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Combined experimental and modeling study of direct plasma conversion of methane[1] JOSEPH TOTH, XIAOZHOU SHEN, DANIEL LACKS, R. MOHAN SANKARAN, Case western Reserve University — The direct conversion of methane without oxidizing chemistry is desired to avoid COx species and produce hydrogen or higher order hydrocarbons. However, the methane molecule is difficult to dissociate by thermal energy alone and tends to coke and inactivate catalysts. Here, we studied atmospheric-pressure, non-equilibrium plasmas for the direct conversion of methane. A key contribution of our work is that the discharge was spatially confined to decouple power and volume effects on methane conversion. In support of experimental results, a microkinetic model was developed, solving 352 elementary reactions involving 36 species including neutrals, ions, and radicals that takes into consideration both spatial and temporal dependencies of the filamentary behavior. Our results show that while methane conversion increases with increasing plasma power, it is relatively independent of volume. Since volume is controlled, these trends reflect the importance of power density. The product distributions are a stronger function of power at small volumes, with a tendency to form hydrocarbons at lower volumes and powers, and hydrogen and solid carbon at higher volumes and powers.

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