A New Platform Concept for μ-SOFCs
Using Low Temperature Co-fired Ceramic Technology

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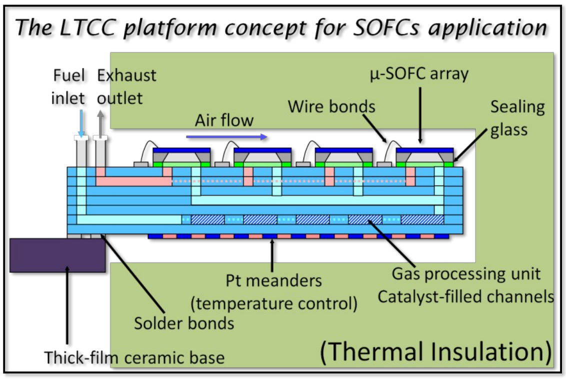
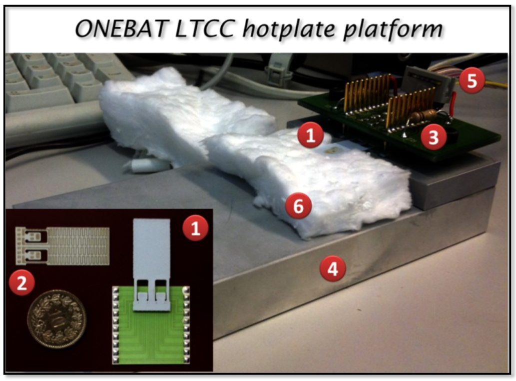
Introduction

- Micro-scale solid oxide fuel cell (μ-SOFCs) is a promising power generation technology for portable devices, however, its packaging system faces many challenges.
- Low temperature co-fired technology (LTCC) is a potential solution for μ-SOFC packaging due to its easy 3D structuration for fluidic channel integration, stable electrical connections, and outstanding thermal and chemical stability.
- The LTCC hotplate system (shown below) is designed as a high-integration packaging and test platform for μ-SOFCs.
- The current work aims to fabricate and assemble the LTCC hotplate system in order to reach high temperature (550°C).


The LTCC platform concept for SOFCs application

The LTCC hotplate System

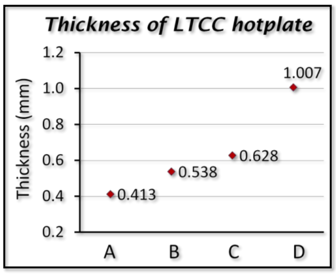
The system mainly consists of a LTCC hotplate, a ceramic base, a control circuit and a mechanical base. The system is operated by the LabView program with PID control through a LabJack UE9-Pro data acquisition card.

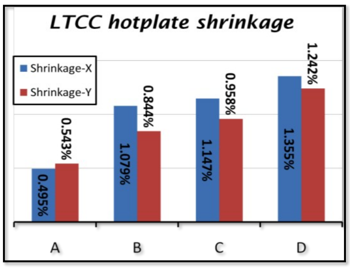

ONEBAT LTCC hotplate platform

1.A LTCC hotplate soldered on the ceramic base
2.A LTCC hotplate with 2 Platnium meander heating tracks (btm.)
3.A control circuit for the R measurement of Pt PTC heating track
4.A mechanical base
5.An electrical connection to the power supply and LabJack UE9-pro data acquisition card
6.Thermal insulation (Superwool™ 607)

The LTCC hotplate processing

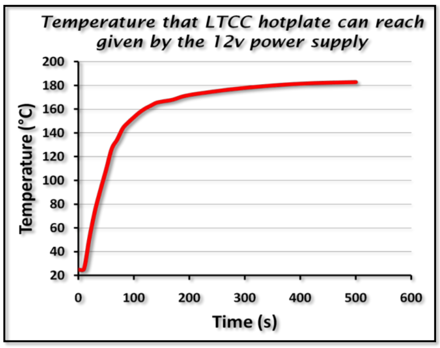
- Self-constrained Heraeus HeraLock HL2000 green tape used for better dimensional control.
- DuPont 951 (thicker, but large nominal ≈13% XY shrinkage) used to achieve 1 mm thickness required for fluidic integration.
- HL2000 can largely constrain the shrinkage of ≈ 3x thicker DuPont 951 (X: 1.36%, Y: 1.24%).


Thickness of LTCC hotplate

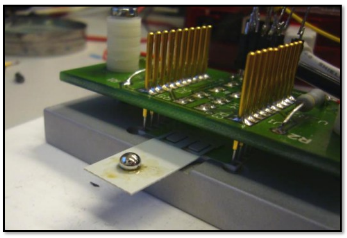

LTCC hotplate shrinkage

Samples layout (HL = HeraLock HL2000 ; DP = DuPont 951)
A: HL/HL/HL/HL B: HL/DP/DP/HL C: HL/DP/HL/DP/HL D:HL/DP/DP/HL/DP/DP/HL

Temperature characterization


Temperature that LTCC hotplate can reach given by the 12v power supply

The temperature of the LTCC hotplate system, measured by the attached Pt1000 thermistor, is currently limited to 180 °C by the power supply.



The LTCC hotplate system can melt SN96 solder (melting point 221 °C) as a wetting ball given by the 12 V voltage supply.

Conclusion

- A LTCC hotplate system was fabricated for developing μ-SOFC applications.
- Combining different LTCC materials allows manufacture of thick (≥ 1 mm) LTCC hotplates with low firing shrinkage.
- System temperature is currently limited to ≈200°C due to combination of low supply voltage (12 V) and high heating track resistance (~150 Ω).
- Future work will focus on improving the heating capability of the LTCC hotplate system.

Acknowledgement
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