DFD13-2013-001163

Abstract for an Invited Paper
for the DFD13 Meeting of
the American Physical Society

Spray combustion: scales, regimes, and formulations[1]

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This talk will cover some recent results relevant to the modeling of spray flames. Controlling parameters and combustion regimes will be reviewed. Conditions will be identified under which analyses of laminar mixing layers can shed light on aspects of turbulent spray combustion. Conservation equations will be derived for dilute sprays, including separate equations for the gas and liquid phases. Linear combinations of the gas-phase conservation equations for the species and energy will be used to formulate the problem in terms of chemistry-free coupling functions, including the relevant mixture fraction and the total enthalpy, which are not conserved scalars, because their conservation equations include source terms associated with the vaporizing droplets. Implications for spray-flamelet modeling, associated with the multivalued spatial dependence of the mixture fraction, will be explained. Applications of the coupling-function formulation to the computation of spray flames in the limit of infinitely fast reaction rate will be discussed, including the high-order corrections needed to account for the presence of droplets on the air side of the flame. Recent work on ignition of spray flames will also be presened.

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[1]This work was supported by the Spanish MCINN through project CSD2010-00011.