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Modeling Soot Formation in High-Pressure Turbulent Spray Flames DANIEL HAWORTH, SEBASTIAN FERREYRO-FERNANDEZ, Pennsylvania State Univ — Most soot models are based on physical understanding derived from experiments at atmospheric or moderately elevated pressures, compared to the pressures that are of interest in engines and other applications. The emphasis in model development has been on kinetic processes rather than on turbulent hydrodynamics and mixing, but there is evidence that transport and mixing become relatively more rate-controlling with increasing pressure. Here simulations are performed of transient high-pressure turbulent spray flames under engine-relevant conditions. An unsteady RANS formulation is adopted, with various gas-phase chemical mechanisms and soot models, and a transported composition probability density function method to account for unresolved turbulent fluctuations in composition and temperature. Computed total soot mass and soot spatial distributions are highly sensitive to the modeling of unresolved turbulent fluctuations. To achieve agreement between model and experiment and to capture the highly intermittent nature of soot in the turbulent flame, it is necessary to accurately represent mixing and the low diffusivity of soot particles. The results suggest that mixing is at least as important as kinetics in controlling soot formation and evolution in high-pressure turbulent flames.

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