Oak Ridge National Laboratory

Sustainable Transportation Update

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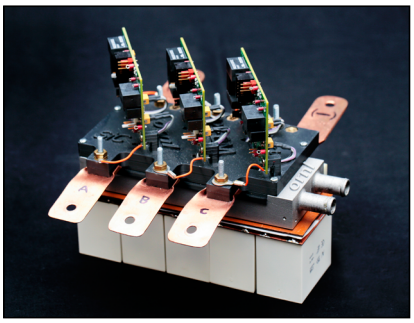
ORNL creates novel 3-D printed inverters with wide bandgap devices



This novel power inverter offers greater reliability and power in a compact package.

ORNL's Power Electronics and Electric Machinery (PEEM) research group is using additive manufacturing to shrink the size and weight of power inverters for vehicles. With funding from the DOE Electric Drive Technologies Program, PEEM is working with the Manufacturing Demonstration Facility to 3-D print novel aluminum-based heat exchangers with integrated cooling systems.

The prototype inverters are the first to incorporate both additive manufacturing and wide bandgap (WBG) materials. WBG technology enables devices to perform more efficiently at a greater range of temperatures than standard semiconductor materials.

Additive manufacturing creates many advantages for the development of new inverters, allowing use of complex 3-D geometries, increasing power density, and reducing weight along with waste.

PEEM's first prototype, a liquid-cooled all–silicon carbide traction drive inverter, features 50% printed parts and incorporates WBG materials. The inverter was successfully tested up to 20 kW with efficiency at 98.7%. The projected power density of this inverter is expected to surpass DOE targets.

With lab funding, researchers designed and built a second printed inverter that is half the size of a Nissan Leaf inverter. It is scheduled for testing in the next month.

DOE funds 20 new sustainable transportation projects

ORNL's Sustainable Transportation Program (STP) recently won funding for 20 projects from the DOE Office of Energy Efficiency and Renewable Energy through various program-wide and incubator Funding Opportunity Announcements (FOAs).

"Many exciting new projects are beginning," said STP director Ron Graves. "I'd like to recognize our researchers for their efforts on these proposals and express gratitude to our sponsors and industry partners for their confidence in our work."

With awards from the Vehicle Technologies Office (VTO) program-wide FOA, ORNL will lead four projects and support five others. ORNL is supporting three additional projects with small businesses and universities through the VTO Incubator FOA. With support from the Bioenergy Technologies Office (BETO), ORNL will work with the National Renewable Energy Laboratory (NREL) to develop renewable carbon fiber.

STP conducts a wide variety of research aimed at making passenger and freight transportation safer, cleaner, more efficient, and more affordable.

The ORNL Fuel Cell Technologies Program (FCTP) won new funding through the Fuel Cell Technologies Office (FCTO) R&D laboratory call for proposals. ORNL will lead two of the winning proposals and support three others. Combined with previous FOA awards, these projects bring the FCTP team's total to seven new projects this year.

In collaboration with industry, academic, and national lab partners, ORNL researchers will be working on a variety of projects, from better batteries to low temperature catalysts to carbon fiber made from synthetic spider silk.

For project details, see pages 4 and 5.

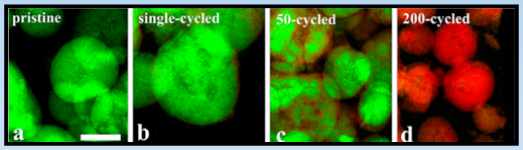
Features

Seeking the sources of battery voltage fade

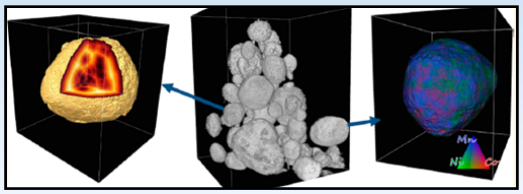
A team led by ORNL researcher Jagjit Nanda has applied a new technique to study the mechanisms driving structural degradation in a high potential, high capacity cathode material. The material (nominal composition $Li_{1.2}Mn_{0.525}Ni_{0.175}Co_{0.1}O_2$) promises almost twice the useable capacity (~280 mAh/g) of standard cathodes. Doubling the capacity could mean a much longer range for electric vehicle batteries. Unfortunately, when this particular class of materials is electrochemically cycled at voltages greater than 4.5 V, the battery progressively loses energy, a phenomenon known as voltage fade.

With support from VTO, Nanda and collaborators used full-field transmission x-ray microscopy (TXM) to study the cathode material over multiple charge cycles. The TXM technique provided 3-D imaging at high spatial resolution, which illuminated the ways in which bulk and surface regions of the battery materials change with cycling.

Comparison of the morphology and 3-D internal structure of electrodes provides detailed information and valuable insights into the degradation mechanism at a materials level. This new understanding can better equip researchers to address critical technical barriers and improve battery performance and cycle life.



2-D x-ray absorption near edge structure images of pristine, 1X, 50X, and 200X cycled cathode particle.



Energy resolved x-ray tomography reconstruction of cathode particles showing internal morphology and elemental imaging.

This research was conducted at the Stanford Synchrotron Radiation Light source at SLAC National Accelerator Laboratory.

Researchers study shift in source of particulate matter

Vehicle sources of PM are changing with new technologies.

When you think of sources of airborne particulate matter (PM), you might picture a big diesel truck emitting thick clouds of black smoke. The reality is that, since 2007, modern diesels are producing far less PM, and a growing percentage of the PM on our roadways today is generated by a new class of automobiles with gasoline direct-injection (GDI) engines.

Researchers at ORNL's Fuels, Engines, and Emissions Research Center (FEERC) have determined that GDI engines emit 5–10 times higher concentrations of PM than their older, port fuel-injection (PFI) counterparts (2.5–5 mg/mile vs. < 0.5 mg/mile for PFI).

A growing number of new cars and trucks are being manufactured with GDI engines as automakers respond to higher fuel economy standards and market demand for more fuel efficient vehicles. Market share for GDI vehicles is projected to be more than 50% by 2017. GDI engines inject fuel directly into the cylinder, increasing efficiency and compatibility with turbocharging, which allows drivers to achieve more power with smaller, lighter engines. The tradeoff is higher PM emissions.

"Emissions from GDI engines are different from what you see with diesel engines," said researcher John Storey. "The GDI PM is smaller, shows more variance in the particle size, and contains more elemental carbon than diesel PM."

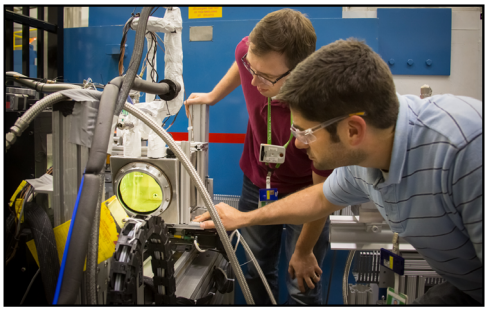
Elemental carbon, also known as black carbon, absorbs sunlight in the atmosphere and contributes to global warming. Smaller particles are generally of concern, because they can create potential health risks.

"Overall, PM emissions are still very low," said Storey. "Diesel vehicles were the primary source of PM in urban airsheds. As new trucks with diesel particulate filters (DPFs) replace older models on the roadways, urban PM will decline, despite the increase in PM from GDI vehicles."

ORNL research for this project was funded by DOE VTO.

Imaging fuel injectors with neutrons

By Katie Bethea



Researchers Derek Splitter and Eric Nafziger prepare their fuel injector test system for experiments at HFIR.

A team of FEERC researchers led by Eric Nafziger, Derek Splitter, and Todd Toops worked with collaborators from ORNL's High Flux Isotope Reactor (HFIR) to make the first-ever neutron images of cavitation inside the body of a gasoline fuel injector. Cavitation leads to the formation of bubbles, which can disrupt fluid flow and damage metal.

"Neutrons are ideally suited for this study due to their high sensitivity to hydrogen atoms in the fuel and low interactions with the metal part of the injector," said HFIR instrument scientist Hassina Bilheux.

Other complementary research has been done with lasers, x-rays, and even with fuel injectors made partially with acrylic to make them transparent. However, those experiments had temperature and pressure limitations. This neutron technique, explained Toops, is uniquely suited to see what's happening inside the injector at normal operating conditions.

The FEERC team developed a closed loop fuel injection system designed to operate with commercial and prototype injectors and deliver fuel to the injectors at pressures up to 120 atmospheres. They compiled about 1 million injection events to capture a 7-millisecond composite injection sequence with 0.02-millisecond time resolution.

"In the initial analysis of the composite neutron images, it is possible to see both internal injector motion and the spray exiting the nozzle," said Nafziger. "Just inside the nozzle area, a marked difference in fluid density is also observed during the injection event, indicating vaporization of the fluid and possible cavitation."

The team is now working on detailed analysis of the data and has plans for future work at HFIR to evaluate additional fuel injector models. The experimental data will be used by the ORNL high-performance computing team to validate fluid dynamics simulation models as part of the second year of this project.

This research is supported through Laboratory Directed Research and Development funds.

Employee Excellence

Jones to coordinate International Energy Agency wireless charging activity

Researcher P. T. Jones has been selected to coordinate the new "Wireless Charging for Electric Vehicles" task as part of the International Energy Agency Hybrid and Electric Vehicle Implementing Agreement. The task involves developing a greater global understanding of wireless charging systems by working with member countries to identify and summarize variations in standards, opportunities, and barriers to this maturing technology.

Three honored with SAE International Outstanding Oral Presentation awards

FEERC's Scott Sluder, John Storey, and Scott Curran each received the Society of Automotive Engineers (SAE) International Outstanding Oral Presentation award for presentations they delivered at the 2014 SAE World Congress. The award, which is based on feedback from meeting attendees and organizers, is intended to recognize outstanding presenters for their contributions to maintaining a high standard of quality at SAE technical meetings.

Onar named associate editor for new IEEE journal

Researcher Omer Onar has been named associate editor for the new Institute of Electrical and Electronics Engineers (IEEE) *Transactions on Transportation Electrification* journal, which is a joint publication of several IEEE societies. Onar is also guest associate editor for the IEEE *Transactions on Power Electronics* special issue on wireless charging systems.

Kass joins SAE automotive security task force

Researcher Mike Kass has been invited to participate on the SAE Task Force on Automotive Security Guidelines and Risk Development. This committee coordinates activities related to automotive cyber security issues.

Kahl participates on task force for heavy-duty truck automated driving

Researcher Keith Kahl joined the American Trucking Association Truck Maintenance Council task force on automated driving and platooning. The group is identifying opportunities, new technologies, key requirements, and concerns for applying partially and fully automated driving to heavy-duty truck operations.

New Projects

Vehicle Technologies

Ionic lubricants boost fuel economy

ORNL will work with General Motors to further develop ionic liquid additives for low-viscosity engine oils. The team previously demonstrated these lubricants can enable a 2% gain in fuel efficiency. This project will work with additional ionic liquids and expand the application of these lubricants to the rear axle to gain a 4% improvement in vehicle fuel economy.

Researchers are targeting a 4% fuel economy increase with these ionic lubricants.

Co-optimizing future gasoline formulations and engines

In close partnership with the Coordinating Research Council, ORNL will make use of next generation engine technologies and ethanol blends to develop an integrated strategy for improved engine efficiency and emissions. The target is a minimum 25% reduction in petroleum consumption.

Ultraefficient light-duty powertrains

Delphi, ORNL, Hyundai, and Umicore are collaborating on a project to use low temperature gasoline combustion to create more fuel efficient powertrains with lower emissions. ORNL will characterize the particulate matter and hydrocarbon emissions from these advanced engines.

New materials for improved tire efficiency

ORNL researchers, in collaboration with Michelin, will replace existing fillers like carbon black and silica with higher performance graphene and silica nanofibers to produce longer lasting tires with high traction and ultralow rolling resistance for better fuel economy.

New tire materials could increase fuel efficiency.

Solid electrolytes for solid-state and lithium-sulfur batteries

University of Michigan, ORNL, and the Army Research Laboratory will work together to demonstrate garnet-based solid electrolyte polycrystalline membranes in lithium-metal and lithium-sulfur batteries that support current densities approaching that of defect-free crystals. These membranes will improve solid-state ionic conductivity, increase power density, and eliminate safety hazards associated with conventional lithium-ion batteries.

Three-way catalysts for highly efficient engines

ORNL will partner with Ford Motor Company and the University of Michigan to identify potential low-temperature automotive catalysts that meet future emissions requirements. This project will build on promising research in the areas of nanostructured, highly engineered support materials and chemical treatments.

Carbon fiber made from spider silk

Utah State University and ORNL will use *E. coli*–generated synthetic spider silk as a model for engineering a biomimetic precursor material to replace current polyacrylonitirile precursors. Spider silk fibers could offer advantages over current carbon fibers in their ability to flex, making them more damage resistant when used in vehicle body panels and other applications.

Researchers are using orb-weaver spider genes to make synthetic silk for carbon fiber production.

Analyzing degradation processes in Li-ion batteries

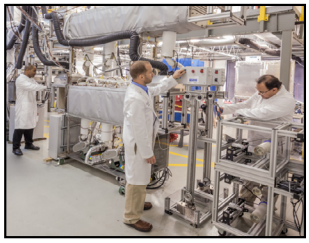
ORNL, the University of Tennessee, and Michigan State University will apply state-of-the-art methods to study the lithium–solid electrolyte interface to gain a better understanding of the degradation processes that can cause premature battery failures.

High-strength aluminum alloy for lightweighting

Alcoa, ORNL, Honda, and Cosma are partnering to develop a low-cost, high-strength aluminum alloy for vehicle lightweighting. ORNL will focus primarily on developing joining and forming technologies essential to the application of the new alloy to vehicle body structures.

New carbon fiber production process

RMX Technologies and ORNL will scale up a plasma oxidation demonstration line. This advanced method reduces energy consumption and speeds production by a factor of 2 to 3 times over conventional processing of carbon fiber, which increases yield and lowers costs.



Researchers from ORNL and RMX Technologies work with a pilot line that uses advanced oxidation technology to accelerate the production of low-cost carbon fiber.

Multispeed transmission for commercial delivery vehicles

ORNL is partnering with Eaton Corporation, Smith Electric, and NREL to demonstrate multi-speed transmissions for medium-duty electric delivery trucks to extend their range and drivability. A team at ORNL's Vehicle Systems Integration (VSI) Laboratory will conduct powertrain evaluations and support development of vehicle supervisory control strategies.

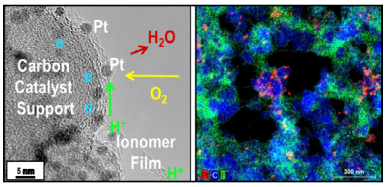
Catalysts for low-temperature diesel oxidation

The University of Connecticut and ORNL will develop low-cost, stable, low-temperature diesel oxidation catalysts (DOCs) for emissions control. The aim is to identify a series of DOCs with advantages including high materials usage efficiency, multifunctional catalytic oxidation efficiency, excellent robustness, and cost-effectiveness in both materials and manufacturing protocols.

Fuel Cell Technologies

Enhanced catalytic activity

ORNL is collaborating with NREL to explore the potential of high magnetic field annealing to produce highly active surface structures of platinum alloy oxygen reduction reaction (ORR) catalysts for proton exchange membrane fuel cells (PEMFCs). Researchers aim to demonstrate scalable and commercially viable magnetic field processing conditions for ORR catalysts.



Researchers use advanced microscopy and x-ray mapping to study low-platinum, highly durable electrocatalysts for fuel cells.

New membranes for greater power density

ORNL is leading a project to develop highly conducting, durable anion exchange membranes (AEMs) for demonstration in alkaline fuel cells (AFCs). AFCs can be designed without platinum, reducing costs over PEMFCs. AFCs typically produce lower power density, which presents an opportunity that high conductivity AEMs could address.

High-strength hydrogen storage

ORNL will demonstrate a low-cost, steel-concrete composite vessel for high-pressure hydrogen storage at fuel cell vehicle refueling stations. In a separate but related project, researchers will work with WireTough Cylinders to measure mechanical properties of WireTough's high-strength stationary hydrogen storage tank design.

Better operating efficiency

ORNL will assist Sandia National Laboratory in developing non-perfluorosulfonic acid, high acid content polymer membranes for PEMFCs that operate efficiently under hot, dry conditions in excess of 80°C. With the greater range of operating conditions, the vehicle balance-of-plant design becomes simpler and less expensive.

Low-cost fuel cells

ORNL will partner on two projects to decrease or eliminate the platinum in fuel cells, which will reduce costs. ORNL will assist Los Alamos National Laboratory in creating novel, low-platinum catalyst layers and will assist Argonne National Laboratory in developing next generation low- and non-platinum cathode electrocatalysts for PEMFCs

Bioenergy Technologies

Renewable carbon fiber

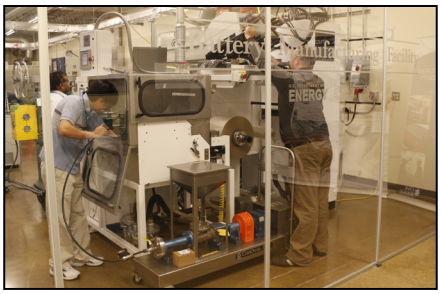
ORNL is participating in an effort led by NREL to advance the production of cost-competitive, high-performance carbon fiber from renewable, non-food-based feedstocks such as agricultural residues and woody plants. The project will focus on demonstrating new biomass conversion technologies that enable the manufacture of bio-acrylonitrile for use as a carbon fiber precursor at a cost of less than $1 per pound.

Corn stover could provide a renewable raw material for carbon fiber production. (Source: 3media.com via dailytech.com)

Briefs

New process creates production efficiencies for lithium-ion batteries

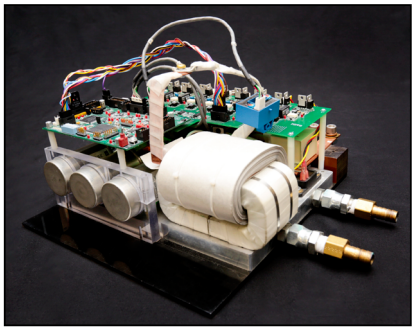
ORNL, in partnership with Miltec UV, established a new demonstration system in the DOE Battery Manufacturing R&D Facility (BMF) to showcase a unique ultraviolet (UV) curing process for producing lithium-ion electrodes. The UV curing process enables substantial gains in production efficiency and cost savings of more than 50% versus conventional solvent drying systems. The UV system operates without volatile organic compound solvents at production speeds 10 times those of conventional systems. ORNL will use the new demo line to optimize this process, which could lead to the development of new materials and low-cost batteries for use in electric vehicles and other applications. This project is funded by Miltec UV with support from DOE VTO and installation assistance from ConQuip, Inc.



Researchers from ORNL and ConQuip, Inc. set up the new UV demonstration line.

New Hybrid Technologies licenses ORNL power conversion technology

Oak Ridge start-up New Hybrid Technologies, LLC, has licensed new power conversion technology developed by PEEM researcher Gui-Jia Su. The patented current source inverter takes direct current voltage and converts it into a multi-phase alternating current for powering electrical vehicle motors. The technology offers improved durability and power range in a smaller package, which enables reductions in battery size, saves costs and weight, and increases fuel economy.

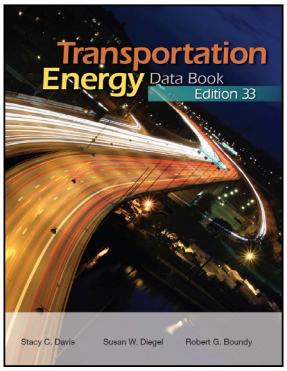


ORNL developed a 55 kW current source inverter and licensed the technology.

New project begins with EPA

The Center for Transportation Analysis (CTA) Advanced Vehicle Systems program is beginning a new project, "Develop Potential Powertrain Test Procedures for EPA Greenhouse Gas (GHG) Certification of Medium- and Heavy-Duty Engines and Vehicles." The purpose of this project is to assist the US Environmental Protection Agency (EPA) with the development and evaluation of test procedure options and technologies associated with potential heavy- and medium-duty GHG certification processes. The VSI Laboratory will be used exclusively to execute a broad range of tests on various powertrain configurations and support development of engine and powertrain test procedures for EPA's upcoming rule making.

Transportation Energy Data Book 33 published



The 33rd edition of the *Transportation Energy Data Book* (TEDB) is now available online. Produced for the DOE Vehicle Technologies Office, the TEDB provides transportation data with an emphasis on energy, including statistics and data that characterize transportation activity and related energy use. This useful desktop reference is available in Excel and PDF formats at http://cta.ornl.gov/data/index.shtml. Email Stacy Davis at davissc@ornl.gov to request copies.

Analysis identifies the most effective transportation uses for natural gas

Is it more efficient to use our abundant natural gas resources to generate electric power for an electric vehicle or to put the natural gas directly into the vehicle? To answer that question, researchers at ORNL engaged in a well-to-wheels analysis that included evaluation of total energy use and GHG emissions. The results show that the high efficiency of modern natural gas power plants makes using natural gas–generated electricity to power electric vehicles the better option with current technologies. Natural gas in the stationary power application won by a small margin. That advantage might shift if new technologies increase the fuel conversion efficiency of natural gas vehicles. The study was published in *Energy* and is available with open access online.

ORNL partners with Toyota on wireless charging

Electric vehicle (EV) owners may be free of the power cord soon. ORNL and Toyota have signed a cooperative research and development agreement to equip EVs with new wireless charging technology. ORNL has created and demonstrated stationary wireless charging that operates with the same efficiency as plug-in charging. Researchers are now partnering with Toyota and Evatran to integrate this system into a small fleet of Toyota vehicles.

Phase III of this project will include dynamic wireless charging, which offers the potential for drivers on specially equipped roadways to charge their vehicles in motion on their daily commutes. The integrated vehicles will be evaluated in both static and dynamic operations at the Clemson University International Center for Automotive Research (CU-ICAR). As a partner on this wireless charging project, CU-ICAR is responsible for developing a new evaluation facility and the vehicle-to-grid communications. ORNL research for this project is funded by DOE VTO.

Wireless charging demonstration vehicle in service at ORNL

Researchers equipped a Prius with ORNL wireless charging technology and set up a wireless charging station at the main lab. The vehicle is serving dual purposes as both a mail delivery and field test vehicle. As part of the Sustainable Campus Initiative, the Prius is being used in standard plug-in hybrid mode to deliver mail. Through wireless charging demonstrations with the vehicle, the research team is gaining new knowledge about the operation and deployment of wireless charging in a real-world setting.

The Prius backs into the wireless charging station at ORNL.

ORNL partners with Sharp on longer life batteries

Researchers at the BMF are supporting a new effort led by Sharp Laboratories of America to develop sodium-ion batteries. Sodium-based batteries offer the potential to increase battery cycle life at reduced cost while preserving high energy capacity. ORNL will assist in slurry/ink development, electrode coating, and pouch cell assembly for further development of the chemistry and the technology. This project is funded by the DOE Advanced Research Projects Agency-Energy and conducted in collaboration with the University of Texas and Oregon State University.

Long Wang of Sharp Laboratories works with new materials in the BMF.

Highly cited lithium-ion battery research

A team of researchers from the BMF used a new experimental tool to pinpoint the voltage window (3.5–2.5 V) where structural changes occur in a high potential cathode material, causing voltage fade in high-energy-density lithium-ion batteries.

Debasish Mohanty led the team in authoring a paper titled "Structural transformation of a lithium-rich $Li_{1.2}Co_{0.1}Mn_{0.55}Ni_{0.15}O_2$ cathode during high voltage cycling resolved by in situ x-ray diffraction." It has the highest number of citations of any original research paper on lithium and sodium batteries published in the *Journal of Power Sources* in 2013. The paper is included in the same journal's special edition on this topic as well.

Outreach

Omer Onar and Zhenhong Lin presented a seminar on dynamic wireless charging technology and its potential effects on market adoption of electric vehicles.

Transportation seminars continue with "Taking the NOx out of Knoxville: ORNL Science Improving Clean Transportation"

The next talk in the Transportation Science Seminar Series is scheduled for November 21, 2014, at 10 a.m. in ORNL's JICS Auditorium (building 5100, room 128) and will feature Jim Parks speaking about innovations in transportation technology that reduce engine pollutant emissions. Parks is the group leader for the emissions and catalysis research team.

The Transportation Science Seminar Series features the crosscutting capabilities of transportation R&D to encourage collaboration across the lab. To view past presentations, please contact Kim Askey at 865-946-1861.

Tim Theiss presented a seminar on the role of biofuels in the national effort to address sustainable transportation challenges.

Take Your Child to Work Day

STP researchers participated in ORNL's Take Your Child to Work Day, introducing batteries, power electronics, electric motors, and combustion engines to about 100 children and their parents in an event sponsored by the ORNL Committee for Women.

In the News

- In an article about EPA and automaker measurements of fuel economy, *The Wall Street Journal* referenced fueleconomy.gov and quoted CTA researcher Rick Goeltz. CTA maintains the fueleconomy.gov site, including data from driver-submitted mileage estimates, which were referenced in the article.
- The *Detroit Free Press* published an article about ORNL's work with ionic lubricants, wireless charging, carbon fiber, and batteries. The story, "Lab rolls out ideas for future vehicles," was picked up by *USA Today* and many other media outlets.
- *Scientific American* published an article about autonomous and connected vehicle technologies. Researcher Andreas Malikopoulos is quoted in the story, which includes a description of ORNL-developed algorithms and their potential applications for eliminating traffic congestion.
- *Automotive World* interviewed David Wood and Zhili Feng for a story about ORNL's fuel cell and hydrogen storage projects and the future prospects for fuel cell vehicles.
- Researcher Zhenhong Lin published a paper in *Transportation Science* that concluded most US consumers would be better off choosing an EV with a range below 100 miles. This conclusion was for battery electric vehicles and based on battery costs of ≥ $100/kWh. The research received coverage through numerous media outlets, including *Science Codex*, Phys.org, and *International Fleet World*.
- The R&D 100 award-winning tunable membranes were featured in a DOE BETO monthly e-newsletter, and BETO posted ORNL's membrane video on its Bioenergy Knowledge Discovery Framework Facebook, Twitter, and LinkedIn pages. The story was picked up by Phys.org and other news outlets under various headlines, including "Filling up could cost less thanks to biomolecular engineering breakthrough."
- ORNL-developed biofuel-to-hydrocarbon conversion technology and its potential applications for jet fuel received coverage in *Biofuels Digest*.
- Green Car Congress has covered a variety of ORNL research projects recently, including stories about the following:
  - vehicular thermoelectric generators project,
  - high performance computing projects with Ford and GM,
  - IEEE inverter challenge article references ORNL,
  - wireless charging technology in the Cadillac ELR,
  - GM power electronics co-developed with ORNL and NREL,
  - hydrogen production and delivery technologies projects, and
  - neutron imaging of fuel injectors.
- The announcement of ORNL's eight new R&D 100 awards received coverage from media, including *HPC Wire*, *Bio-Medicine*, and *Energy Industry News*. This year's award-winning STP technologies include ionic liquid antiwear additives, the RF-DPF™ diesel particulate filter sensor, super-hydro-tunable membranes, and a high-performance vehicle battery charger.

Filter Sensing Technologies, Inc., RF-DPF™ prototype installed next to DPF stack on Volvo/Mack truck.

- SAE International announced the winners of the 2014 Forest R. McFarland Award, including ORNL's Scott Sluder. The award recognizes individuals for outstanding contributions to the SAE Engineering Meetings Board and for facilitating or enhancing the exchange of technical information. The news was picked up by regional media outlets across the nation.

Visits and Events

- Researchers Hsin Wang and David Singh served as the conference chairman and cochairman for the International Conference on Thermoelectrics—ICT2014—in Nashville. This year's conference attracted 550 participants from 27 countries, and the program included more than 500 presentations.

- Sunita Satyapal, FCTO director, attended the hydrogen delivery team meeting and toured several facilities including the BMF and the Carbon Fiber Technology Facility. During her visit, she gave a presentation sponsored by the ORNL Committee for Women on "DOE Hydrogen and Fuel Cell Activities and Career Perspectives."

Sunita Satyapal presents a seminar on fuel cells.

- The US DRIVE Electrochemical Energy Storage Tech Team met at the National Transportation Research Center (NTRC) recently for discussions about computer-aided battery design and exploratory and applied research and development.

- Gary Capps hosted the Tennessee Trucking Association-East Region Safety and Maintenance Council meeting at NTRC. The group toured the VSI Lab during the visit.

- Johnathan Male, head of BETO, visited ORNL to meet with researchers and tour the facilities at NTRC and the main lab. He gave a seminar during his visit on current BETO research results and priorities.

Johnathan Male and Jae-Soon Choi discuss biofuels research.

- Scott Elrod, vice president of PARC, met with ORNL research staff to discuss potential collaborative R&D for advanced batteries. While at ORNL, Dr. Elrod presented a seminar on "Printing Technologies for Sensors, Energy Devices, and 3-D Objects."

Claus Daniel and Scott Elrod discuss advanced technologies at the BMF.

- FEERC researchers organized the 8th annual International Conference on Environmental Catalysis. Todd Toops served as chair, Bill Partridge as cochair, Jae-Soon Choi as treasurer, and Charles Finney as web chair. About 400 participants from 44 countries attended.

- Susan Rogers, DOE Advanced Power Electronics and Electric Machinery technology manager, visited NTRC for a quarterly team meeting and discussion of the upcoming fiscal year.

The ORNL power electronics team meets with Susan Rogers (center right).

- The ORNL Hydrogen Delivery team held a new project kickoff meeting recently. Participants included representatives from FCTO and the DOE Golden Field Office and project managers/principal investigators from ORNL, WireTough Cylinders LLC, Nuvera Fuel Cells, and Southwest Research Institute.

- At the 2014 Microscopy and Microanalysis conference, researcher Raymond Unocic demonstrated the use of unique in situ microscopy systems developed by Protochips in collaboration with ORNL. These systems allow investigation of electrochemical processes in liquid environments at high spatial resolution.

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

Please submit to Kim Askey,
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