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On the Catalytic Combustion Behaviors of CH4 in a MCFC Power Generation System

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Abstract : Catalytic combustion is generally accepted as an environmentally preferred alternative for the generation of heat and power from fossil fuels mainly due to its advantages related to the stable combustion under very lean conditions with low emissions of NOx, CO, and UHC at temperatures lower than those occurred in conventional flame combustion. Despite these advantages, the commercial application of catalytic combustion has been delayed because of complicated reaction processes and the difficulty in developing appropriate catalysts with the required stability and durability. To develop the catalytic combustors, detailed studies on the combustion characteristics of catalytic combustion should be conducted. To the end, in current research, quantitative studies on the combustion characteristics of the catalytic combustors, with a Pd-based catalyst for MCFC power generation systems, relying on numerical simulations have been conducted. In addition, data from experimental studies of variations in outlet temperatures and fuel conversion, taken after operating conditions have been used to validate the present numerical approach. After introducing the governing equations for mass, momentum, and energy equations as well as a description of catalytic combustion kinetics, the effects of the excess air ratio, space velocity, and inlet gas temperature on the catalytic combustion characteristics are extensively investigated. Quantitative comparisons are also conducted with previous experimental data. Finally, some concluding remarks are presented.

Keywords : catalytic combustion, methane, BOP, MCFC power generation system, inlet temperature, excess air ratio, space velocity
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