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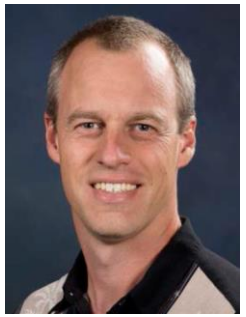
Materials Physics and Applications

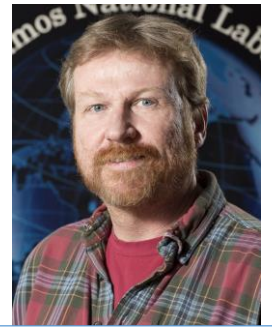


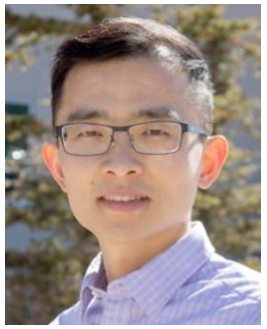











- **exploring** and **exploiting materials** and their properties,
- **developing practical applications of materials**, and
- **providing world-class user facilities.**

Meet our leaders: Tanja Pietraß

Tanja Pietraß is the Materials Physics and Applications' Division Leader.

Background: Chemistry

Research Interests: Solid-state nuclear magnetic resonance (NMR) spectroscopy with an emphasis on optical techniques to enhance the nuclear spin polarization with applications in gas sorption in porous materials and surface-selective NMR; surface characterization; optical pumping in semiconductors; heterogeneous catalysis; and ion mobility in battery materials.

Stop in and meet her!

Contact Tanja at tanja@lanl.gov or 7-8475

Meet our leaders: Rick Martineau

Rick Martineau is the Materials Physics and Applications' Deputy Division Leader.

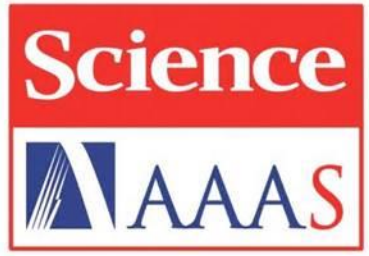
Background: High strain-rate deformation and the dynamic behavior of materials

Research Interests: Fundamental behavior of materials when subjected to high-rate loading. Numerical modeling, simulation and experimental techniques to evaluate the nucleation and growth of damage mechanisms in ductile materials.

Let him know how he can help you!

Contact Rick at rickm@lanl.gov or 5-0518

MPA researchers are fellows of:



James Werner: MPA's Newest APS Fellow

James H. Werner, MPA-CINT was among eight LANL scientists selected for an APS Fellowship in 2016 for pioneering contributions to single molecule tracking, optical microscopy, and the development of fluorescent probes for biological imaging and sensing.

Contact Werner at jwerner@lanl.gov

MPA's Newest LANL Fellows

Jennifer Hollingsworth, MPA-CINT. Jen's breakthrough discovery consists of "giant" NQDs, which eliminate the nanomaterial's previously problematic photophysical phenomenon of "blinking." Her work has led to significant international influence, particularly on the synthesis and elucidation of the underlying photophysical properties of NQDs.

Scott Crooker, MPA-CMMS, is an accepted international authority in the optical studies of semiconductors. Scott's many contributions include designing spin currents in semi-conductors, developing and applying optical spectroscopies to probe magnetization and studying spin dynamics in condensed matter.

Sandberg Chair of LCLS Users' Exec Committee

Richard Sandberg, MPA-CINT, has become committee chair of the Linac Coherent Light Source (LCLS) Users' Executive Committee.

Opened in 2009 at the Department of Energy's SLAC National Accelerator Laboratory in California, LCLS is the world's first hard x-ray laser. It has enabled Sandberg and collaborators to create the first-ever in situ images of void collapse in explosives using an x-ray free electron laser (XFEL).

Sandberg holds a PhD in physics, with a certificate in optics, from the University of Colorado Boulder. He joined LANL in 2009 as a Director's Postdoctoral Fellow and became a staff scientist in 2011.

Contact Sandberg at sandberg@lanl.gov

Janoschek Awarded Hans Fischer Fellowship

Marc Janoschek of MPA-CMMS has been selected for a Hans Fischer Fellowship at the Technical University of Munich (TUM) Institute for Advanced Study in Germany.

At the Munich research reactor, Janoschek and TUM collaborator Christian Pfleiderer will use novel state-of-the-art neutron-resonance spin-echo (NRSE) spectroscopy techniques that provide unprecedented energy resolution in order to investigate the emergent properties of quantum matter.

Since 2011, Janoschek has been the capability leader for neutron scattering in MPA-CMMS.

Contact Janoschek at mjanoschek@lanl.gov

Ronning Recognized as Distinguished Mentor

Filip Ronning (Condensed Matter and Magnet Science, MPA-CMMS) is a recipient of a Laboratory Postdoctoral Distinguished Mentor Award. The awards recognize the positive and significant impact a Los Alamos National Laboratory mentor has had on a postdoctoral researcher's experience at the Lab by providing outstanding leadership, guidance, and career advice substantially beyond what would normally be expected.

Contact Ronning at fronning@lanl.gov

Majewski recognized as 2016 NSSA Fellow

Jaroslaw (Jarek) Majewski (Center for Integrated Nanotechnologies, MPA-CINT) is a 2016 Neutron Scattering Society of America (NSSA) Fellow. The society recognized Majewski "for contributions to our understanding of weakly organized two-dimensional systems, including surfactant molecules found in biological systems."

Contact Majewski at jarek@lanl.gov

2016 Fellows Prize for Outstanding Research

Marc Janoschek (MPA-CMMS) led the first experiment of its type with a multi-disciplinary team at the Spallation Neutron Source that utilized plutonium-242; many have said this is the most significant measurement on plutonium in a generation. His research focuses on the use of elastic and inelastic neutron scattering to elucidate complex behavior in materials exhibiting emergent phenomena.

Jennifer Martinez (MPA-CINT) is among the best-known nano-cluster scientists in the world. Her research focuses on the development of biosensors for threat reduction, tuberculosis and breast cancer and the synthesis and characterization of optical and biologically reactive polymers.

Postdoc Research Day Presentation Winner

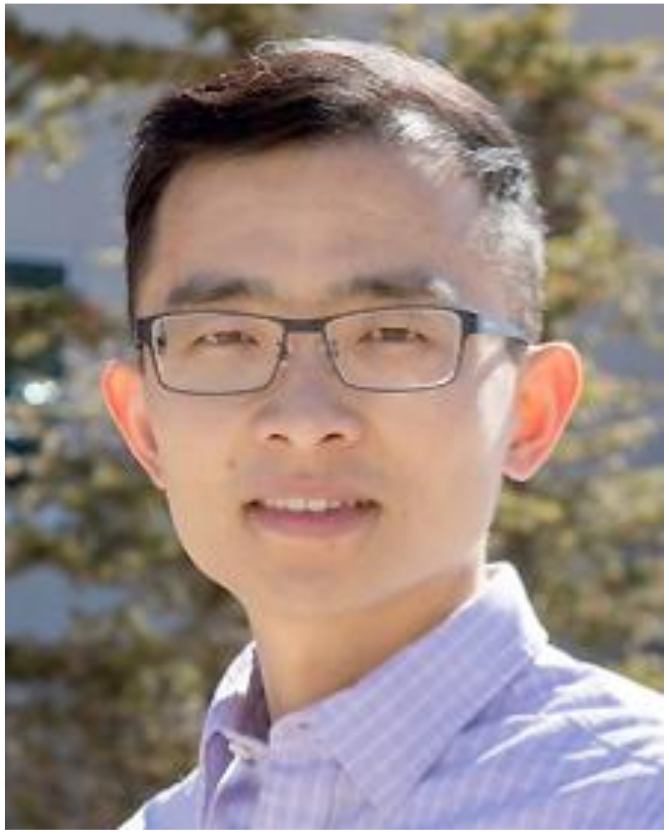
***Shalinee Chikara*, MPA-CMMS, was selected as one of four postdocs to receive an "Outstanding Presenter" designation at Research Day, a Laboratory-wide event where postdocs are provided the opportunity to present a summary of their research. This year, 59 LANL postdocs and 10 Sandia National Laboratory postdocs showcased their research.

Chikara presented "Beyond Conventional Magnetism: New Path to Multiferroic Behavior." Chikara's work demonstrated for the first time multiferroic behavior due to spin-state transitions using high magnetic fields at the National High Magnetic Field Laboratory facilities at Los Alamos and in Tallahassee, FL.

Contact Chikara at schikara@lanl.gov

J. Robert Oppenheimer Distinguished Postdoctoral Fellow

Xujie Lu, MPA-CINT, has expertise in interdisciplinary fields including energy materials/devices, high pressure/temperature techniques, synchrotron characterization and film deposition. His LANL research project develops highly conducting oxides with extraordinary electronic properties by combining high-pressure techniques and thin-film deposition methods, for environmental and energy-related applications. Lu received the Excellent PhD Thesis Award, the prestigious President Award of the Chinese Academy of Sciences, and a DOW Chemical Scholarship. He joined LANL as a Postdoctoral Research Associate in 2015.



Contact Lu at xujie@lanl.gov

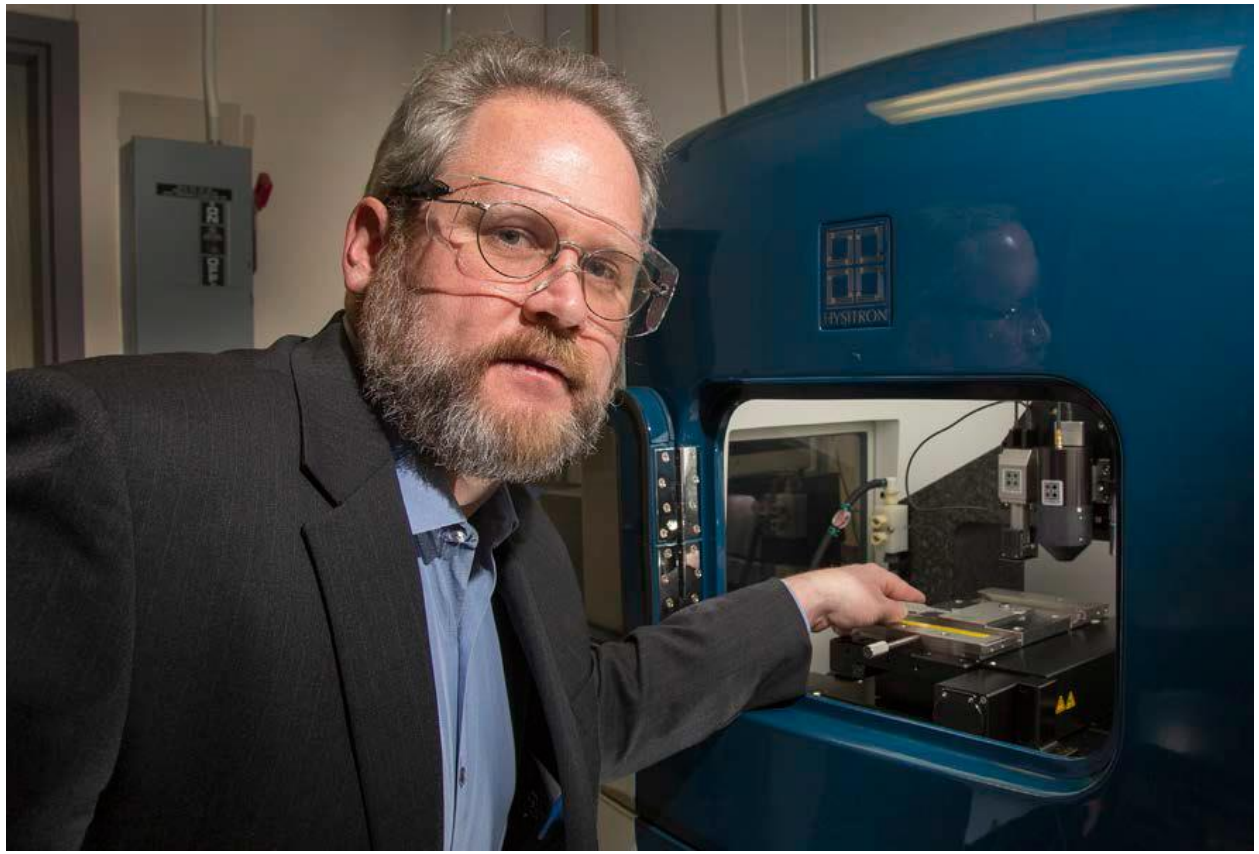
APS Outstanding Referee

Filip Ronning, MPA-CMMS, has been selected by APS as an Outstanding Referee for 2016 for his work assessing manuscripts for publication in the society's ***Physical Review*** journals. Ronning is currently the transport and thermodynamics capability leader in MPA-CMMS, where he studies strongly correlated, topological, and superconducting materials. He is an APS Fellow.

Contact Ronning at fronning@lanl.gov

CINT Highlight

Bulking up lightweight nanomaterials



Nate Mara designs materials with specific properties by manipulating and controlling atoms one by one at the nanoscale – and using novel nanomanufacturing processes.

Mara is known in his field for bulking up nano-layered composites. Through the Lightweight Materials Consortium, sponsored by DOE's Vehicle Technologies Office, American industries can tap into Mara's expertise, including his techniques for damage-tolerant layered nano-composite bulk fabrication.

Contact Mara at namara@lanl.gov or 667-8665

ECS Recognition

Sensor Achievements

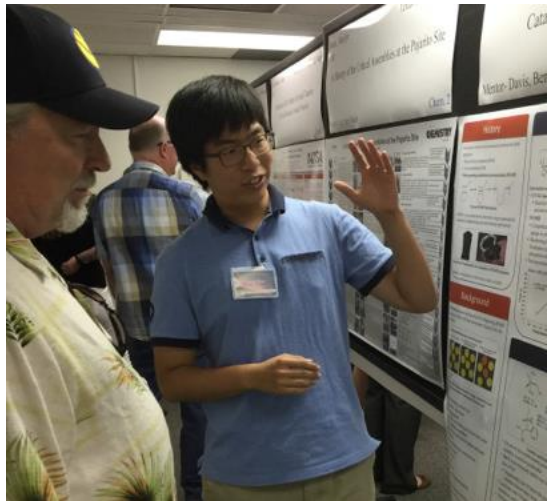
Rangachary Mukundan (MPA-11) has won the 2016 Sensor Division Outstanding Achievement Award, presented biennially by the Sensor Division of the Electrochemical Society (ECS). The award is the highest recognition the division can bestow.

Mukund graduated from the Indian Institute of Technology, Roorkee, India, with a bachelor degree in metallurgical engineering and received his Ph.D. in Materials science and engineering at the University of Pennsylvania. He joined LANL in 1997 as a postdoc and has been a staff scientist since 1999. His research interests include electrochemical gas sensors, fuel cells, and energy storage devices.

Contact Mukund at munkundan@lanl.gov or 665-8523

MPA students in the news

MPA student researchers ***Jung Ahn*** (Materials Synthesis and Integrated Devices, MPA-11), ***Benjamin Pound*** (Center For Integrated Nanotechnologies, MPA-CINT) and ***John Ryter*** (MPA-11), won awards for the work they presented at the Laboratory's 16th Annual Student Symposium.



Jung Ahn won an award for research on "Tuning and Assessing Ruthenium Catalysts for Self-Healing Applications."

Contact: jahn@lanl.gov

Benjamin Pound was recognized for research on "Coherent Diffractive Imaging in the Near Field."

Contact: bpound@lanl.gov

John Ryter was recognized for research on "Advanced Sensor Arrays and Packaging."

Contact: ryter@lanl.gov

Awards of Merit for Fuel Cell Efforts

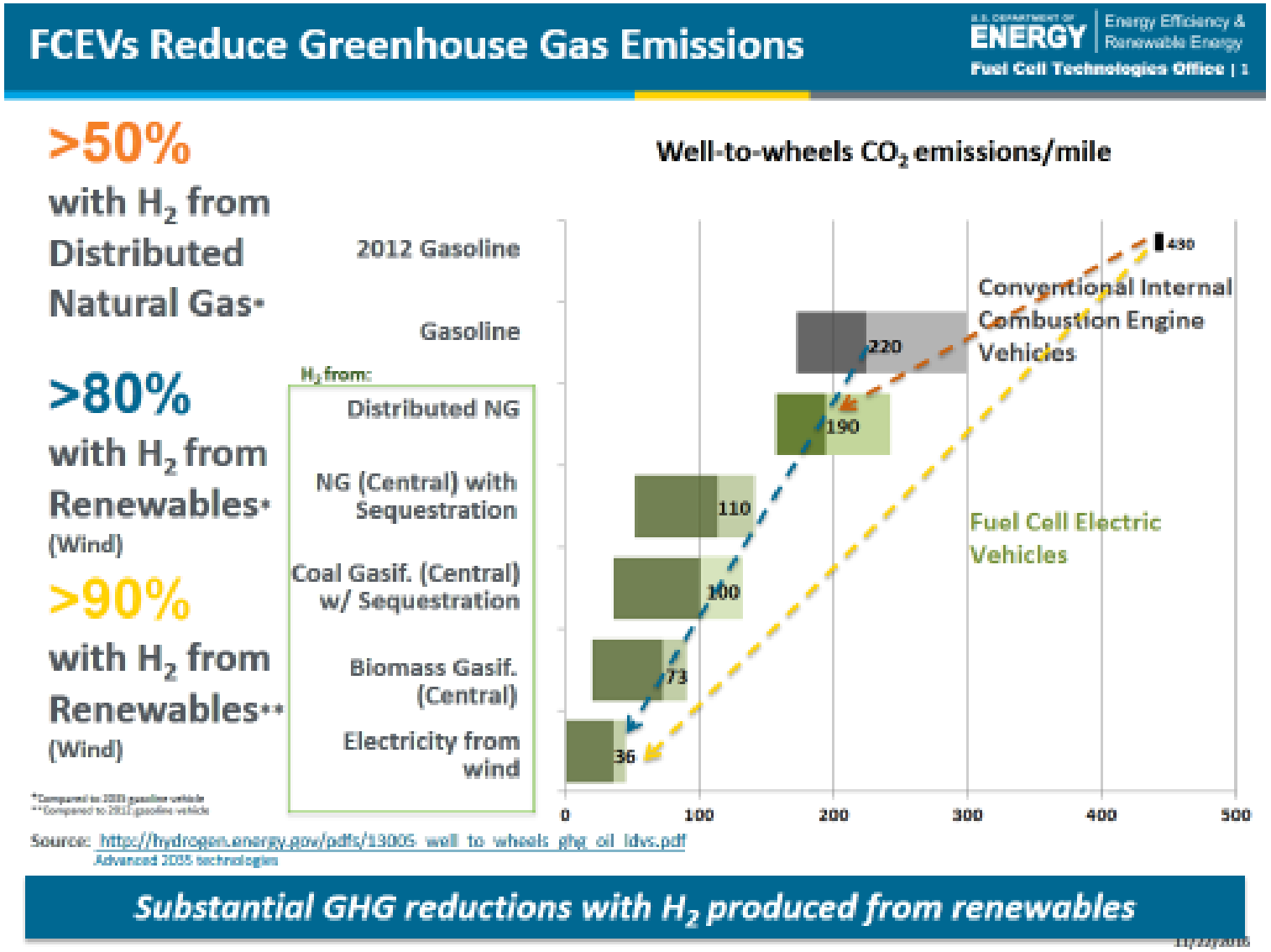
Rod Borup, MPA-11, was recognized for his outstanding role as director of DOE's Fuel Cell Consortium for Performance and Durability (FC-PAD). He has been instrumental in setting up and leading the core team of five national laboratories and in reaching out to industrial developers to accelerate improvements in polymer electrolyte membrane fuel cell performance and durability.

Contact Borup at borup@lanl.gov

Yu Seung Kim, also ***MPA-11,*** and collaborator Cy Fujimoto (SNL) were recognized for outstanding technical contributions and achievements in the development of alkaline exchange membrane fuel cell technology. As a result of their work, this nascent technology is beginning to show promise for low-cost fuel cells and electrolyzers.

Contact Kim at yskim@lanl.gov

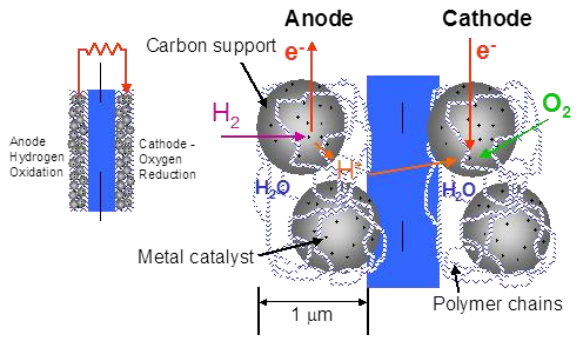
FCEVs Reduce Greenhouse Gas Emissions



Fuel Cell R&D at Los Alamos

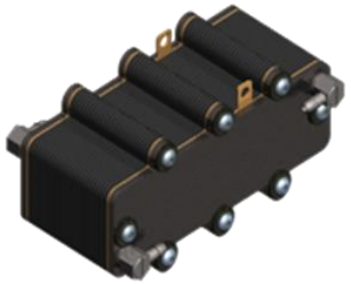
- One of longest running non-weapons programs at LANL (since 1977)
  - The first fuel cells for transportation program
- The current DOE FCTO program grew out of the original Los Alamos program
- Primarily polymer electrolyte membrane (PEM) technology
- Cost and durability are biggest barriers to commercialization
- Program focus is obtaining fundamental understanding to enable "knowledge-based innovation," and subsequent materials and process development

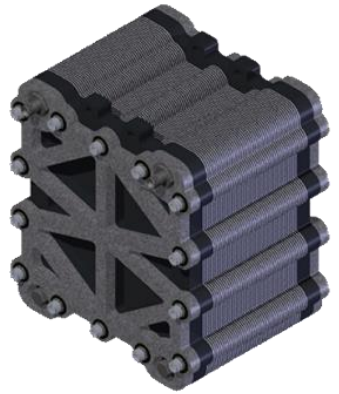
LANL Enabling Breakthrough Thin Film Electrode



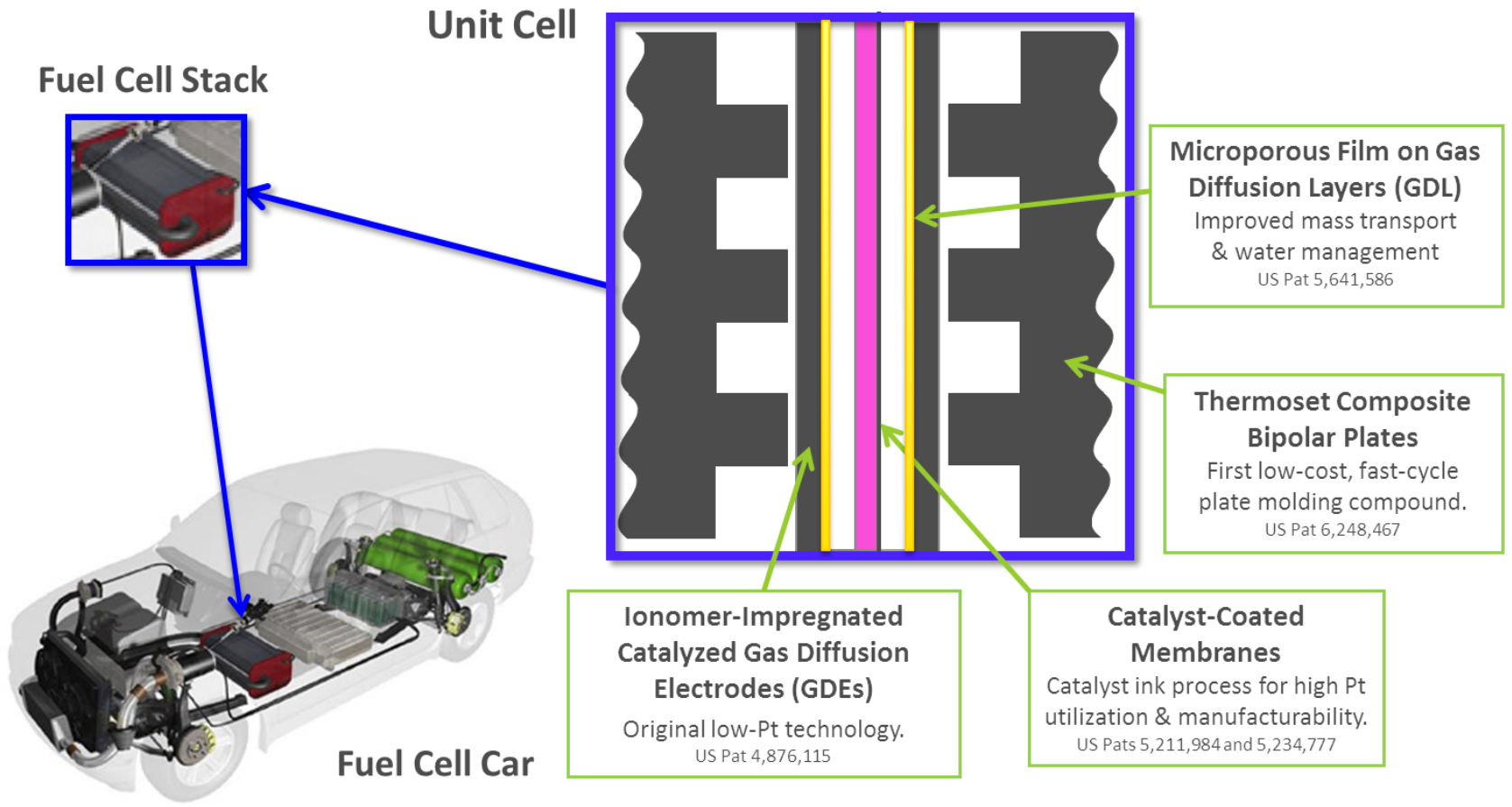
An electrochemically active reaction site must have reactant access to catalyst, available electronic and ionic conduction paths, and manage water

US Patents #4,876,115, #5,211,984 and #5,234,777





LANL-Led Innovation in Fuel Cells



LANL's innovation in fuel cells technology has played a critical role in the technical viability of fuel cell stacks for FCEVs

FC-PAD is the National Lab capabilities & people

Los Alamos NATIONAL LABORATORY

Argonne NATIONAL LABORATORY

BERKELEY LAB

NREL NATIONAL RENEWABLE ENERGY LABORATORY

OAK RIDGE National Laboratory

FCPAD FUEL CELL PERFORMANCE AND DURABILITY

FC-PAD NL Consortium – Relevance & Objectives

Overall Objectives:

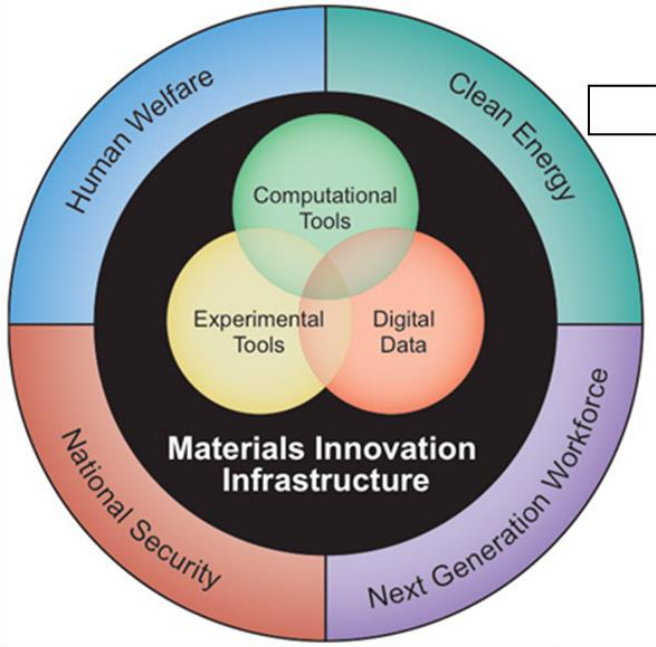
- Advance performance and durability of polymer electrolyte membrane fuel cells (PEMFCs) at a pre-competitive level

- Develop the knowledge base and optimize structures for more durable and high-performance PEMFC components
- Improve high current density performance at low Pt loadings
  - Loading: 0.125 mg Pt/cm^2 total
  - Performance @ 0.8 V: 300 mA / cm^2
  - Performance @ rated power: 1,000 mW / cm^2
- Improve component durability (e.g. membrane stabilization, self-healing, electrode-layer stabilization)
- *Provide support to industrial and academic developers*

- *Each thrust area has a sub-set of objectives which lead to the overall performance and durability objectives*

FCPAD
FUEL CELL PERFORMANCE AND DURABILITY

In Support of the Materials Genome Initiative (MGI)



MGI - Framework

Energy Materials Network
U.S. Department of Energy

Coordinated resource network with a suite of capabilities for advanced materials R&D

Predictive Simulation Across Scales	Synthesis & Characterization	Rapid Screening	End Use Performance
Process Scalability	Process Control	Real-time Characterization	Reliability Validation

Data Management & Informatics

Materials Design & Synthesis → Functional Design → Process Scale-Up & Qualification

New Material Innovations for Clean Energy 2× Faster and 2× Cheaper

Electrocatalysts for Fuel Cells

Electrocatalysis Consortium (ElectroCat Electrocatalysis Consortium): Platinum group metal-free (PGM-free) electrocatalysts for fuel cells

Materials Discovery and Development	**Catalysts** for oxygen reduction in low-temperature PEFCs and PAFCs
	Catalysts for oxygen reduction and hydrogen oxidation in AMFCs
	Development of **electrodes** and **MEAs** compatible with PGM-free catalysts
Tool Development	Optimization of **atomic-scale** and **mesoscale models** of catalyst activity to predict macro-scale behavior
	High-throughput techniques for catalyst synthesis
	High-throughput techniques for characterization of catalysts, electrodes, and MEAs
	Aggregation of data in an easily searchable, public database to facilitate the development of catalyst materials and MEAs

Los Alamos NATIONAL LABORATORY

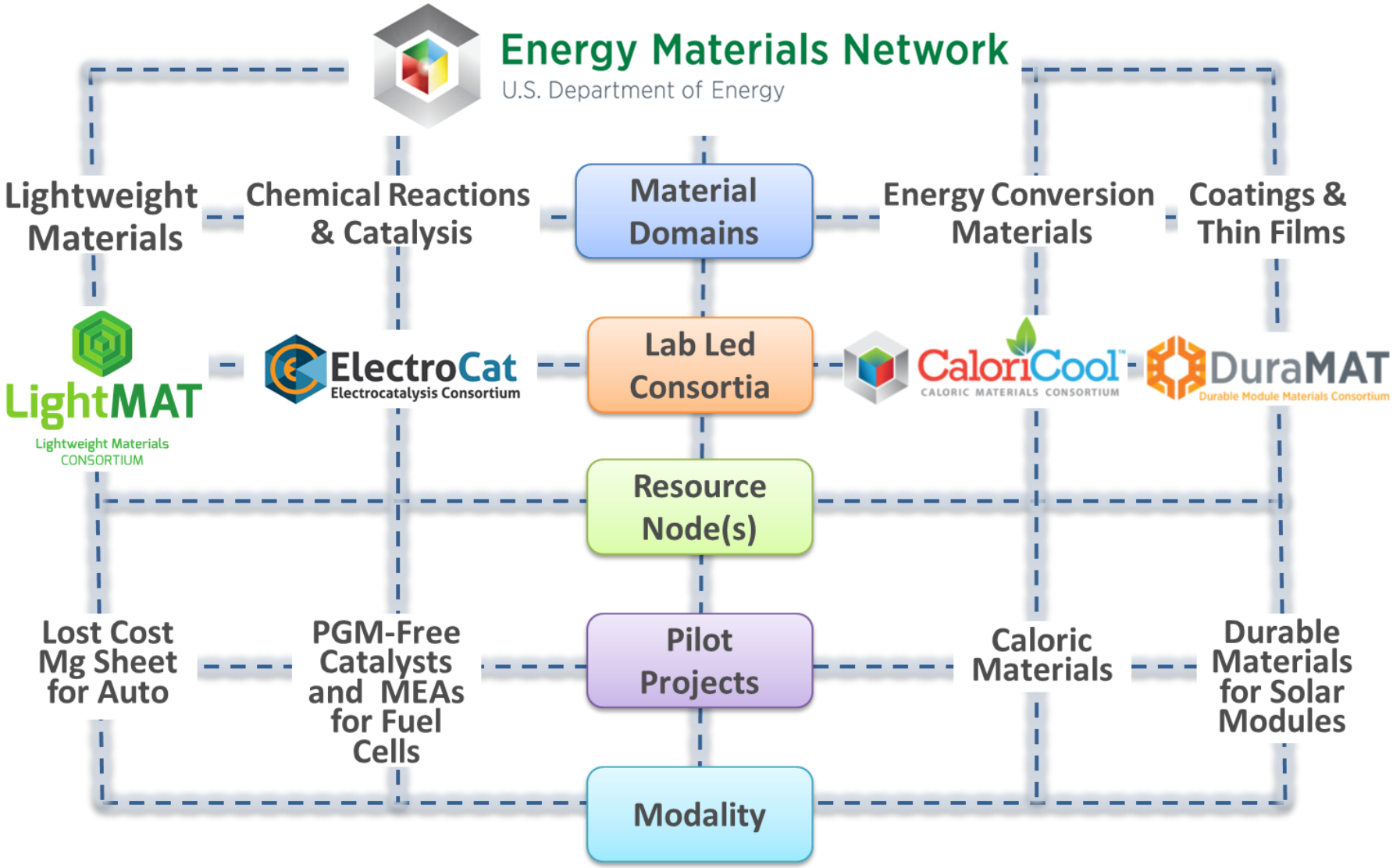
Argonne NATIONAL LABORATORY

NREL NATIONAL RENEWABLE ENERGY LABORATORY

OAK RIDGE National Laboratory

- **Goal**: Accelerate deployment of fuel cell systems by eliminating platinum group metal catalysts
- **Co-leads:** Los Alamos National Laboratory and Argonne National Laboratory
- **Lead laboratories roles**: (i) PGM-free catalyst development and atomic-scale modeling (LANL)
  (ii) High-throughput techniques and mesoscale models (ANL)
- **Member laboratories:** National Renewable National Laboratory (characterization and data hub) and Oak Ridge National Laboratory (electron microscopy, atomic-level characterization)

EMN Framework



Consortium on Materials and Energy Studies (CMaES)

MSIPP (Minority Serving Institutions Partnership Program)

"The MSIPP is designed to enrich the STEM capabilities of HBCUs in a sustainable manner that aligns with the broad interests of DOE sites and emphasizes the entire career pipeline." *http://nnsa.energy.gov/mediaroom/pressreleases/msipp101212*

Project Overview:

- **Establish student exchanges to LANL from HBCUs**
- **Train students to couple extensive computational and analytical capabilities**
  - ➢ Investigate and characterize novel materials from atoms and molecules to nanostructures
  - ➢ Use findings to facilitate the search for novel materials by identifying their desired properties

Members:

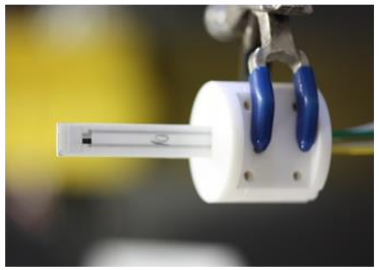
Florida A. & M. University
Allen University, S. Carolina
Benedict College, S. Carolina
Morehouse College, GA
Prairie View A&M University, TX
Southern University A. & M. LA
Tennessee State University, TN
Tuskegee University
National Lab: LANL & LLNL

Current LANL-HBCU interactions:

➢Fuel Cell Short Courses
➢Joint Curriculum Building

➢Summer Internships
➢Long-term appointments

➢LANL staff assist with lab set-up at partner universities



➢Allow access to our facilities
➢Hands-on research

Future: Broaden Research Areas

- **Continue current research interactions**
- **Expand research collaborations**
- **Find more mentors**

POC: Tommy Rockward, MPA-11
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