# Nano-Catalyst Infiltration by Bio-Surfactant Catechol Modification of Anode Supported SOFC Electrodes

O. Ozmen<sup>1,2</sup>, S. Lee<sup>1,2</sup>, G. Hackett<sup>1,3</sup>, H. Abernathy<sup>1</sup> and E. M. Sabolsky<sup>1</sup> <sup>1</sup>US Department of Energy, National Energy Technology Laboratory, Morgantown WV; <sup>2</sup>West Virginia University, Morgantown, WV; <sup>3</sup>AECOM / GES, Morgantown, WV

## Introduction:

#### **Objectives**:

- 1. Enhance the solid oxide fuel cell (SOFC) performance by incorporating nano-catalyst particles by infiltration within the porous NiO/YSZ anode and LSM/GDC cathode electrodes.
- 2. Utilize on commercial SOFCs in order show process applicability on existing electrode microstructures.
- 3. Investigate performance and stability as a function of infiltrated  $CeO_2$ nano-catalyst amount.

#### Mussel Inspired Adhesives: Dopamine and Norepinephrine

Catechol based bio-adhesives dopamine and norepinephrine have been utilized to enhance the wetting property of substrates and provides material deposition versatility owing to their multifunctional end groups. poly-Norepinephrine offers smoother and more uniform coating than poly-Dopamine.



#### **Polarization Resistance vs Nano-Catalyst Amount**



- Two characteristic regions were observed.
- 5 mg nano-ceria infiltrated cell reached the lowest polarization resistance value.
- Above that point, Rp of the cell was close to base-line cell probably due to gas limitation issues.

Electrode Overpotential reduced gradually up to 5 mg nano-ceria loading (up to 35% decrease in electrode overpotential). However at 8.5 mg, the overpotential jumped back just under the baseline cell performance.





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### **Experimental: Benefits of Bio-Coating:** Infiltration Study on Anode-Supported Cells 1. Independent of substrates and coating composition. 2. Catalyst (or any nanoparticle) can be with the adhesive/chelation pinned Cathode mechanism. LSM/LSM-GDC 3. Facile method to control the overall 12.5 mm diameter process (deposition rate etc.) ~ 50 µm thickness Anode Surface Norepinephrine

#### **Electrode Overpotential vs Current Density**



#### Baseline Cell ~48h ▲ 1.3 mg CeO<sub>2</sub> ~48h ◆ 3.5 mg CeO<sub>2</sub> ~48h ▼ 5 mg CeO<sub>2</sub> ~48h 8.5 mg CeO<sub>2</sub> ~48l 0.06 -0.04 Frequency (Hz 0.10 -

- At 48<sup>th</sup> hour, all the cells seemed not activated yet (higher resistance than the BC.
- At 150<sup>th</sup> hour and 300<sup>th</sup> hour, both anode and cathode were activated.
- Gas limitation zone has started to get narrow in time meaning that the coarsening of nanocatalyst relieved the gas pathway.

### **Conclusion:**

- levels.
- 300 hours of SOFC testing.
- impregnation/firing protocol.
- deposition decoration (island, thin film formation etc.)

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#### **EIS Characterization**

0.01





poly-norepinephrine dip-coat templating assisted higher nano-catalyst deposition

A systematic infiltration study was performed to aim the optimum nano-catalyst infiltration needed to get the lowest electrode resistance and overpotential within

Both the anode and cathode can be infiltrated at the same time using only a singular

On-going AFM study is aimed to reveal nano-catalyst coarsening kinetics in different

### **Acknowledgement and References:**

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