# Development of Swirl-flow Non-Premixed Mesoscale Combustor

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## Extended Abstracts

A non-premixed mesoscale combustor is designed and fabricated to investigate its possibility for energy conversion into electricity via thermophotovoltaic effect. Numerical and experimental studies are carried out with hydrogen-air mixtures at various fuel and air velocities. An experimental test rig is built to perform experiments to investigate the flame stability, and temperature measurements within the combustor. This combustor is shown to have promising outcomes in terms of the flame stability over a wider range of operating conditions and does not need external preheating to stabilize the flame. The flame is found to be stabilized at air and fuel velocity at 5.0 and 0.5-11.0 m/s respectively, while the lean equivalence ratio was around 0.2. Due to decrease in the combustor size, the surface to volume ratio increases significantly, consequently strong thermal and chemical coupling exists between flame, and flame-solid structure [1]. This causes difficulty to stabilize the flame within the micro-to-mesoscale combustor without preheated fuel-air mixtures. The heat loss in the present combustor is used to preheat the incoming air that helps to extend the lean blow out limit of hydrogen-air mixtures event at high velocity. Numerical studies showed that the flame remains inside the combustor with increase in the velocity up to a certain limit, however, moves to the downstream. The air preheat temperature calculated and measured are found to be similar in trend, however; with a slight difference, which might be possible due to 1) modeling of heat transfer through the combustor walls, and 2) the thermocouple sensitivity of temperature measurement. Therefore, further improved studies on validation of the numerical model are essential. Most of the work on micro-to-mesoscale combustors is related to the energy conversion for various applications. However, we are also looking to develop a small propulsion system for UAVs' (Unmanned aerial vehicles) application.

## References

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