ARL Fuel Cell & Logistics Fuel Processing Programs

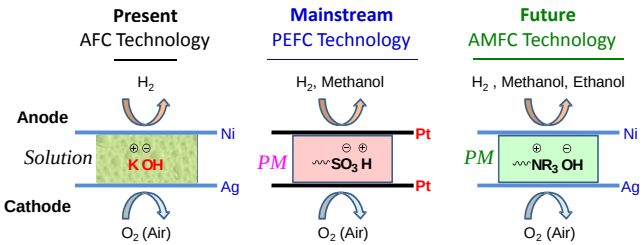
Team: Deryn Chu (T.L.), Rongzhong Jiang, Charles Rong, Dat Tran, Xiaoming Ren, Zach Dunbar, Kyle Grew, Joshua McClure
Sensors and Electron Devices Directorate
Energy and Power Division
Electrochemistry Branch (RDRL-SED-C)

Alkaline Membrane Fuel Cells:

Develop high performance, low cost and compact fuel cell power units for portable power applications

Fuel Cell Technologies: Present and Future

Future

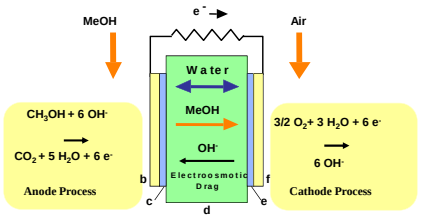


AMFC Advantages

- Use non-precious metal catalysts in alkaline medium
- Unique opportunity to discover high performance low cost catalysts by tailoring the catalyst surface
- Highly selective cathode catalysts for oxygen reductions
- Potential to develop fuel cells capable of multiple hydrocarbon fuels, inorganic fuels and renewable biofuels

Overcome the barriers in cost, performance and performance stability of current PEMFCs

AMFC Components & Challenges



1.Alkaline membrane and ionomer
- **Low anionic conductivity**
- **Low thermal and chemical stability <80ºC**
- **Too high water uptake and swelling**

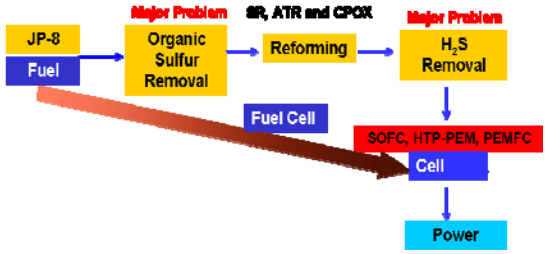
2.Non-Pt cathode catalysts
- **There are no systematic approach and efforts**

Logistics Fuel Processing:

Provide an affordable and efficient process to convert JP-8 to hydrogen rich reformate for fuel cells including enabling technologies for JP-8 reformation

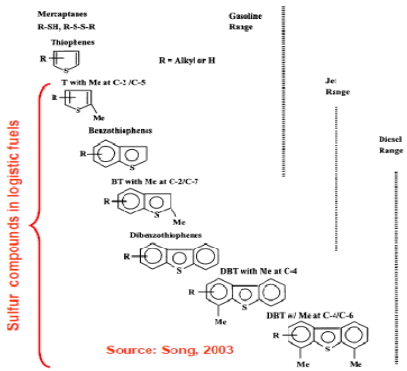
Technical Challenges:

- Sulfur removal/sulfur poison: Sulfur in the JP-8 poisons the reformation catalysts and fuel cell stack (catalysts, …)
- Carbon formation/deposition (coking)
- Compact & lightweight system/balance of plant



(Internal) Approaches :

- Explore and develop organic metallic compounds to remove organic sulfurs compounds from liquid phase JP-8 fuel
- Develop high efficient sorbent materials to remove hydrogen sulfide from reformate



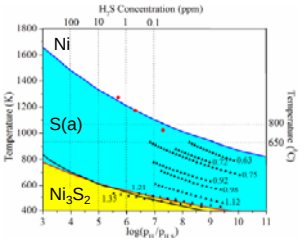
Hydrocarbon	JP-8 (%)
Paraffins	71
Alkylbenzenes	19
Naphthalenes	6.2
Olefins	3.5

Long-Term Interest- Solid Oxide Fuel Cells:

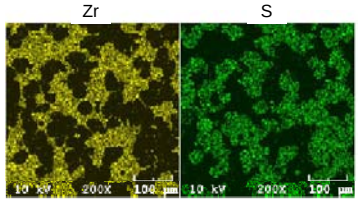
Develop high performance, low cost, and durable (rugged) fuel cell that is capable of operating off of logistics fuel, JP-8

Technical Challenges:

- Sulfur, chromium, carbon, etc. from JP-8, interconnects, and other components can degrade system (poisoning, coking)
- Elevated temperatures require thermal conditioning periods
- Mismatches in coefficients of thermal expansion of cell components can lead to degradation and failure
- Thermal cycling stability and reliability are not sufficient



J.-H. Wang, M. Liu, Electrochem. Comm. 2007, 9, 2212.



EDX: 48h at 800 ˚C with 50 ppm H_2S, N_2 (48.5%), H_2 (50%), H_2O (1.5%)

Z. Cheng, M. Liu, Solid State Ionics. 2007, 178, 925.

POC: Dr. Deryn Chu (301)394-0308