Fed. funding:	$1.1M
Length	18 mo.

Cost-effective, Intermediate-temperature Fuel Cell for Carbon-free Power Generation

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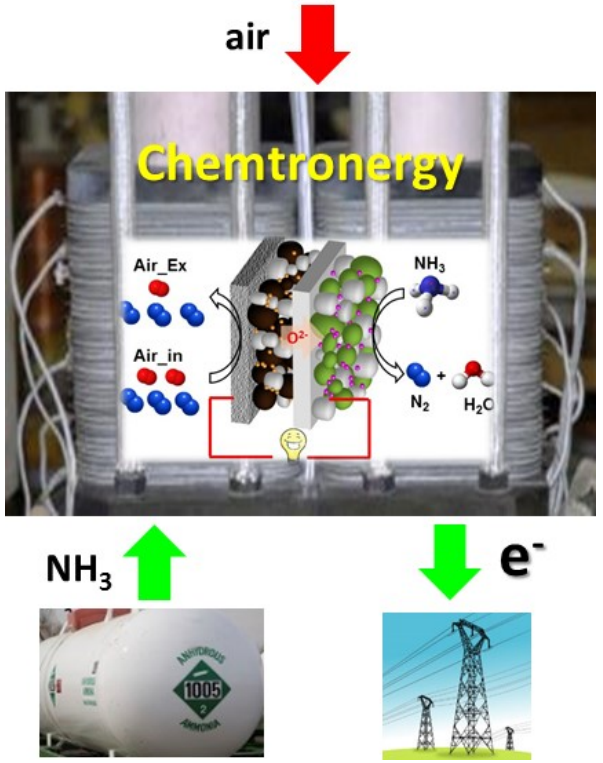
Project Vision

To develop and demonstrate a transformational technology that cost-effectively and efficiently converts the chemical energy of the ammonia fuel directly into electricity at a reduced T (<650ºC) through the design and manufacturing of an advanced IT-SOFC possessing unique hierarchical structures.



Project Impact

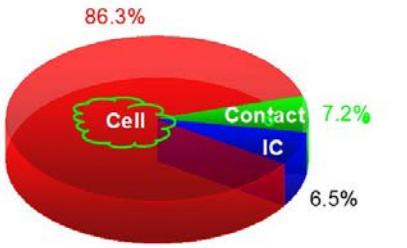
Providing a new pathway to expand our domestic energy production capacities and to strengthen energy dominance, while significantly reducing carbon footprint.

Innovation and Objectives

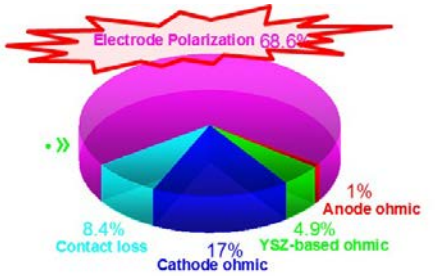
Innovation

To tackle the limitations of NH_3-based fuel decomposition in-situ, the performance, lifetime, scalability, and costs of IT-SOFCs through the integration of

- a unique hierarchically-structured cell design;
- advanced anode catalysts and highly performing cell materials enabling power generation directly from NH_3 below 650ºC
- development of a cost-effective manufacturing process



Overpotential breakdown at a stack level



Overpotential breakdown at a cell level

Task outline, technical objectives

Performance:

- Advanced IT-SOFC design (**CTG**, Q1)
- NH_3 catalyst development (**CTG**, Q1-Q4)
- Highly-performing SOFC development (**CTG**, Q2-Q4)
- Experiments & Proof-of-concept demonstration at a scale-up cell level (**CTG**, Q3-Q6)

Cost:

- Manufacturing process development (**UMD** & **CTG**, Q1-Q4)

Tech-to-Market strategy

Aiming for the sustainable energy sectors, mainly for power generation (**TechOpp** & **CTG**):

- Market analysis & assessment; understanding competitive barriers while profiling the target power generation segments.
- Customers: a broad array of power generation (sub W ~ kW) from portable to stationary sources
- Small scale production; licensing; joint ventures

Innovation and Objectives

Project history

- Collaborative efforts to be carried out by a team constructed with highly complementary strengths in the areas of SOFCs (**CTG**), advanced manufacturing process (**UMD**), and T2M development (**TechOpp**):
  - **CTG**: implementing 20 yrs of experience in the development and commercialization of solid-oxide electrochemical devices (from sub-W to 4 kW)
  - **UMD**: expanding their established microfabrication processes and advanced deposition techniques for rapid prototyping
  - **TechOpp**: utilizing their proven expertise in transitioning new technologies into commercial products

Proposed targets

Metric	State of the Art	Proposed
Delivered SUE Cost	> $0.3 /kWh	~ $0.3/kWh
Max operating temperature	800~900ºC	650ºC
Current density at 0.75V	0.4 A/cm^2	0.3 A/cm^2
Electrical efficiency	52~60%	> 55%
Cell degradation rate	> 1%/1kh	< 0.3%/1kh

Anticipated challenges

- Highly performing-cell components at reduced operating temperatures (adv. materials), and
- Materials compatibility & stability under desirable operating conditions (process implementation)
- Fuel catalysts & implementation (adv. materials)
- Cost-effective cell fabrication processes (engineering process parameters for maximum throughput)
- Scale-up & economic viability (OEM manufacturer, $$$)

Desirable partnerships

Partners capable of transitioning laboratory technologies into marketable products:

- Scale-up demonstration at a sub-kW scale (~ 1 yr)
- System integration (2 FTE within 2 yrs)
- “an end user” having a specific need & willing to perform a proof-of-concept demonstration at a small-scale system level (~2 yrs @ 1 kW)
- Investors (private & government w/ PA$$)