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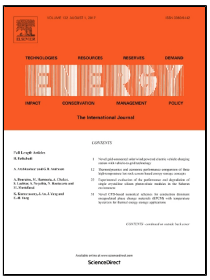

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Effect of Micro Combustor Geometry on Combustion and Emission Behavior of Premixed Hydrogen/Air Flames

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Abstract

In this study, effect of micro combustor geometry on combustion and emission behavior of premixed hydrogen\air mixtures is numerically investigated. An experimentally tested micro combustor geometry is varied by establishing a cavity or a backward facing step or micro channels inside the combustor. Considering effect of combustor geometry on the amount of heat transferred through wall based on outer wall and combustor centerline temperature distributions, combustion behavior is analyzed. Emission behavior is examined by means of mixing conditions, combustion efficiency and maximum temperature value which are highly bound to geometric properties of a micro combustor. Turbulence model used in this study is Renormalization Group k-ε. For turbulence chemistry interaction, Eddy Dissipation Concept model is used. Multistep combustion reaction scheme includes 9 species and 19 steps. Numerical results obtained from this study are validated with published experimental data. Results of this study revealed that combustion in such combustors can be improved by means of quality of mixing process, residence time, combustor centerline and outer wall temperature distributions, conversion rate of input chemical energy to utilizable heat and emanated NO_x levels from combustor outlet with proposed geometric variations.

Keywords: Hydrogen; Micro scale combustion; Combustor geometry.

1. Introduction

Micro power generators such as micro gas turbine, micro rotary engine, micro-thermoelectric and micro-thermo-photovoltaic (MTPV) systems are mostly investigated, experienced and prototyped energy sources for micro devices. Because, the energy supplied by these devices are at a tremendous rate compared to lithium-ion batteries [1]. Micro power generators convert fuel bound chemical energy to utilizable thermal energy via micro combustor (a major component of micro devices) to produce electrical energy needed for micro devices.

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