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Investigation of the Thermal Flow inside the Catalytic Combustor for Lean CH4-Air Mixture on a Platinum Catalyst with H2 Addition

Authors : Kumaresh Selvakumar, Man Young Kim

Abstract : In order to elaborate the main idea of investigating the flow physics inside the catalytic combustor, the characteristics of the catalytic surface reactions are analyzed by employing the CHEMKIN methodology with detailed gas and surface chemistries. The presence of a catalyst inside an engine enables complete combustion at lower temperatures which promotes desired chemical reactions. A single channel from the honeycomb monolith catalytic combustor is preferred to analyze the gas and surface reactions in the catalyst bed considering the fact that every channel in the honeycomb monolith behaves in similar fashion. The simplified approach with single catalyst channel using plug flow reactor can be used to predict the flow behavior inside the catalytic combustor. The hydrogen addition to the combustion reactants offers a way to light-off catalytic combustion of methane on platinum catalyst and aids to reduce the surface ignition temperature. Indeed, the hydrogen adsorption is higher on the uncovered Pt(s) surface sites because the sticking coefficient of hydrogen is larger than that of methane. The location of flame position in the catalyst bed is validated by igniting the methane fuel with the presence of hydrogen for corresponding multistep surface reactions.

Keywords : catalytic combustor, hydrogen adsorption, plug flow reactor, surface ignition temperature
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