DOE-NETL Kickoff Meeting; Thursday, December 3, 3:45 pm – 5:15 pm

LSCF-CDZ Composite Cathodes for Improved SOFC Electrical Performance

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Presentation Outline

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- Risk Management

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Background

- Solid Oxide Fuel Cells (SOFCs) use cathodes that must have very specific properties.
- SOFC cathodes need to have high electrical conductivity and excellent catalytic activity for reducing oxygen.
- In addition, they must be compatible with other cell components in ways that no unwanted reactions occur and no significant mismatch occurs in the thermal expansion coefficients.
- For intermediate and low temperature SOFCs, lanthanum strontium cobalt ferrite (LSCF) cathodes are used with good performances mainly due to an increased catalytic activity for reducing oxygen.
- However, a gadolinium doped ceria (GDC) barrier layer needs to be used to prevent unwanted chemical reactions at the electrolyte interface.
- This poses a concern for long term operation of SOFC systems because this layer introduces additional interfaces where degradation may occur increasing cell resistance.
- In addition, such layer adds more fabrication steps and increases cell fabrication cost.
- Researchers have shown that a LSCF-CDZ (ceria doped zirconia) mixture does not produce the unwanted $SrZrO_3$ compounds after sintering at 850^{o}C.
- They further indicate that this mixture stabilizes the Sr^{2+} cations in LSCF and suppresses the mobility of strontium, and therefore prevents the reaction between LSCF and YSZ.
- However, these studies are limited to one composition and the mechanism of preventing Sr segregation in not fully explained.
- It is therefore the objective of this investigation to study different composition of CDZ in LSCF composite cathodes and to determine the mechanism that prevents Sr segregation.

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Technical approach

- Composite cathodes made of LSCF and CDZ with different compositions will be:
  - fabricated, characterized, and electrically tested to determine and quantify cell electrical performance improvements.
- The new composite cathodes will be screen printed on commercially available anode supported bi-layers, and:
  - button cell testing will be performed followed by post-mortem analysis.
- In addition, a performance baseline will be established using Delphi's anode supported bi-layers and/or complete cells.

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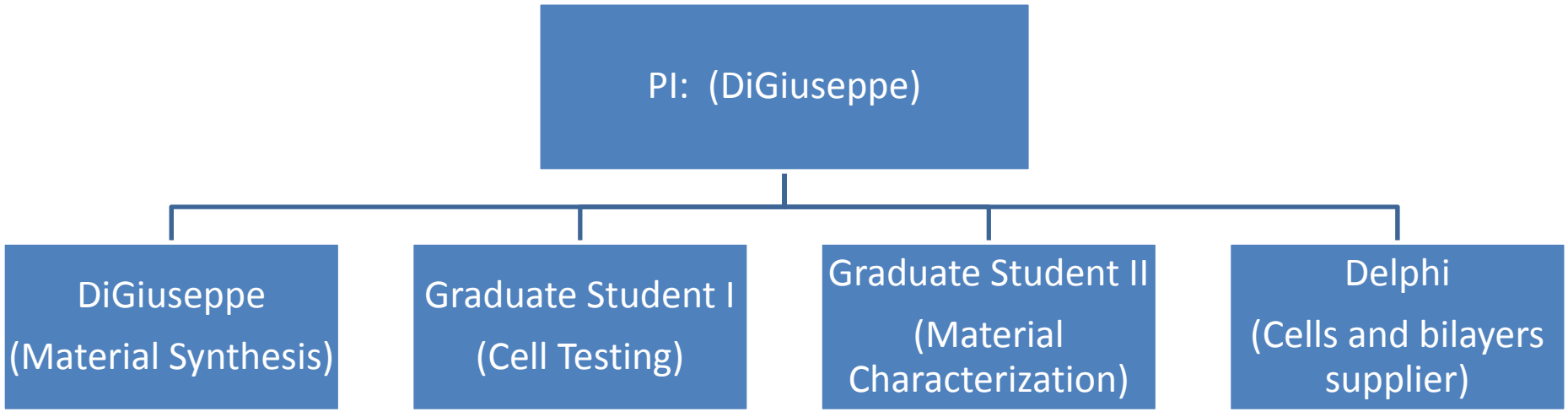
Project objectives

- The goal of this project is to advance SOFC cathodes by fabricating and studying composite LSCF-Ce-doped zirconia (LSCF-CDZ) ability to prevent Sr segregation in order to enhance the performance, reliability, robustness, and endurance of commercial SOFC systems.
- The proposed work is broken down into the following objectives:
  1. Study composite cathodes made of LSCF and CDZ with different composition and determine Sr segregation prevention capabilities.
  2. Determine the electrical performance improvements that results from preventing Sr segregation.
  3. Determine the mechanism by which Sr segregation is prevented.

Project structure



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Project schedule

- Start date:
  - Oct. 01, 2015
- End date:
  - Mar. 31, 2017
- Gantt Chart attached
  - Double-click Project icon

Microsoft Project Document

Project budget

- The attached word document shows the breakdown of the project cost.
- Double-click word icon.

Microsoft Word Document

Project Management Plan

- The PI will manage and direct the project in accordance with a Project Management Plan to meet all technical, schedule and budget objectives and requirements.
- The PI will coordinate activities in order to effectively accomplish the work.
- The PI will ensure that project plans, results, and decisions are appropriately documented and project reporting and briefing requirements are satisfied.
- The PI will update the Project Management Plan as necessary to accurately reflect current status of the project.
- Updates may include:
  - project management policy and procedural changes.
  - changes to the technical, cost, and/or schedule baseline for the project.
  - significant changes in scope, methods, or approaches.
  - anything required to ensure that the plan is the appropriate governing document for the work required to accomplish the project objectives.

Risk Management

- This project has a very low risk factor because of the PI's extensive experience in SOFC, and Delphi leadership in fabricating and testing SOFCs button cells.
- Kettering SOFC research lab has already performed several thousand hours testing on button cells fabricated by Delphi.
- Some minor factors that could impact the schedule are the following:
  - Potential loss of one the students.
  - Equipment failures that require repairs.
- Though unlikely, if such an event were to occur, NETL would be immediately notified and appropriate actions will be taken.
- That is, a new student will be found, and the equipment needed repair will be repaired.
- In addition, if needed Delphi can and will provide assistance in the fabrication process and button cell testing.
- There are no technical risks associated with the project since this work is based on sound material science principles, and extends what has been successfully done and applied in the automotive exhaust catalyst field.
- The PI will manage the project risks in order to identify, assess, monitor and mitigate technical uncertainties as well as schedule, budgetary and environmental risks associated with all aspects of the project.
- The results and status of the risk management process shall be presented during project reviews and in Progress Reports with emphasis placed on the medium- and high-risk items.