

U.S. DEPARTMENT OF
ENERGY

Office of
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

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arpa-e
CHANGING WHAT'S POSSIBLE

Gregorii Soloveichik
Mark Pouy

Fuel Cell Technologies Office (FCTO)

Dimitrios Papageorgopoulos,
John Kopasz, David Peterson,
Simon Thompson, Donna Ho

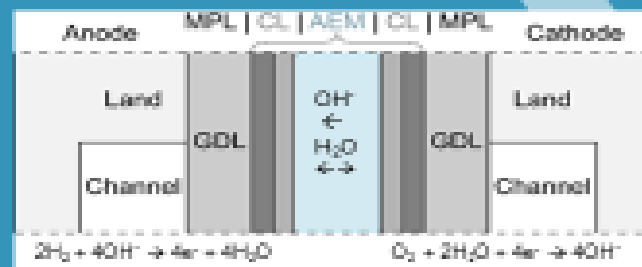
Anion Exchange Membrane Workshop

May 30, 2019 – Dallas, TX



Sheraton Dallas
Hotel
Dallas, Texas
Thursday
30 May 2019

in coordination with
2019 Spring Meeting
Electrochemical
Society



AEM WORKSHOP

ANION EXCHANGE MEMBRANE



Challenges

identifying challenges of anion exchange membrane/ionomer (catalyst/ionomer interactions, water management, and carbonate formation)



Baseline Materials

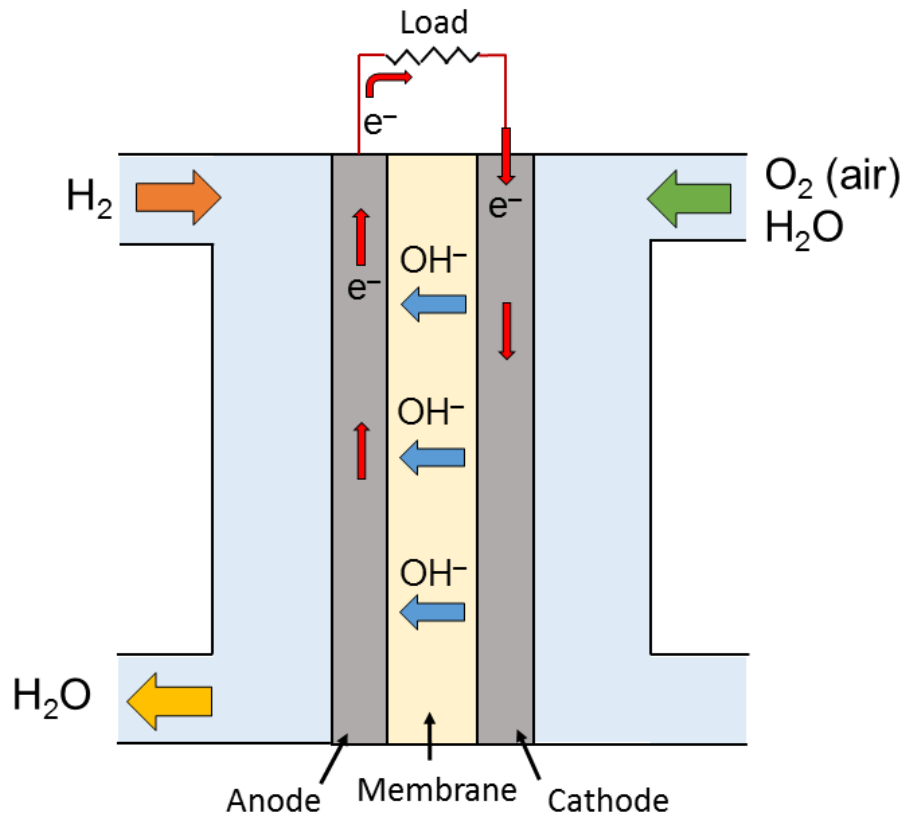
baselining membrane and ionomer materials (selection and manufacturing of standard materials and round robin testing)



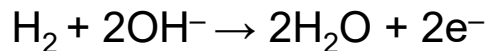
Test Protocols

testing protocols (application-specific metrics and targets)

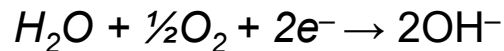
AEMFC Advantages and Challenges



Anode:



Cathode:



Overall:



Advantages

- Improved ORR kinetics
- PGM-free catalysts
- Reduced cost BPP materials
- Cheaper polymers
- Direct liquid fuels

Technological Challenges

- Alkaline/oxidative stability
- IEC/conductivity
- Carbonation
- Suitable electrode ionomers
- Water uptake
- Water management
- HOR catalyst

AEMFC Milestones

From FCTO Fuel Cells Multi-Year Research, Development, and Demonstration Plan

Key drivers for targets: performance, durability, and cost

- **Q2, 2019:** Demonstrate alkaline membrane fuel cell **initial performance of 0.6 V at 600 mA/cm² on H₂/air** (maximum pressure of 1.5 atm) in MEA a total loading of **<0.125 mg_{PGM}/cm²**, and **<10% voltage degradation over 2,000 hour hold** test at 600 mA/cm² at T>60°C. Cell may be reconditioned during test to remove recoverable performance losses (Task 3.6).
- **Q2, 2020:** Develop non-PGM catalysts demonstrating alkaline membrane fuel cell peak power performance **>600 mW/cm²** under hydrogen/air (maximum pressure of 1.5 atm) in PGM-free MEA (Task 1.9).

MYRD&D Plan to be updated taking into account developments in technology

Fuel Cells MYRD&D Plan:

<http://energy.gov/eere/fuelcells/downloads/fuel-cell-technologies-office-multi-year-research-development-and-22>

AGENDA

8:00	-	8:20	Opening Remarks <i>Donna Ho (FCTO)/Grigorii Soloveichik (ARPA-E)</i>
8:20	-	8:40	Workshop Overview/AEM Status <i>Bryan Pivovar (NREL)</i>
8:40	-	9:05	Membrane Targets/Metrics <i>Mark Pouy (ARPA-E)</i>
9:05	-	9:30	Membrane Testing Challenges, Standardization <i>Mike Yandrasits (3M)</i>
9:30	-	9:45	Break
9:45	-	11:45	Break Out Session 1 (AEM Focus)
11:45	-	12:45	Working Lunch – Briefs from Breakout Session 1 & Discussion
12:45	-	1:15	AMFC Milestones/Performance/Durability Status <i>Bill Mustain (USC)</i>
1:15	-	1:45	Catalyst-Ionomer Interactions/AMFC Durability <i>Yu Seung Kim (LANL)</i>
2:00	-	3:45	Breakout Session 2 (AEM Fuel Cell Focus)
3:45	-	4:00	Break
4:00	-	5:00	Briefs from Breakout Session 2 & Discussion
5:00			Concluding Remarks

Breakout Sessions

Breakout Session 1 – AEM Focus

- Standardized Protocols – conductivity, CO₂ (Mike Hickner)
- Standardized Protocols – degradation, IEC, mechanical (Chulsung Bae)
- Membrane Metrics/Targets (John Kopasz, Mike Yandrasits)

Breakout Session 2 – AEM Fuel Cell Focus

- Electrode Performance (Yu Seung Kim)
- Water/CO₂ Management (Adam Weber)
- Fuel Cell Performance and Durability Milestones/Metrics/Targets (John Kopasz, Bill Mustain)