A combustion chamber incorporating a high temperature porous matrix was designed and tested. The effects and merits of combining combustion on porous media and catalytic enhancement were explored, in addition to the proof of concept of integrating these technologies with simple heat engines, such as thermoelectric generators, to generate efficient and reliable power. The direct observation of the flame during the combustion becomes possible due to a specially designed stainless steel chamber incorporating a quartz window where the initiation and propagation of the combustion reaction/flame was directly visible. The simple design of the combustion chamber allowed for a series of thermocouples to be arranged on the central axis of the porous media. With the thermocouples as output and two flow controllers controlling the volumetric flow of fuel and air as input, it was possible to explore the behavior of the flame at different volumetric flow ranges and fuel to air ratios. Additionally, the design allowed for thermoelectric modules to be placed in the walls of the combustion chamber. Using combustion as a heat source and passive fins for cooling, the device was able to generate enough power to power a small portable electronic device.

The effects of La-Sr-Fe-Cr-Ru based perovskite catalysts on matrix stabilized combustion in a porous ceramic media were also explored. Highly porous silicon carbide ceramics are used as a porous media for a catalytically enhanced superadiabatic combustion of a lean mixture of methane and air. Perovskite catalytic enhancement of SiC porous matrix with $\text{La}_{0.75}\text{Sr}_{0.25}\text{Fe}_{0.95}\text{Cr}_{0.05}\text{Ru}_{0.05}\text{O}_3$, $\text{La}_{0.75}\text{Sr}_{0.25}\text{Fe}_{0.6}\text{Cr}_{0.35}\text{Ru}_{0.05}\text{O}_3$, $\text{La}_{0.75}\text{Sr}_{0.25}\text{Fe}_{0.6}\text{Cr}_{0.4}\text{O}_3$, $\text{La}_{0.75}\text{Sr}_{0.25}\text{Fe}_{0.95}\text{Ru}_{0.05}\text{O}_3$, and $\text{LaFe}_{0.95}\text{Ru}_{0.05}\text{O}_3$ were used to enhance combustion. The flammability limits of the combustion of methane and air were explored using both inert and catalytically enhanced surfaces of the porous ceramic media. By coating the SiC porous media with perovskite catalysts it was possible to lower the minimum stable equivalence ratio and achieve more efficient combustion.

Major: Mechanical Engineering

Educational Career:
Bachelor’s of Mechanical Engineering, BS, 2012, University of Central Florida

Committee in Charge:
Nina Orlovskaya, Chair, Mechanical & Aerospace Engineering
Ruey-Hung Chen, Mechanical & Aerospace Engineering
Subith Vasu, Mechanical & Aerospace Engineering
Jayanta Kapat, Mechanical & Aerospace Engineering

Approved for distribution by Nina Orlovskaya, Committee Chair, on March 27, 2014.

The public is welcome to attend.