Operational Characteristics of Catalytic Combustion in a Platinum Microtube

趙怡欽,陳冠邦,許家睿,呂宗行,吳志勇,鄭藏勝
Mechanical Engineering
Engineering
tscheng@chu.edu.tw

Abstract

Catalytic combustion of hydrogen in a platinum micro tube, or sub-quenching diameter tube, is studied by theoretical analysis, experiments, and numerical simulation in terms of the major operation and design parameters. Fine thermocouple, laser induced fluorescence (LIF) and Raman scattering are used to measure the temperature and major species and OH concentration data at the tube exit. The experimental results show that the tube-exit temperature increases with fuel concentration, velocity and tube size. For high fuel concentration and velocity cases in the 1000 and 500μm tubes, obvious gas-phase reaction behind the exit can be detected by thermocouple and LIF-OH images. Numerical simulation results show that smaller tube sizes and lower velocities would enhance the conversion ratio on catalytic surface, due to the enhanced diffusion of surface species of H2 and O2. Based on the current results and analysis, the characteristic operation regions of hydrogen catalytic combustion in micro tubes are quantitatively identified in terms of parameters related to heat generation and heat loss characteristics, competition among the

time scales,
and tube size. Decreasing the tube size will shift the operation region toward the
high-concentration and high velocity portion of the domain with a smaller operation
area.

Keyword：Catalytic Combustion, catalytic micro tube, Platinum, Raman scattering,
Numerical simulation, MEMS technology