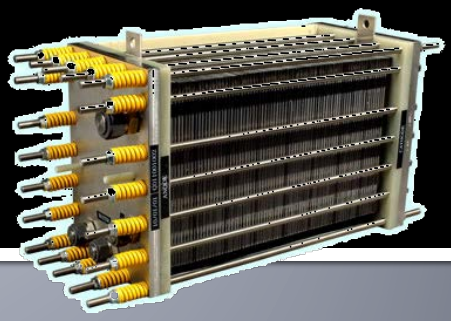
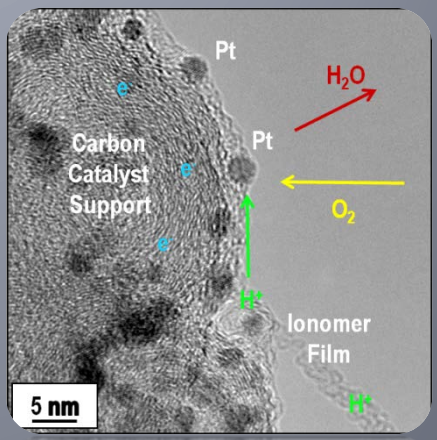
Oak Ridge National Laboratory's

Fuel Cell Technologies Program Overview



Our Core Competencies

- Novel in-situ characterization methods and advanced electron microscopy for critical materials (Karren More)
- Electronically conductive, corrosion resistant coatings for stamped metallic bipolar plates (Mike Brady and Dane Smith)
- Hydrogen reformer outlet gas analysis and correlation to PEMFC operating conditions and reaction kinetics (Todd Toops)
- Expertise in the study of hydrogen permeation through the walls of carbon-fiber composite pipelines and on-board storage tanks (Bart Smith)
- Low cost approaches to large-scale, stationary hydrogen storage tanks such as metal-lined, steel-reinforced concrete designs (Zhili Feng)
- Low-cost PAN precursors for carbon-fiber composite storage tanks (Bob Norris and Felix Paulauskas)
- Modeling of the impact of stationary and transportation fuel cells on society including technical feasibility, environmental risk, financial risk, and economic compatibility with national and international policies (David Greene)



Fuel cell materials are characterized and optimized through advanced microscopy techniques, allowing fuel cell lifetimes to be extended in real-world applications.

1:20 scale of a commercial grade carbon-fiber production line.

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Featured Projects

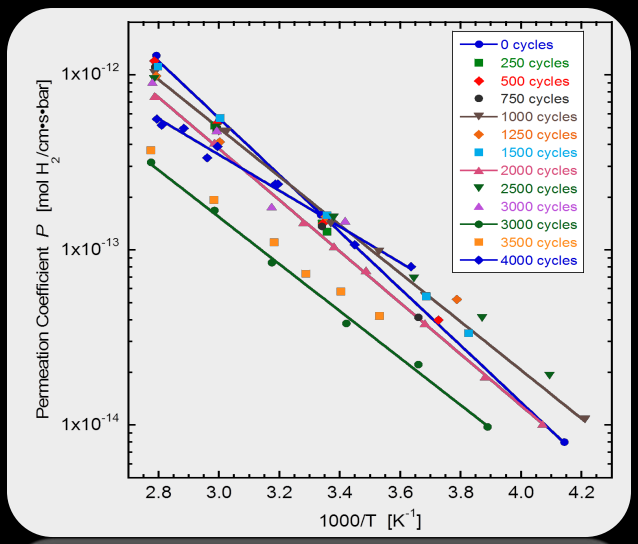
Nanoscale Materials Characterization and Component Development

- Support of 3M in developing new oxygen evolution reaction (OER) electrocatalysts for localized anode fuel starvation conditions during start-up and shut-down
- Support of ANL for development of ultralow Pt loading cathode electrocatalysts with high oxygen reduction reaction (ORR) activity
- Support of NREL to develop nanostructured Pt cathode electrocatalysts with controlled geometries and high ORR Pt utilization
- Support of LANL in developing ultralow Pt-content cathode electrocatalysts with non-spherical geometries and high mass activities
- Support of LANL to study fundamental membrane electrode assembly (MEA) chemical degradation mechanisms, material interface durability, and nanoscale structural features using novel, in-situ diagnostics
- Investigation of structural and compositional mechanisms contributing to MEA degradation and failure using advanced electron microscopy and X-ray photoelectron spectroscopy
- Non-flame, non-plasma-based method of surface nitriding stamped metallic bipolar plates for GM automotive fuel cell stacks

Images:

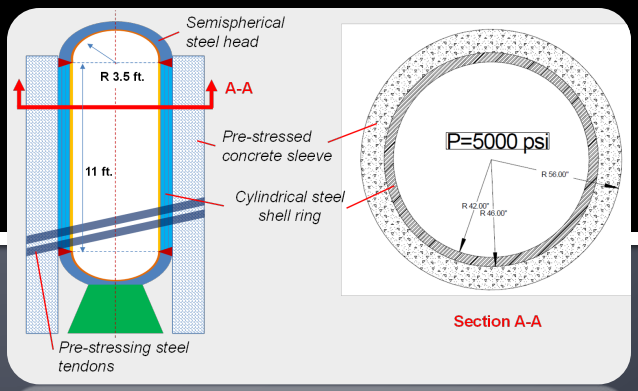
(Top left) Permeation coefficients P for hydrogen in polymer specimen, measured at 430 bar.

(Lower left) Baseline stationary hydrogen storage vessel design.



Hydrogen Storage & Delivery

- Development of higher strength commercial textile polyacrylonitrile – methylacrylate (PAN-MA) precursors for carbon-fiber storage tanks with 400 ksi tensile strength and 32 Msi modulus
- Evaluation of hydrogen permeation through Type IV carbon-fiber tank liners under thermal cycling and demonstration of melt spun tows capable of conversion into carbon fiber
- Understanding hydrogen permeation through the walls of carbon-fiber reinforced polymer pipeline during pressurization and de-pressurization for development of an ASME standard
- Development of low-cost hydrogen storage using metal lined reinforced concrete tanks



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