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Non-linear stability and transition analysis in reactive hypersonic shear-layers LUCA MASSA, University of Texas at Arlington — Carbon chemistry and the endothermic reactions it supports were previously shown to delay hypersonic boundary layer instability and transition. The present analysis addresses the analogous problem in free shear-layers and arrives to the conclusion that the lack of the acoustic trapping mechanism implies that endothermic chemistry can lead to stabilization or destabilization of the shear-layer depending on the free-stream temperature. This study identifies three mechanism by which carbon chemistry affects instability and transition. The first is rooted in the changes to the inflectional profiles caused by the visco- chemical interaction. The second is due to damping of the perturbation by finite rate chemistry. The third is linked to streamwise relaxation which delays the onset of secondary instability of vortical structures generated by a saturated primary instability wave. Linear analysis predicts changes in growth rate lower than 30% for Mach numbers below 5. Nonlinear parabolized stability analysis predicts significantly larger differences, depending on whether the primary or secondary instability trigger the transition onset.

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