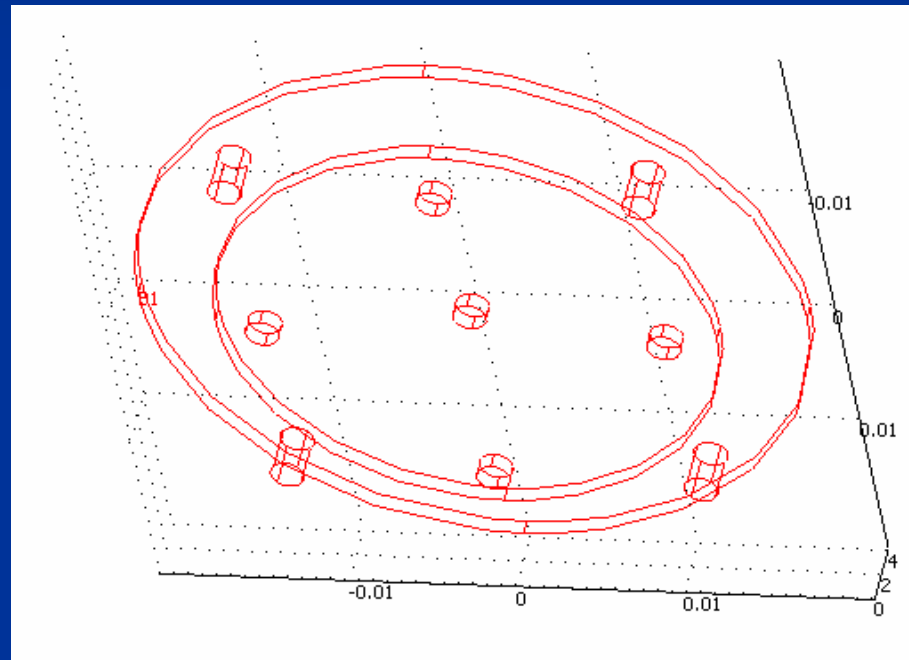


Implementation of sintered LTCC for the fabrication of a 3D cylindrical Micro combustor



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Sun fest Program 2006

Outline of the presentation

- Introduction
- Applications (why is important)
- Advantages and disadvantages of both micro combustors
- Micro combustor design process
- Future Works
- Conclusion
- Acknowledgments
- Questions

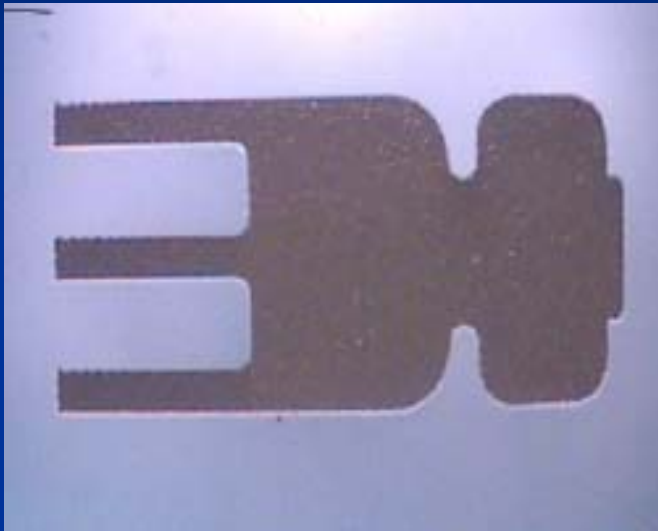
Introduction

- The micro-combustor will harness the heat produced from combustion and directly converted it to electricity through thermoelectric element.
- The micro-combustor control the mixing of propane and oxygen gas in stoichiometric proportions.
- Implementation of LTCC tape were used to build the cylindrical micro combustor.
- The combustion process takes place inside the micro combustor, this process occur because the mixing of fuel and oxygen.

Applications

- It provides more energy than commercial batteries.
- The absence of mechanical parts within the micro-combustor gives it a much smaller size and quiet operation during power generation.
- It has more life time duration compared to the commercial batteries.
- Chemical control reaction.

Advantages and disadvantages of both micro combustors



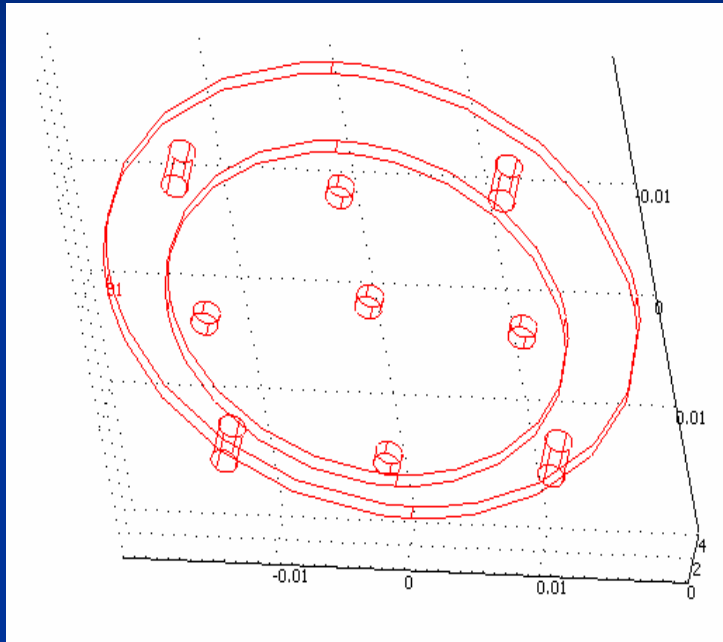
Advantages

- Small device and less layer.
- One geometry defined in Auto Cad.

Disadvantages

- Only 3 input
- Not to efficiently, only the combustion process occur in one area of the structure.

Advantages and disadvantages of both micro combustors



Advantages

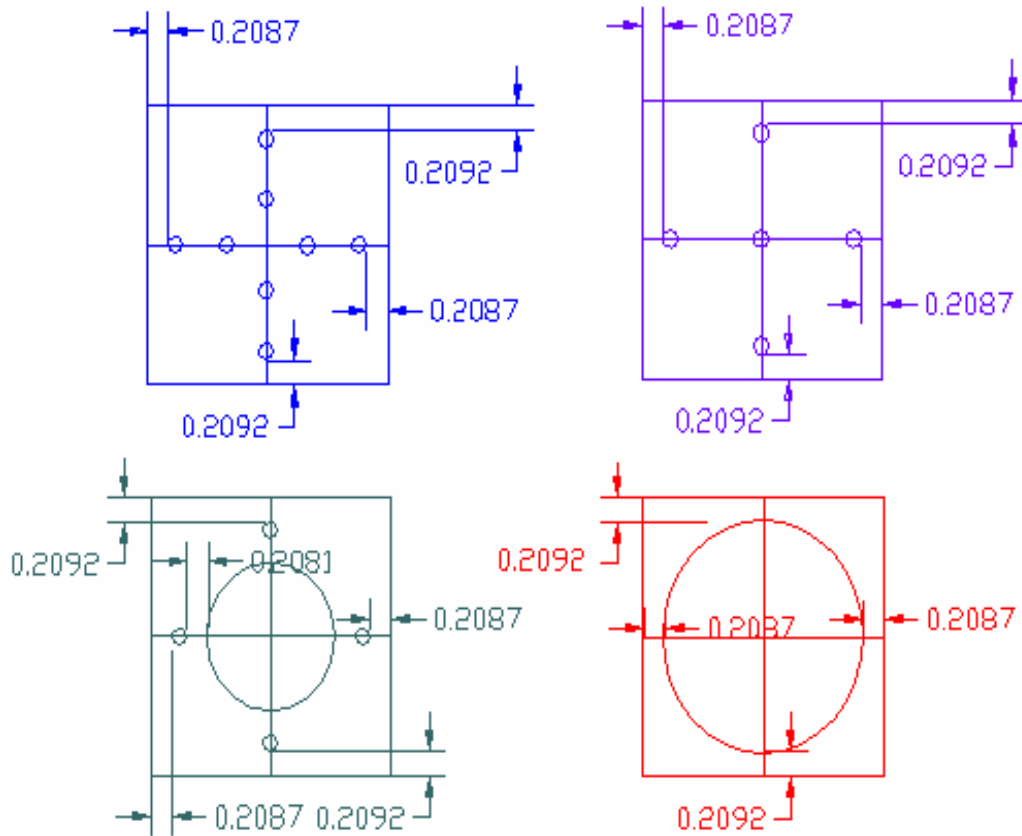
- Several gas inputs can be placed under and several outputs can be placed around the mixing chamber.
- Composed of a mixing and a burning chamber.

Disadvantages

- Complex process to build it, more and different layers.
- Bigger than the first micro combustor, but it can be improve to be smaller.

Micro combustor design process

- First design the layers in AutoCAD.



Layer Color	Circle diameter	Quantity of layer created
Blue layer	.0729" every circle	8
Violet layer	.0729" every circle	8
Green layer	.0729" the small circle and the bigger circle have .6391"	23
Red layer	1.000"	23

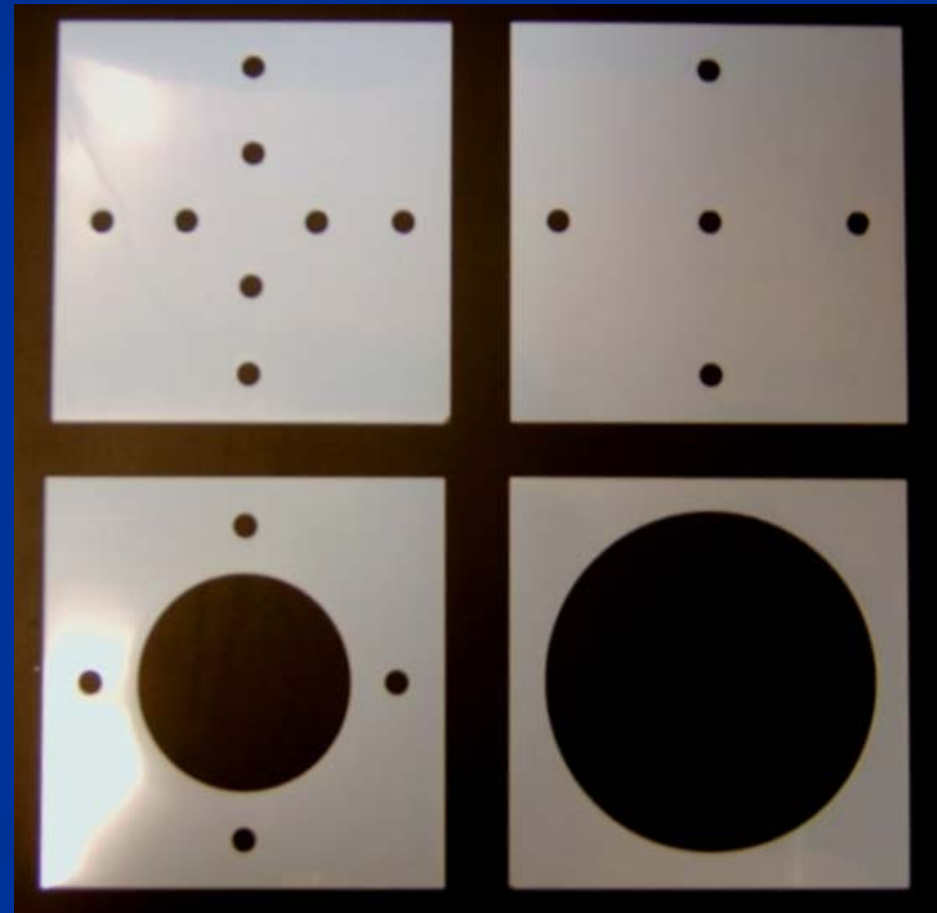
Micro combustor design process

- Choose LTCC tape
(low temperature co-fired ceramics)



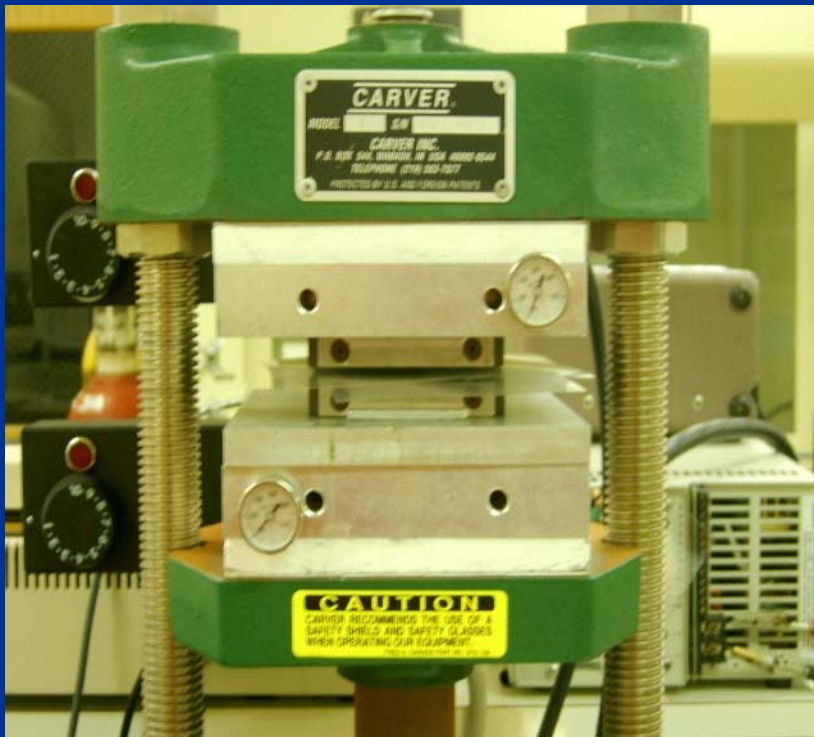
Micro combustor design process

- Laser milling process (speed of 5% and power of 5%)



Micro combustor design process

- Lamination process



Thickness of .5mm using 50 layers and applying 2000 psi in the press.

Micro combustor design process

Furnace process

- The heating schedule as programmed in the resistance furnace:
- From room temperature to 300°C at a rate of $10^{\circ}\text{C}/\text{min}$.
- Kept at 300C for 30 minutes
- Ramp from 300C to 850°C at a rate of $10^{\circ}\text{C}/\text{min}$
- Kept at 850°C for 1 hour and 45 minutes.
- Turn furnace off and let it cool to room temperature.



Future works

- Visual Characterization using different proportions of fuel (*experimentation part*).
- Analysis of the structural integrity as a function of temperature.
- Analysis of transduction.

Conclusion

- The Femlab simulation show nice mixture of both gas (oxygen and propane).
- The design of the structure is a very complex process but not to difficult to do.
- The laser milling process can make the layers in terms of minutes.

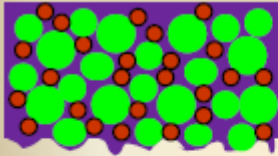
Acknowledgments

- Thanks to my advisor Jorge Santiago
- My professor from Puerto Rico Rogerio Furlan
- The Sun fest Program

Questions



Micro combustor design process



Green Tape™ consists of Alumina particles (green), glass particles (red) and polymeric binder (blue). Packing density of the particles in Green Tape™ is very high, with binder occupying interstitial areas. The binder will burn out during firing.



Advantages of using LTCC tape

- Cost efficiency
- High layer count
- Good dimensional control of structures
- Can resist high temperature