Oak Ridge National Laboratory

Sustainable Transportation Update

2016 Vol 1 | February

Coming soon to a road near you:
Safer, more secure vehicles

Connected vehicle technology has the potential to reduce accidents by 81% according to a study by the US Department of Transportation (DOT). With the opportunity to save lives, save money, and even save fuel, Jason Carter of ORNL's Cyber and Information Security Research Group calls connected vehicle technology "a game changer."

Carter and his team have been assisting DOT on connected vehicle research since 2012. In fact, ORNL's work was cited in DOT's 2014 proposed rulemaking announcement regarding the potential regulation of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) connectivity.

In the near future, new vehicles will include devices to allow them to communicate (connect) with similar devices in other vehicles, sending basic safety messages with information such as vehicle position, direction, speed, braking status, and size. Similar information will be transmitted to stationary devices in the infrastructure, such as "smart" traffic lights.

Before this can happen, several challenges associated with the technology must be addressed. Carter gives high marks to DOT in this regard, saying that it has been very proactive in examining security and privacy, as well as safety issues. "DOT cares and really wants to get it right," he says.

ORNL is assisting DOT with the development of a vehicle-based credential management system that can increase safety and security while maintaining privacy in V2V and V2I communications.

Carter is currently working on two projects with DOT, one addressing the security issues, the other privacy. It's a thorny, interconnected problem, and the two projects do intersect.

On the security side, there has to be a means of ensuring the validity or trustworthiness of the messages exchanged between vehicles and between vehicles and the infrastructure without revealing identifying information. Authenticating message broadcasts is a complex problem made more complicated in this case by the sheer size of the proposed deployment. Carter says that when implemented the credential management system will be the largest system of its kind ever, dwarfing a similar Department of Defense system for information exchange. *(see* Road *page 6)*

New Vehicle Cyber Security Laboratory installed at NTRC

Modern vehicles are essentially computers-on-wheels, operating with an average of 100 million lines of code and 60 control units. Those numbers are on the rise as automakers expand safety, entertainment, navigation, and autonomous driving features. Each of these sensors and connectivity features—from adaptive cruise control to tire pressure monitors to Wi-Fi and GPS—creates a potential opening for cyber attack.

ORNL's Vehicle Security Center (VSC) brings together expertise and facilities from across the laboratory to address this national transportation challenge.

Through the VSC, researchers are focused on assessing potential threat vectors and partnering with industry to engineer secure solutions for new vehicles before they hit the road.

"Predictive assessment is our main focus," says Stacy Prowell of ORNL's Cyber Warfare Research Team and acting director of the VSC. "We've got a team of researchers with backgrounds in computational sciences, sensors and controls, vehicle systems, and global security who are collaborating to identify threats and to build security features that neutralize them." *(Continued on page 2)*

VSC Capabilities

- Prototyping
- Malware discovery
- Large-scale data analysis
- Vehicle security assessment for current and future vehicles
- Anti-tamper and encryption devices
- Authentication and privacy protections
- Reverse engineering embedded systems
- Vehicle-based credential generation

(Continued from page 1) The VSC's newest facility, the Vehicle Cyber Security Laboratory, places cyber experts and award-winning software analysis tools at ORNL's National Transportation Research Center—in close association with vehicle and manufacturing researchers.

The Vehicle Cyber Security Laboratory at NTRC integrates ORNL expertise in vehicle systems, cyber security, and predictive modeling.

The Vehicle Cyber Security Laboratory offers a suite of capabilities to assess cyber vulnerabilities while vehicles are in operation. It includes a full vehicle dynamometer with specialized scanning equipment (CAN communications analysis and ECU calibration tools) in a space with signal isolation, ensuring data integrity. The lab is scheduled to be commissioned in the next few weeks.

For more information about the ORNL Vehicle Security Center, please contact Stacy Prowell at prowellsj@ornl.gov or 865-241-8874.

ORNL tool for deep software analysis wins major awards

Hyperion, a tool developed by Stacy Prowell and a team from ORNL's Cyber Warfare Research Group, received an R&D 100 Award and an FLC Excellence in Technology Transfer Award. The tool leapfrogs past current technologies that search only for known cyber threats; instead, Hyperion analyzes code for all the possible behaviors the code might initiate, reading those behaviors without triggering them. This powerful new approach to assessing cyber vulnerabilities uses precise mathematics to uncover the intent buried in the code and eliminate threats proactively.

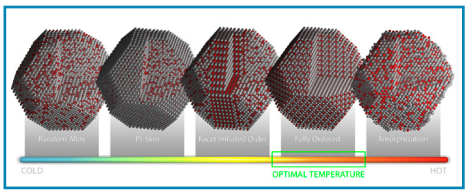
ORNL microscopy captures real-time view of evolving fuel cell catalysts

Atomic level imaging of catalysts by scientists at ORNL could help manufacturers lower the cost and improve the performance of emission-free fuel cell technologies.

Fuel cells rely on costly platinum catalysts to enable the reactions that convert chemical energy into electricity. Alloying platinum with transition metals such as cobalt reduces the overall cost, but such alloyed catalysts vary in performance based on their atomic structure and processing history. Because of this, post-processing annealing is often used to tailor the catalytic performance of such catalysts.

An ORNL team used scanning transmission electron microscopy to better understand the structural changes following annealing of platinum catalysts used in fuel cells. Their results, which were documented in *Nature Communications*, provide insights for the rational design of catalysts at the atomic scale using annealing and may lead to improved catalysts for fuel cell applications.

"This is the first time individual nanoparticles have been tracked this way—to image structural and compositional changes at the atomic level from the start of an annealing process to the finish," ORNL's Karren More said. The atomic level detail in the ORNL study will guide researchers and manufacturers who want to fine-tune catalyst atomic structures to meet the demands of specific applications.



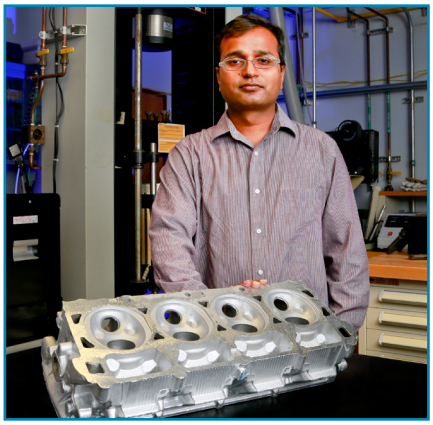
Models of platinum-cobalt nanoparticle catalysts illustrate how specific atomic configurations originate and evolve as the particles are heated.

The multi-organization project team that made the discovery included ORNL's Miaofang Chi, Karren More, Andrew Lupini, and Lawrence Allard, as well as partners from Johns Hopkins University, the University of Pittsburgh, and Argonne National Laboratory. The research was sponsored by the DOE Fuel Cell Technologies Office, and microscopy was performed at ORNL's Center for Nanophase Materials Sciences, a DOE Office of Science User Facility.—*Morgan McCorkle*

New limited-time cost-share opportunity for industry developing fuel cell technologies

The DOE Fuel Cell Technologies Office (FCTO) is offering a 50% cost share (worth up to $50k) for up to 10 organizations wishing to access ORNL's world-class materials characterization capabilities for projects that align with the FCTO mission. These cost-share partnerships at the lab's Materials Characterization Center (MCC) will be implemented via a streamlined short-form CRADA (cooperative research and development agreement). The MCC offers a broad range of state-of-the-art microscopy, spectroscopy, and other characterization techniques and services to provide insight into the structure and composition of materials at the atomic level. Karren More and David Wood are the key contacts for more information on MCC capabilities and ORNL's fuel cell technologies program respectively.

Atoms to Engines: ORNL, industry partners use high-performance computing to drive alloy design



A team of researchers led by ORNL's Amit Shyam is using high-performance computing to speed the development of new high-temperature aluminum alloys for automotive cylinder heads.

ORNL, FCA US LLC, and the foundry giant Nemak of Mexico are combining their strengths to create lightweight powertrain materials that will help the auto industry speed past the technological roadblocks to its target of 54.5 miles per gallon by 2025.

Automakers need powertrain materials that are not only lighter but also low cost and able to withstand the elevated temperatures and pressures in high-efficiency turbocharged engines. With the typical materials development cycle taking 10 to 20 years, there is little time to waste.

The ORNL-led project is part of a new initiative from DOE's Vehicle Technologies Office (VTO) to develop new high-performance alloys. Ford, General Motors (GM) and FCA US are collaborating with national laboratories, universities, and the casting industry to develop an affordable, 300°C-capable high-strength cast aluminum alloy.

This target means engineering a material that is 25 percent stronger than current alloys and durable at temperatures 50°C higher, a necessity for next-generation engines. The real challenge is to accomplish this while keeping costs low for automotive manufacturers and consumers.

"The aggressive goals of these projects compress about half a century of typical materials development into a 4-year project," said DOE program manager Jerry Gibbs.

A team of researchers from ORNL, FCA US and Nemak is using integrated computational materials engineering (ICME) to speed the development of new high-temperature aluminum alloys for automotive cylinder heads. ICME enables researchers to tailor new alloys at the atomic level to achieve desired properties such as strength and ease of manufacturability.

"Aluminum has been in mass scale production for more than a century, but current cast aluminum alloys cannot withstand the temperatures required by new advanced combustion regimes," said ORNL principal investigator Amit Shyam. "Our goal is to take high-temperature cast aluminum where it has never been."

ORNL is breaking new ground by scaling ICME to run on DOE's Titan supercomputer, the second fastest computer in the world. Using Titan's speed and parallel processing power, ORNL researchers can predictively model new alloys and select only the best candidates for further experimentation. This predictive capability dramatically reduces the time, energy, and resources devoted to casting trial alloys.

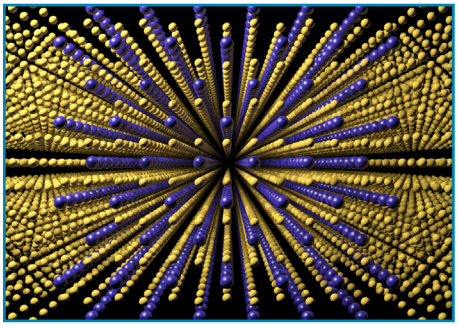
"Using about 100,000 cores simultaneously on Titan, we can increase the speed and scale of our first-principles quantum mechanics calculations by at least an order of magnitude," said ORNL researcher Dongwon Shin.

Before the shift to Titan, Shin was using a Linux cluster with about 300 cores to create atomistic simulations of single elements diffusing to intermetallic precipitates within the alloy. Now researchers can achieve larger scale simulations on Titan that are much closer to real-world scenarios.

The team is also verifying the computational models through atomic scale imaging and analytical chemistry measurements. ORNL's scanning transmission electron microscopy and atom probe tomography allow researchers to identify and examine the location and chemistry of each atom in the alloy matrix, precipitates, and the interfaces between them.

ORNL and collaborators are creating a database that captures their aluminum alloy materials discoveries. This materials genome approach will help guide efforts to improve ICME capabilities and accelerate the development of new high-performance materials.

The Oak Ridge Leadership Computing Facility, a DOE Office of Science User Facility, approved 6 million hours on Titan for the ORNL alloy development project. The research uses microscopy resources at ORNL's Center for Nanophase Materials Science, a DOE Office of Science User Facility. The alloy development research is funded by the DOE VTO Propulsion Materials Program.



Using high-performance computing, ORNL researchers are modelling the atomic structure of new alloys to select the best candidates for physical experimentation.

Solid Power signs exclusive license for lithium-sulfur battery tech

Solid Power, Inc., of Louisville, Colorado, has licensed a portfolio of ORNL patents relating to lithium-sulfur compositions for development of more-energy-dense batteries. ORNL's proof-of-concept battery research has demonstrated the technology's potential to improve power, operating temperature, manufacturability, and cost.

"We're thrilled to add the technology developed at ORNL to Solid Power's portfolio of novel materials and processes," said Douglas Campbell, president and CEO of Solid Power. "The intellectual property ORNL has perfected better positions Solid Power to successfully achieve its mission," developing next-generation storage devices for the rechargeable battery market.

The ORNL technology will aid Solid Power in the development of solid-state rechargeable batteries that can provide 2–3 times the energy of conventional lithium ion technologies and are safer because they lack any volatile or flammable liquid components. The company recently constructed a 700 ft^2 dry room facility with roll-to-roll processing capabilities that will allow production of the first large-scale prototypes.

The technology was developed by a team of current and former ORNL researchers with support from the DOE Office of Science and the Vehicle Technologies Office. Materials synthesis and characterization were conducted in part at ORNL's Center for Nanophase Materials Sciences, a DOE Office of Science User Facility. —*Morgan McCorkle*

ORNL's Nancy Dudney (center) and former lab researchers Jane Howe and Chengdu Liang were among the developers of lithium-sulfur materials that have been licensed to Solid Power for use in next-generation batteries.

Developing International Fire Codes for the Bioenergy Industry

ORNL is working with Underwriters Laboratories to evaluate how feedstock type, bale shape, and bale spacing affect fire intensity under controlled conditions. Images courtesy of UL.

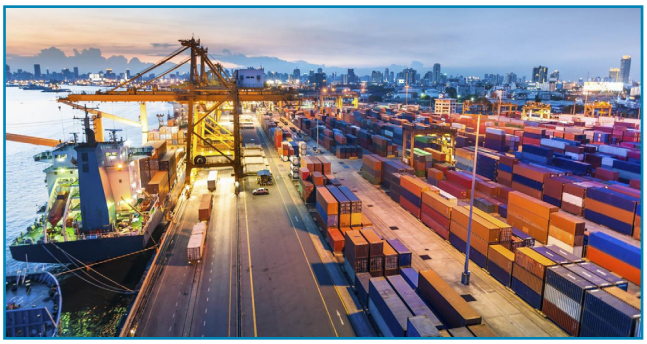
Reducing the risk of biomass fires through science-based codes and standards is the focus of a multi-member project led by ORNL in collaboration with the American Society of Agricultural Biological Engineers, Idaho National Laboratory, and industry leaders Abengoa, DuPont, POET, Antares, and Genera Energy. Collectively known as the Biomass Industry Panel for Codes and Standards (BIPCS), the committee is actively influencing the development of international fire codes for the bioenergy industry.

"The risk of fire—real and perceived—has emerged as a potential barrier to the developing bioenergy industry," said ORNL's Erin Webb, who co-chairs the BIPCS committee. "The volumes of feedstock processed by commercial biorefineries necessitate new standards that proactively address and ameliorate risks and promote improved safety strategies for the industry."

As part of the BIPCS effort, ORNL is conducting experiments at Underwriters Laboratories to determine how factors such as feedstock type and bale size, shape, and spacing affect the speed at which a biomass fire can spread. Results show, for instance, that round bales burn more quickly than square bales. These studies will inform the development of future standards and codes on the safe handling and storage of biomass.

With support from the DOE Bioenergy Technologies Office (BETO), the BIPCS effort has accomplished five code changes to the International Building Code to date. The new codes better reflect current knowledge of biomass properties and conventional and emerging storage, handling, and preprocessing technologies.

ORNL team uses data expertise to update national freight database



The Freight Analysis Framework captures detailed data on the movements of freight in the United States, including domestic movements of foreign imports and exports.

A team of researchers from ORNL's Center for Transportation Analysis (CTA) provided specialized data development, statistical analysis, and sophisticated modeling to support the release of the latest version of the Freight Analysis Framework (FAF), the most comprehensive and widely used freight transportation data source in the United States.

The Department of Transportation updates the framework every 5 years based on numbers from its Bureau of Transportation Statistics (BTS) Commodity Flow Survey, which captures about 70% of freight transportation. ORNL fills in the other 30%, adding data on the domestic movements of foreign trade along with business segments such as crude petroleum and retail services that are not represented in the BTS survey.

"FAF data help planners in the public and private sectors better understand freight movement, analyze market trends, and make strategic decisions," said Diane Davidson, leader of ORNL's Transportation Planning and Decision Science Group. "Transportation planners use it to target resources to improve operations or increase capacity."

FAF is one of the most used tools in a suite of transportation analytics developed by CTA, which supports vehicle and transportation system-wide efficiency gains through the development of predictive information, analytical methods, and vehicle systems data. Ho-Ling Hwang served as technical lead on the FAF project, which was jointly funded by DOT BTS and the Federal Highway Administration.

Developing electric drive motors without rare earth materials

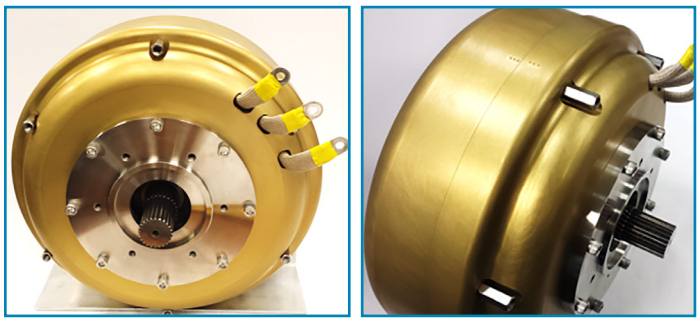
Most motors in electric and hybrid electric vehicles rely on permanent magnets to make the rotors spin and produce torque. These permanent magnets are commonly made with rare earth materials that must be imported. The expense of rare earth materials routinely accounts for at least 40% of the total motor cost.

To increase national energy security and reduce costs for the growing electric vehicle market, researchers at the ORNL Power Electronics and Electric Machinery Research Center (PEEMRC) develop novel motors that operate without any rare earth materials.

One approach the research team led by Tim Burress is exploring is the use of ferrite permanent magnets. Ferrite is made of common iron oxide that is both highly electrically resistive and able to be magnetized. Researchers have simulated efficiencies and power levels for ferrite permanent motors that are comparable to those of current commercial motors. This promising solution offers the potential to produce efficient motors using lower cost materials that are easily sourced in the United States.

ORNL has also developed novel motors that operate without any magnets at all. Built from scratch by PEEMRC researchers, one such synchronous reluctance prototype was evaluated in comparison with the 2014 Toyota Prius motor. Simulations show the ORNL motor reaches higher peak power with comparable efficiency in a similarly sized package.

This motor work is supported by DOE VTO and is just one aspect of an array of research aimed at accelerating the adoption of electric drive technologies.



This novel synchronous reluctance motor prototype with no permanent magnets can reach higher peak powers than the motor used in the 2014 Toyota Prius.

Road *(Continued from page 1)*

ORNL's role is assessing the feasibility of building a system of this nature with the trust/validation function delegated to the vehicles, including investigating the various technical solutions to make this approach feasible. So far the ORNL team has delivered a concept of operations for this vehicle-based system. The next phase of the project will involve more in-depth modeling and vetting of some of the approaches—especially under abnormal conditions such as vehicle/device malfunctioning.

The second project deals with how this technology can best preserve privacy while meeting the promise of improved safety and security. To achieve this, researchers are looking at technology known as "privacy-preserving data publishing," where certain identifying characteristics are removed or modified so the likelihood of the data being associated with a particular individual is reduced while the usefulness of the data is retained. The ORNL team successfully developed algorithms to do this for vehicle trajectory information collected from pilot studies, and they continue to examine how additional designed-in privacy techniques can be integrated into future operational connected vehicle technology.

These projects are supported by the National Highway Transportation Safety Administration, the Federal Highway Administration (FHWA), and the Intelligent Transportation Systems Joint Program Office (ITS JPO).

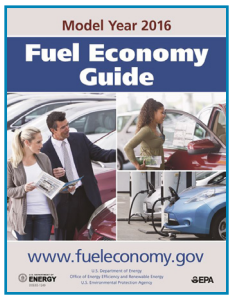
Briefs

Ionic lubricants paper ranks in top 10 all-time most-cited articles

One of the top tribology journals, *Tribology Letters*, announced the "Top ten all-time most-cited articles in *Tribology Letters*" at the 2015 Tribology Frontiers Conference. The ORNL paper, "Ionic liquids with ammonium cations as lubricants or additives" (*Tribology Letters*, 22, 207–214, 2006), authored by J. Qu, J. J. Truhan, S. Dai, H. Luo, and P. J. Blau, ranks 9th with 118 citations on Web of Science. This article was the first in the literature reporting a new group of ORNL-invented ammonium-based ionic liquids (U.S. Patent #7,754,664) with superior lubricating properties. Qu and his team's work with the ionic liquids resulted in a 2014 R&D 100 Award. Ongoing development of ionic liquids in partnership with GM is currently focused on achieving a 4% fuel economy gain.

2016 Fuel Economy Guide publishes

The Fuel Economy Information Project released the online and print versions of the *2016 Fuel Economy Guide*. EPA and DOE support the production of this annual guide and the fueleconomy.gov website to help car buyers choose the most fuel-efficient vehicles that meet their needs. Essential information covered by the guide includes projected greenhouse gas emissions and annual fuel costs for model year 2016 light-duty vehicles. In addition, fueleconomy.gov features top 10 vehicle lists and "Best (and Worst) in Class" lists for 2016.



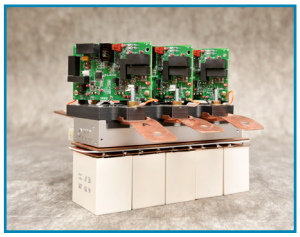
Mechanical Engineering magazine features Wagner's perspective on the future of engines

Robert Wagner, director of ORNL's Fuels, Engines, and Emissions Research Center, wrote the featured cover story for the December 2015 issue of *Mechanical Engineering* magazine. The article presents a perspective on the future of internal combustion engines as well as a discussion of the intersection of science and application for a more sustainable transportation future. *Mechanical Engineering* is the award-winning flagship publication of the American Society of Mechanical Engineers.

Laboratory consortium to enhance fuel cell technology

ORNL is part of a five-laboratory consortium called Fuel Cell Performance and Durability (FC-PAD) led by Los Alamos National Laboratory (LANL) to investigate enhancing the performance of polymer electrolyte membrane (PEM) fuel cells while improving their long-term performance and reducing cost. PEM fuel cells are a clean energy alternative for stationary and transportation power generation; however, cost and durability issues have prohibited widespread transportation applications. The consortium will coordinate the work at member labs, leveraging core capabilities, to magnify the impact of DOE FCTO funding. In addition to LANL and ORNL, Argonne National Laboratory, Lawrence Berkeley National Laboratory, and the National Renewable Energy Laboratory are participating.

3D printed inverter showcased at Smithsonian



ORNL's first-of-its-kind 3D-printed electric drive inverter, incorporating wide bandgap devices and advanced packaging techniques, was exhibited at the Smithsonian's Innovation Festival in Washington, DC. The ORNL Power Electronics and Electric Machinery 3D Printed Inverter Team previously received a 2015 DOE VTO Distinguished Achievement Award for developing the inverter.

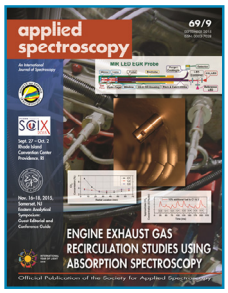
GM-ORNL advanced engine collaboration wins ALCC award

Ron Grover and Ramachandra Diwakar of GM and Dean Edwards and Wael Elwasif of ORNL received a DOE ASCR Leadership Computing Challenge (ALCC) allocation for 8M processor hours on Titan to explore the feasibility of developing a steady-state engine calibration using high-performance computing and a virtual engine modeled using state-of-the-art computational fluid dynamic tools.

This new effort is part of a continuing collaboration between GM and ORNL aimed at using high-performance computing to accelerate design, development, and deployment of advanced engines capable of meeting future efficiency and emissions goals. GM and ORNL will use commercial engine simulation tools and a suite of tools developed by national labs, including ORNL's TASMANIAN software toolkit, to construct a virtual engine model and optimize calibration of key engine parameters (e.g., boost, exhaust gas recirculation, air-fuel ratio, rail pressure, fuel injection quantities, and timings) across the full engine operation map. If successful, virtual engine calibration could lead to significant cost and time reductions in the development of new engine calibrations by greatly reducing the number of on-engine experiments required.

Diagnostic tool featured on cover of *Applied Spectroscopy*

The EGR Probe, a unique diagnostic developed in collaboration with industry partner Cummins, Inc., was featured as the cover art for a recent issue [69(9)] of *Applied Spectroscopy*, one of the world's leading spectroscopy journals. The corresponding paper in the same issue features technical details of the EGR Probe, which uses laser-diode-based adsorption spectroscopy to measure exhaust gas recirculation (EGR) rates in multi-cylinder engines.

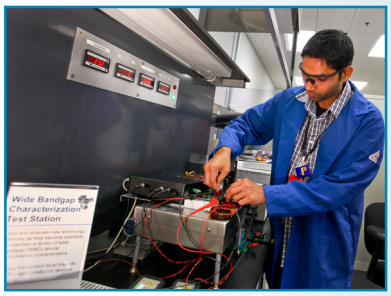


Compatibility research heavily cited in *PEI Journal* article

PEI Journal, a trade journal for the petroleum equipment industry, recently published an article that heavily cites work led by researcher Mike Kass on the compatibility of the nation's fueling infrastructure with isobutanol and ethanol additions to gasoline. The journal reaches an international audience of more than 1,600 companies, in over 80 countries, that manufacture, distribute, and service petroleum marketing and liquid handling equipment. The highlighted ORNL work shows that ethanol and isobutanol are compatible with most fuel system components and that isobutanol can be expected to exhibit similar compatibility properties to oxygen-equivalent levels of ethanol. Several ORNL studies were referenced in the article, some supported by Butamax Advanced Biofuels LLC and others by DOE BETO.

ORNL partners with major universities to develop wide bandgap education and training

Secretary of Energy Dr. Ernest Moniz recently announced that DOE has selected The University of Tennessee and Virginia Tech in collaboration with ORNL Electric Drive Technologies Program researchers to create design-oriented education and hands-on training with cutting-edge wide bandgap power electronics for the next-generation power engineering workforce. The project will focus on development and dissemination of recruiting and teaching materials to other US institutions, 100% student placement at the end of the program, and development of a clear strategy for recruitment of women and minority students into the workforce. The 5-year power electronics traineeship programs, set to begin at ORNL in the fall of 2016, are part of the Obama Administration's commitment to accelerating American manufacturing and developing STEM (science, technology, engineering, and math) education programs that support the next generation of engineers and manufacturers.



Researcher Madhu Chinthavali works with wide bandgap evaluation equipment.

Visits and Events

USCAR directors stand with the printed utility vehicle created for the Additive Manufacturing Integrated Energy project. From left: Claus Daniel, ORNL; Saad Abouzahr and Steve Barnhart, FCA US; Steve Zimmer, USCAR; Bill Peirce, GM; Christy Cooper, DOE; Mike Martin, USCAR; Ed Gundlach, GM; Mark Mehall and Brian Nottmeier, Ford; Johney Green and Ron Graves, ORNL.

- Directors from the United States Council for Automotive Research (USCAR) recently visited ORNL. USCAR is the consortium of Ford, GM, and FCA US that collaboratively works with DOE through the United States Driving Research and Innovation for Vehicle efficiency and Energy sustainability (U.S. DRIVE) Partnership. The directors interacted with key ORNL leaders and researchers and toured facilities at the National Transportation Research Center (NTRC), Spallation Neutron Source, Carbon Fiber Technology Facility, and the main ORNL campus. Their favorable review is expected to advance collective objectives for the development, commercialization, and use of innovative and sustainable transportation technologies.

- Robert Wagner co-organized and led an industry-DOE breakout session at the U.S. DRIVE All-Hands Tech Team Meeting on the potential of high-performance computing to accelerate the vehicle design process.

- Sharon E. Burke, assistant secretary of defense for operational energy plans and programs and new member of the UT-Battelle Scientific Advisory Board, toured laboratories at NTRC as part of her visit to ORNL.

- Andreas Malikopoulos, deputy director of ORNL's Urban Dynamics Institute, organized a 1-day conference on opportunities in connected and automated vehicles called the "Road to Future Urban Mobility." Leaders from government, industry, and academia gathered to discuss emerging technologies and the potential optimization of traffic flow to increase safety and reduce fuel consumption and greenhouse gas emissions.

Andreas Malikopoulos presents at the "Road to Future Urban Mobility" conference.

- ARPA-E Director Ellen Williams toured a variety of facilities during her visit to ORNL, including a viewing of the Additive Manufacturing Integrated Energy (AMIE) demonstration project with the printed utility vehicle and bi-directional wireless charging developed by NTRC transportation researchers with support from DOE VTO.

- Researchers from ORNL's Center for Bioenergy Sustainability contributed webinars to a Bioenergy Week web-a-thon planned by the Southeastern Partnership for Integrated Biomass Supply Systems. The webinars raised awareness of bioenergy and covered a variety of DOE BETO-funded research, including the Billion Ton study, sustainability analysis, and international standards development.

- Robert Wagner served as conference chair for the American Society of Mechanical Engineers (ASME) 2015 Internal Combustion Engine fall conference, organizing a technical program of 95 publications/presentations and serving as master of ceremonies. He also organized the 2015 SAE Energy Saving and Emission Reduction Forum in Shanghai, China.

- Gary Capps hosted leaders from the FHWA and key industry partners for the final wrap-up meeting for the Safeguarding Truck-Shipped Wholesale and Retail Fuel System Demonstration project. The outcome of the project is a road-tested, commercialization-ready system for monitoring fuel tanker movements in real time, preventing fuel tax evasion and fuel theft. The system can be applied to other situations where real-time tracking and flagging of suspicious activity is necessary.

FHWA's Michael Dougherty discusses the successful development of the Fuel Auditing and Tracking System.

ORNL Sustainable Transportation Program Director, Ron Graves (far right), presents to the DOE Transportation Working Group.

- The DOE Transportation Working Group met at NTRC for a second time in recent months. For this meeting, the focus of the collaborative forum for DOE and national laboratories was vehicle cyber security. Each national laboratory gave a presentation on its current R&D activities related to the topic, and there was discussion of creating a white paper on the national laboratories' capabilities to assist industry in addressing vehicle vulnerabilities to potential cyber attacks.

- Representatives from Hyundai Motor Company met with a cross-cutting group of ORNL researchers to explore strategic collaborations between Hyundai and ORNL. This meeting was the first major action step following the signing of a memorandom of understanding between the organizations in the summer of 2015. Mutual research projects in batteries, power electronics, and lightweighting are currently under consideration.

Thomas Zacharia, ORNL deputy director for science and technology, greets Tae Won Lim, vice president of Hyundai Motor Company.

- ORNL hosted the first Electric Drive Technologies Research Industry Engagement Meeting. The overall goal of the DOE VTO meeting was to accelerate and enable transfer of new technologies into the marketplace. More than 50 participants from industry, national laboratories, and government agencies attended the meeting.

Media

- EERE Industry Day and ORNL's Additive Manufacturing Integrated Energy (AMIE) project garnered coverage from a number of outlets including Energy.gov, Energy Industry Today, and the BBC. Fox News included the printed utility vehicle in its list of "Cars and trucks we can't have…but definitely want."

- Automotive News interviewed Emissions and Catalysis group leader Jim Parks and Fuels and Engines researcher Scott Curran for an article titled "Cleaning up the diesel engine, upstream," reporting on the future potential of diesel engines to reduce emissions in-cylinder.

- Researchers are conducting evaluations of turbocharged gasoline direct-injection technologies with high-octane fuels using a modified Cadillac ATS.

- An article by Andreas Malikopoulos on online optimization of power management control for hybrid electric vehicles and for any driving style was featured recently on Green Car Congress. The article was first published in *IEEE Transactions on Control Systems Technology*.

- A new generation of low-cost, platinum-copper catalysts developed by Tufts University in collaboration with ORNL's Larry Allard received coverage from media including BrightSurf.com. Allard and fellow researchers at ORNL have been at the forefront of the growing trend toward single-atom catalysis.

- Biofuels Digest highlighted an ORNL report on the benefits of high octane fuels. The overview summarizes a body of work by ORNL researchers focused on efficiency gains, knock resistance, well-to-wheels analysis of greenhouse gas emissions and energy impacts, infrastructure, and market analysis. The summary is available on the Bioenergy Knowledge Discovery Framework website at https://bioenergykdf.net/hof.

Employee Excellence

State automotive manufacturers honor Graves

Ron Graves (right) is inducted into the TAMA Hall of Fame with fellow honoree Gov. Phil Bredesen (left) by TAMA President Rick Youngblood.

The Tennessee Automotive Manufacturers Association (TAMA) has inducted ORNL's Ron Graves into its Hall of Fame. TAMA honored Graves for his leadership of the ORNL Sustainable Transportation Program, which includes research in advanced engines, fuels and lubricants, emissions controls, energy storage, fuel cell technologies, lightweight and powertrain materials, power electronics, transportation analysis, and vehicle systems. "His work affects millions of vehicles that are on the road today," the TAMA citation noted. Graves was inducted, along with former Tennessee Governor Phil Bredesen at a ceremony in Nashville this past fall.

Graves and Brady receive top honors at UT Battelle Awards Night

Ron Graves was recognized at the 2015 UT Battelle awards night in the "Research Leadership at the Division Level" category for his exemplary leadership of ORNL transportation R&D, including marshalling and integrating lab-wide science and technology resources to achieve high-impact, distinguished results across industry and government.

Michael Brady was honored as "Inventor of the Year" for his innovative development of new materials, processes, and design approaches with widespread applied scientific, commercial, and social impact, ranging from clean cookstoves for the developing world to new paradigms in heat-resistant alloys for energy and chemical process applications and functional materials with promising magnetic, electrical, and surface stability properties.

Marlino serves as judge for PACE awards

Laura Marlino has been selected to serve as a judge for the 2016 *Automotive News* PACE awards. These awards are given annually to automotive suppliers that exhibit superior technical advances and innovation coupled with business acuity. The awards will be presented during the SAE World Congress in April.

Green named SAE Fellow

Johney Green, Jr., director of the ORNL Energy and Transportation Science Division, has been elected an SAE Fellow, SAE International's highest grade of membership. Green was recognized for his work championing innovative research on advanced combustion applications, which has led to fundamental breakthroughs in more sustainable high-efficiency automotive transportation. During the past two decades, his research and leadership have had significant impacts on advanced combustion, emissions control, renewable fuels, vehicle electrification, and advanced manufacturing.

Malikopoulos named vice chair of IFAC technical committee

Andreas Malikopoulos was recently named vice chair of the International Federation of Automatic Control (IFAC) "Control for Smart Cities" technical committee (TC9.3). The goal of the committee is to promote research and education on control for smart cities, including, but not limited to, buildings, transportation systems, water system management, pollution monitoring, and control systems.

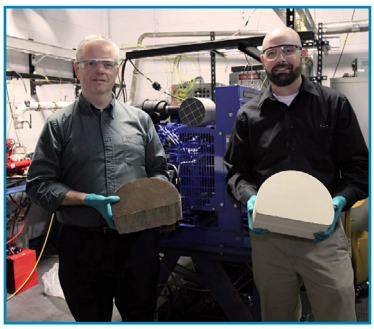
Chinthavali among business journal's '40 under Forty'

Madhu Chinthavali was one of two ORNL researchers selected by the *Greater Knoxville Business Journal* for its list of outstanding early career professionals, known as the "40 under Forty." Chinthavali was cited for his research in power electronics and 3D printing. His leadership in the development of the world's first 3D printed inverter was highlighted by the journal, as well as his role in the Additive Manufacturing Integrated Energy (AMIE) project. Chinthavali led the team that created—in a few short months—the bi-directional wireless charging technology that enables the AMIE vehicle and house to share power.

Dai among Thomson Reuters Highly Cited Researchers

Sheng Dai has been named to a list of the most highly cited researchers in the world. Thomson Reuters Highly Cited Researchers annually recognizes some of the world's leading researchers in the sciences and social sciences. About 3,000 researchers were named to the 2015 list. Sheng is a UT-Battelle Corporate Fellow and leads the ORNL Nanomaterials Chemistry group. His research focuses on the synthesis and characterization of materials for energy-related applications, including transportation.

Lance named Biodiesel Researcher of the Year



Michael Lance (left) and Todd Toops received recognition from the National Biodiesel Board for their groundbreaking research on emissions control devices.

Michael Lance was awarded the 2015 Biodiesel Researcher of the Year Award by the National Biodiesel Board, which represents more than 200 biodiesel producers and acts as a liaison between producers and original equipment manufacturers. The award was given in recognition of Lance's research on the impacts of sodium metal impurities in biodiesel on diesel catalyst systems. Lance's study, conducted in collaboration with ORNL's Todd Toops and Andy Wereszczak; Cummins, Inc.; and the National Renewable Energy Laboratory (NREL), found that sodium had little impact on catalytic functionality and identified lube-oil phosphorous as the primary deactivation source. The award symbolizes ORNL's continuing leadership in providing key research insights for the biodiesel industry: Toops and an ORNL-NREL-Ford team won the award in 2012 for research on the impacts of trace metal impurities on emissions control devices. This research was funded by the DOE VTO Propulsion Materials program.

Welding technology honored at R&D 100 Awards

The Infrared Nondestructive Weld Examination System developed by ORNL's Jian Chen and Zhili Feng with partners ArcelorMittal USA and Eagle Bend Manufacturing, Inc., was a finalist in the Analytical/Test and Market Disruptor Services categories at R&D Magazine's R&D 100 Awards. The technology received a silver special recognition award in the Market Disruptor Services category at the awards ceremony. The technology allows accurate, nondestructive weld checks in real time on the production line. Funding for the technology was provided by the DOE VTO Lightweight Materials Program.

Laboratory recognized by DOE for workplace charging initiative

ORNL was recognized by DOE for fulfilling the voluntary requirements of DOE's Workplace Charging Challenge and demonstrating leadership in the development of a national plug-in electric vehicle charging infrastructure. ORNL is one of fewer than 30% of all challenge partners to receive this recognition from DOE in 2015. Congratulations to Melissa Lapsa, Teresa Nichols, and David Smith for their contributions to this initiative.

Do you have news or information you would like to share?

Please submit to Kim Askey,
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