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Dynamic contraction of the positive column of a self-sustained glow discharge in a reacting flow HONGTAO ZHONG, MIKHAIL SHNEIDER, Department of Mechanical and Aerospace Engineering, Princeton University, MIKHAIL MOKROV, Institute for Problems in Mechanics, RAS, YIGUANG JU, Department of Mechanical and Aerospace Engineering, Princeton University — Contraction occurs when current contracts from a uniform volumetric weakly ionized plasma into a localized channel. This dynamic transition provides a promising technique for reliable ignition of ultra-lean combustion mixtures. In this work we study the dynamic contraction of the positive column of a self-sustained glow discharge in a reacting H2-O2-N2 flow. We developed a one-dimensional numerical model of the plasma contraction in a cylindrical frame. The contraction process is described by a set of time-dependent equations. We analyzed the critical conditions for transitions from the uniform to contracted state. The plasma instability in reacting flows is not only governed by the ionization-thermal mechanism, but also heat release/absorption in chemical reactions. Specifically, electron-impact fuel ionization, combustion heat release and the electron attachment to combustion-related species would shift the critical current for triggering the plasma instability. The study of the plasma instability in a combustion mixture will advance the understanding of the kinetic and thermal interaction between non-equilibrium plasma and combustion and lay foundations for the development of plasma assisted ignition.

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