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Reaction Rate Behavior of a Methane-Air Mixture over a Platinum Catalyst in a Single Channel Catalytic Reactor

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Abstract : Catalytic combustion is an environmentally friendly technique to combust fuels in gas turbines. In this paper, the behavior of surface reaction rate on catalytic combustion is studied with respect to the heterogeneous oxidation of methane-air mixture in a catalytic reactor. Plug flow reactor (PFR), the simplified single catalytic channel assists in investigating the catalytic combustion phenomenon over the Pt catalyst by promoting the desired chemical reactions. The numerical simulation with multi-step elementary surface reactions is governed by the availability of free surface sites onto the catalytic surface and thereby, the catalytic combustion characteristics are demonstrated by examining the rate of the reaction for lean fuel mixture. Further, two different surface reaction mechanisms are adopted and compared for surface reaction rates to indicate the controlling heterogeneous reaction for better fuel conversion. The performance of platinum catalyst under heterogeneous reaction is analyzed under the same temperature condition, where the catalyst with the higher kinetic rate of reaction would have a maximum catalytic activity for enhanced methane catalytic combustion.

Keywords : catalytic combustion, heterogeneous reaction, plug flow reactor, surface reaction rate
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