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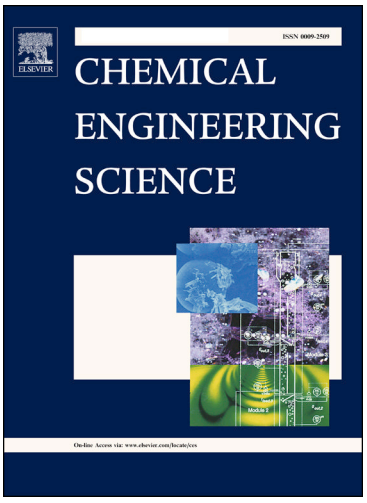

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A Spiral Microreactor for Improved Stability and Performance for Catalytic Combustion of Propane

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Abstract

Numerical CFD simulations are used to demonstrate the performance characteristics of a novel spiral geometry, which is used for catalytic micro-combustion in this work. This reactor has catalytic channel, with inlet at the center and spiraling outwards. The spiral microreactor geometry allows preheating of the cold inlet owing to heat exchange with the hot products flowing in co-current direction in the adjacent channel. Results indicate that the spiral is more stable than the straight channel reactor, due to the transverse heat transfer between adjacent channels in the spiral reactor. 2D simulations are performed to comprehensively analyze the role of this heat recirculation on the thermal management and stability of catalytic combustion of propane/air mixtures; and the spiral microreactor is compared with the well-studied straight channel microreactor. Axial and transverse temperature profiles at various design and operating conditions are analyzed for a better understanding of heat recirculation in this geometry. Effect of various parameters viz. equivalence ratio (ϕ), inlet velocity (u_0), wall thermal conductivity (k_s) and number of turns (N) on the spiral reactor's stability and performance is presented.

Keywords

Catalytic micro-combustion; stability; thermal management; spiral micro-burner; computational fluid dynamics

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