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Soot chemical pathways under elevated pressures in co-flow ethylene flames. SUO YANG, DEZHI ZHOU, HONGYUAN ZHANG, University of Minnesota — Internal combustion engines and gas turbines are operating under high pressures. One of the major concerns in high pressure combustion is its high soot yield, which was found in many sooting flame experiments. Specifically, the maximum soot volume fraction increases with the increasing pressure, with the dependence of soot on pressure weaker as pressure is further increased. To explain the dependence of soot on pressure, most of the experiments attribute this phenomenon to higher temperature, steeper precursor concentration gradients, and increased gas density. However, an exact and comprehensive mechanism behind this phenomenon, from a chemical kinetics perspective, is still elusive. In this study, a series of pressurized (from 1 to 16 atm) co-flow ethylene diffusion flames are simulated with detailed finite rate chemistry. The soot evolution is described by the bivariate Hybrid Method of Moments (HMOM). The experimental maximum soot volume fraction in the flames are reproduced by the simulations. Most importantly, the Global Pathway Analysis (GPA) is conducted to reveal the dominance and sensitivity of soot chemical pathways under elevated pressures.

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