Title: Vortex combustion and heat transfer in meso-scale with thermal recuperation

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Abstract: Vortex flows were utilized as a means to stabilize gaseous flames in micro/meso scale non-premixed combustors for use in small scale power and propulsion systems. In the present study, computational and experimental investigation of a turbulent asymmetric vortex flame is studied. Three-dimensional modeling of reacting flows was conducted to explore flame distribution and flow evolution in the chamber. The wall temperature was measured by using an infrared thermometer under the specified flow conditions. The experimental results showed that in stoichiometric condition, by increasing the mass flow rate of air, the wall temperature increases. The emitter efficiency was evaluated based on the measured wall temperature for outside wall. The emitter efficiency was found to be significantly influenced by the position of flame distribution, for which the mixture preheating (by the combustor wall) is believed to be a main reason. The effect of increasing the swirl was to improve the mixing and flame stability for swirl numbers up to approximately one. Excessive swirl also had the advantage of forcing the flame to move upstream to a position closer to the burner wall, resulting in excessive wall heating and emitter efficiency as well.