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One-step methanol synthesis via methane partial oxidation induced by microreactor integrated DBD TOMOHIRO NOZAKI, SHUHEI YUZAWA, Dept of Mechanical & Control Engineering, Tokyo Institute of Technology, ANIL AGIRAL, MESA+ Institute for Nanotechnology, University of Twente, SHOHEI MORIYAMA, KEN OKAZAKI, Dept of Mechanical & Control Engineering, Tokyo Institute of Technology — Direct conversion of natural gas into synthetic fuels such as methanol attracts broad attention because direct process can reduce capital and operating costs of high temperature, energy intensive, multi-step methane conversion processes. This paper presents a direct and selective synthesis of organic oxygenates such as methanol, formaldehyde, and formic acid via methane partial oxidation at room temperature induced by non-thermal discharge in microreactor. Production of active oxygen species by dielectric barrier discharge is essential to initiate oxidative chain reaction of methane. Heat generated by methane partial oxidation is removed efficiently in the microreactor configuration: liquid components are condensed on the reactor wall and separated from oxygen-rich reactive plasma, enabling selective synthesis of oxygenates while high methane conversion is achieved in a single reactor. As a result, organic oxygenates were synthesized with one-pass yield of 5-20 percent with 70-30 percent selectivity. In addition to oxygenates, syngas was produced with selectivity of 40 percent and H2/CO = 1. Assuming one step catalytic DME synthesis as a post discharge process, one-pass liquid yield of 30 with 80 percent selectivity is feasible.

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