase, and featuring a volume-of-fluid (VOF) approach for the simulation of the liquid phase with gas bubbles – a low Stokes number is assumed. This procedure is applied to a laminar shear flow methane hydrate combustion problem. Particular attention is directed to the effects on simulation results of the high-pressure equation of state, liquid/gas phase transition modelling, and the bubbly liquid phase modelling. Simulation results are compared to experimental observations.

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