［様式－学 5］

主　論　文　要　旨

論文題名　**Aero-thermodynamic Consideration of Nonrotating Components for Single-Crystal Silicon Microscale Turbine Engine**

ふりがな　もりあき　なむら
氏名　Moriaki Namura

主論文要旨

In this paper, the design, microfabrication and design guideline for the aero-thermodynamics of a single-crystal-silicon microscale supersonic nozzle and a can combustor are described. The proposed silicon microscale supersonic nozzle and can combustor may be used in microscale gas turbine engine as a future application. The operation envelope that determines whether the continuum or rarefied flow assumption is appropriate can be expressed as a function of Knudsen number (Kn) and related parameters. The effect of nonadiabatic operation on microscale nozzle flow was investigated on the basis of wall heat transfer. It is suggested from an engineering viewpoint that a quantitative aerodynamic evaluation based on Kn and nonadiabatic operation can provide practical aerodynamic design guidelines for microscale continuum internal flow devices with different dimensions and configurations. Furthermore, we attempt to apply an aero-thermodynamic approach based on the burning velocity, the well-stirred reactor (WSR) and the combustion loading parameter (CLP) models to microscale combustor design. These models take into account the dimensions, inlet static temperature, inlet static pressure and mass flow rate of the combustor, which are useful for practical engineering design. A hydrogen fuel-air premixture was used in the combustion tests. The main purpose of this paper is to provide a unified practical aero-thermodynamic design method for microscale combustors based on a rigorous physical background. To establish an aero-thermodynamic model for microscale combustors, the correlation between the geometrical scale and configuration and the aerodynamic parameters that determine the operation space of stable combustion was investigated in detail. The model has an important role in predicting the practical specifications of new designs of microscale combustors with unknown performance. It is shown that the proposed model provides a rigorous physical interpretation of the performance of the microscale nozzle s and combustors investigated by the authors, and other research institutions.