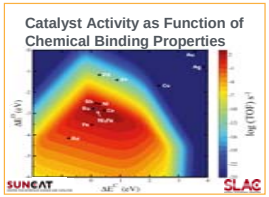
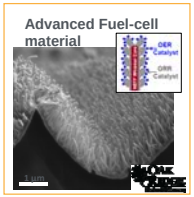
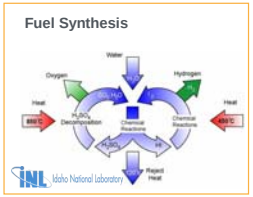
NATIONAL LABORATORY CATALYSIS SOLUTIONS:

Translating Discovery to Technology and Deployment

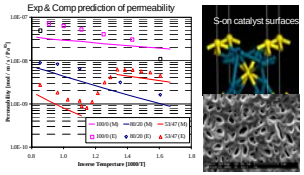
The National Laboratories have taken process, chemical, and materials discoveries and brought them to solution with many partners. Several examples related to fuel production, fuel cells, and emission treatment are shown here. The National Laboratories have several mechanisms available to work with industry for bringing about catalysis solutions.



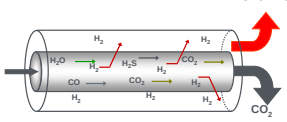




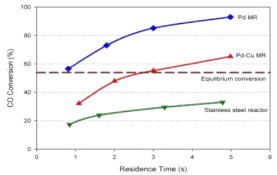
Process Intensification: Integrated Membrane Reactors



Dense Pd-based membrane permeability (left); Sulfur effects on Pd (right); Integrated water-gas shift membrane reactor concept (below)

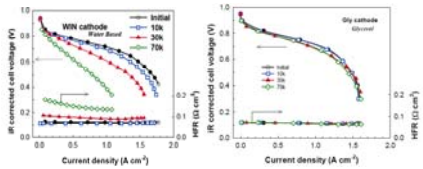


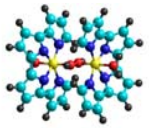
Impact of membrane reactor on CO conversion



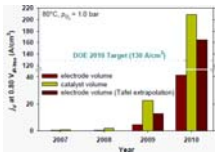
NETL-RUA

Hydrogen and Fuel Cell Research Form the Basis of Modern PEM Fuel Cell Technology





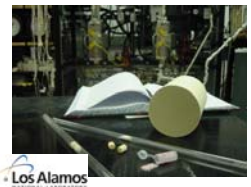
Active site model of non-PGM electrocatalyst



LANL has worked with industrial partners to provide approaches to and the science behind reduced loadings of precious metals.

LANL is a leader in developing catalysts that contain NO precious metals to supplant current Pt PEM technology.

Los Alamos NATIONAL LABORATORY



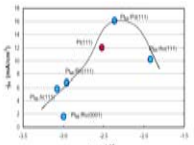
Fundamental and lab-scale research (left) on the mechanisms of lean NO_x reduction has led to the industrial scale up (middle) of novel, patented catalyst compositions for emissions control. The technology is licensed to and practiced by CleanAIR Systems, a Caterpillar company.

Los Alamos NATIONAL LABORATORY

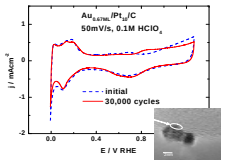
Platinum Monolayer Electrocatalysts for Automotive & Stationary Fuel Cell Applications

DOE – BES: Two Research Advances

1. Pt Monolayer catalysis – high activity with ultralow Pt mass



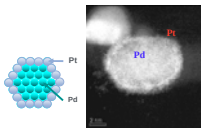
2. Pt stabilized against corrosion in voltage cycling by Au clusters



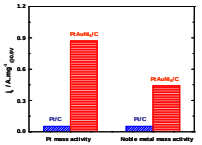
DOE (BES and EERE):

Core Shell Nanocatalysts

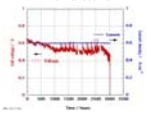
Active Pt ML shell – Metal/alloy core
Core tunes activity & durability of shell



Model and HAADF image of a Pt Monolayer on Pd nanoparticle



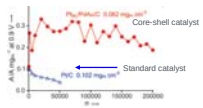
Pt-mass weighted activity enhanced 20x



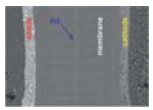
3000 hr Fuel Cell Durability Performance

BNL – Toyota CRADA

Scale-up synthesis: Pt-ML/Pd_2Au_1/C
Excellent fuel Cell durability 200,000 cycles



Membrane Electrode Assembly >200K cycles
Very small Pt diffusion & small Pd diffusion

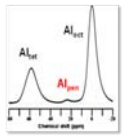


Fuel Cell Catalyst readied for automotive application

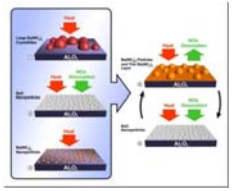
BROOKHAVEN NATIONAL LABORATORY

Catalytic Aftertreatment: From Molecular Understanding to Emissions Reductions

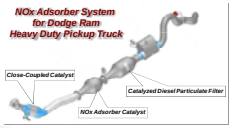
Basic Science: Lean NO_x Trap (LNT) catalysts including a γ-Al_2O_3 support for Ba and Pt catalytic phases



Applied R&D: Study large structure changes during cyclic operation (EERE CRADAs at PNNL: Ford, GM, Dow, GE, Cummins, Johnson Matthey, Caterpiller, PACCAR)



Manufacturing & Commercialization: diesel truck engines with 25% fuel efficiency increase while meeting EPA 2010 emissions regulations



Johnson Matthey Catalysts

Cummins

Pacific Northwest NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY
Office of Science

Lawrence Berkeley National Laboratory