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Global pathway analysis for soot formation and evolution in pressurized sooting turbulent jet flames DEZHI ZHOU, ANDERS VAAGE, University of Minnesota, WESLEY BOYETTE, Ohio State University, THIBAULT GUIBERTI, WILLIAM ROBERTS, King Abdullah University of Science and Technology, SUO YANG, University of Minnesota Twin Cities — Understanding on soot formation and evolution at pressurized flames are of significant interest due to the increasing operating pressures in different combustors and the accompanying increased soot emissions. In this study, a series of pressurized turbulent sooting flames at 1atm, 3atm and 5atm, are simulated to study the pressure effect on the soot formation and evolution. The inflow conditions are chosen such that the Reynolds number at different pressures keep constant. Via a radiation flamelet progress variable approach with a conditional soot sub-filter probability density function to consider the turbulence-chemistry-soot interaction, quantitatively good agreements are achieved for soot volume fraction predictions compared with the experimental data at different pressures. More importantly, a soot based global pathway analysis is employed to reveal the dominant chemical global pathway from fuel to soot in the mixture fraction, progress variable and physical space. The key global pathways that control the soot nucleation, condensation, surface growth and oxidation processes are also identified to show the significance of these processes under different pressures.

Dezhi Zhou
University of Minnesota

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