

SCIENCE

Nano-spike catalysts convert CO₂ directly into ethanol production

In a new twist to waste-to-fuel technology, ORNL scientists have developed an electrochemical process that uses tiny spikes of carbon and copper to turn carbon dioxide, a greenhouse gas, into ethanol. Their finding, which involves nanofabrication and catalysis science, was serendipitous.

“We discovered somewhat by accident that this material worked,” said ORNL’s Adam Rondinone, lead author of the team’s study published in ChemistrySelect. “We were trying to study the first step of a proposed reaction when we realized that the catalyst was doing the entire reaction on its own.”

The team used a catalyst made of carbon, copper and nitrogen and applied voltage to trigger a complicated chemical reaction that essentially reverses the combustion process. With the help of the nanotechnology-based catalyst which contains multiple reaction sites, the solution of carbon dioxide dissolved in water turned into ethanol with a yield of 63 percent. Typically, this type of electrochemical reaction results in a mix of several different products in small amounts.

“We’re taking carbon dioxide, a waste product of combustion, and we’re pushing that combustion reaction backwards with very high selectivity to a useful fuel,” Rondinone said. “Ethanol was a surprise — it’s extremely difficult to go straight from carbon dioxide to ethanol with a single catalyst.”

The catalyst’s novelty lies in its nanoscale structure, consisting of copper nanoparticles embedded in carbon spikes. This nano-texturing approach avoids the use of expensive or rare metals such as platinum

that limit the economic viability of many catalysts.

“By using common materials, but arranging them with nanotechnology, we figured out how to limit the side reactions and end up with the one thing that we want,” Rondinone said.

The researchers’ initial analysis suggests that the spiky textured surface of the catalysts provides ample reactive sites to facilitate the carbon dioxide-to-ethanol conversion.

“They are like 50-nanometer lightning rods that concentrate electrochemical reactivity at the tip of the spike,” Rondinone said.


“A process like this would allow you to consume extra electricity when it’s available to make and store as ethanol.”

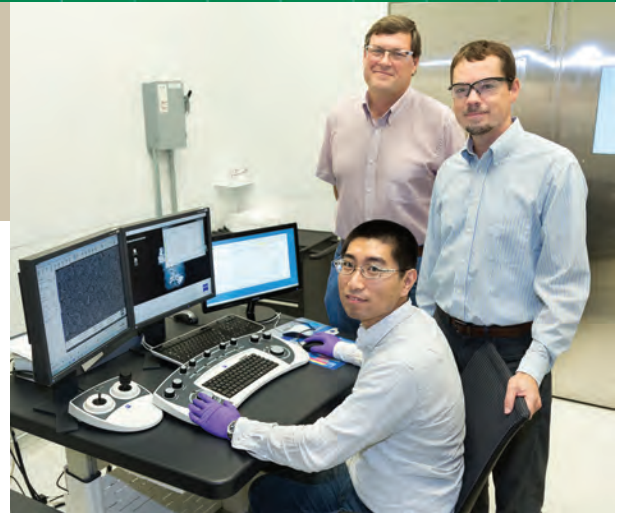
Given the technique’s reliance on low-cost materials and an ability to operate at room temperature in water, the researchers believe the approach could be scaled up for industrially relevant applications. For instance, the process could be used to store excess electricity generated from variable power sources such as wind and solar.

“A process like this would allow you to consume extra electricity when it’s available to make and store as ethanol,” Rondinone said. “This could help to balance a grid supplied by intermittent renewable sources.”

The researchers plan to refine their approach to improve the overall production rate and further study the catalyst’s properties and behavior.

ORNL’s Yang Song, Rui Peng, Dale Hensley, Peter Bonnesen, Liangbo Liang, Zili Wu, Harry Meyer III, Miaofang Chi, Cheng Ma, Bobby Sumpter and Adam Rondinone are coauthors on the study.

—Morgan McCorkle 



ORNL’s Yang Song, seated, Dale Hensley, standing left, and Adam Rondinone examine a carbon nanospike sample with a scanning electron microscope. (ORNL photo by Genevieve Martin)

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ORNL retiree Jim Ealy with his book "The Secret Revealed . . . A Nuclear Odyssey." (ORNL Photo by Carlos Jones)

Retiree Jim Ealy writes Oak Ridge mystery novel 'The Secret Revealed'

Oak Ridge retiree Jim Ealy has recently published a mystery novel titled "The Secret Revealed . . . A Nuclear Odyssey," depicting a scientific terrorism attack on Oak Ridge.

Jim uses Jay Elam as his pen name and the name of the principal character in the book. He uses some actual local events and locations throughout the book.

Jim, who worked as an industrial hygienist in Oak Ridge at all three facilities during a 37-year-span, said the reason he wrote the novel was to remind readers of all of the secrecy involved throughout Oak Ridge history.

"My objective was to reintroduce the reader to how Oak Ridge got to the point where it is today," Jim said.

The story begins with a mysterious attack on Y-12. Retired Army Reserves Col. Jay Elam is called back to active duty by the president of the United States to track down the culprits. He was chosen because, concurrent with his military career, he had worked at all three Oak

Ridge installations and was very familiar with their missions. Adding to his qualifications was the fact that he had also been an embedded FBI agent during his career in Oak Ridge.

Col. Elam gets promoted to brigadier general on acceptance of the mission. He immediately requisitions retired military personnel and other resources needed to get the job done. Elam discovers the Y-12 attack was a smokescreen for a simultaneous intrusion at ORNL for the purpose of hacking the Summit supercomputer to skew calculations necessary for the ITER fusion reactor under construction in France.

The investigation eventually leads Elam's group to Europe where he goes undercover by portraying himself as a businessman. The plot thickens as Elam discovers the main perpetrator has a hidden personal non-scientific agenda.

The initial command operation in the novel is located at McGhee Tyson Air Base in Blount County. The author was a U. S. Army Reserve commander in Oak Ridge and Knoxville for several years.

"I understand how the resources of the base could be brought in if a situation like this actually occurred," Jim said. "People forget that the original mission of McGhee Tyson was to protect Oak Ridge."

In the book, the author describes a unique geographical feature along the Clinch River on the ORNL site that allowed the intruders to gain undetected access to their target at ORNL.

"I got a lot of information about the physical areas of ORNL from ORNL retiree, Ernie Shepherd, who before World War II, lived near where the EGCR facility is now," Jim said. "Ernie knew that area well as he hunted and fished with his brothers along the ridges and valleys."

Jim said it took about a year to craft and write the plot before spending the next year reviewing and refining. ORNL retirees Carolyn Legg and Jerrie Mitchell helped along the way. Carolyn typed his original hand-printed manuscript and Jerrie helped put Jim's ideas into words. Jim also passed the manuscript around to a number of longtime ORNL employees for their comments and suggestions.

Jim noted some of the reviewers of the manuscript wondered if there might be some security issues. In order to make sure nothing in the book might compromise current classified information or security, he offered it to the proper security representatives at Y-12 and ORNL for review before publishing. The manuscript was cleared without any changes.

Jim has received positive feedback from friends and acquaintances. As far as a possible sequel is concerned, he said that is still to be determined. —Fred Strohl 🌿

"My objective was to reintroduce the reader to how Oak Ridge got to the point where it is today."

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Strunk named top scientist at ORNL's Awards Night ceremony

Bill Strunk of ORNL's Nuclear Science and Engineering Directorate received the ORNL Director's Award for Outstanding Individual Accomplishment in Science and Technology during the Laboratory's Awards Night event Nov. 18 at the Knoxville Convention Center.

Strunk was recognized for exemplary leadership of ORNL's uranium science and engineering programs, which has led to enhancements in the nation's nuclear security. He is also credited with the establishment of research and development capabilities and facilities that will enable ORNL to excel in vitally important areas of research.

Strunk, who works in the Enrichment Science and Engineering Division, also earned the Division Level Research Leadership Award.

Roderick Jackson of the Energy and Transportation Science Division received the Director's Award for Outstanding Individual Accomplishment in Mission Support.

Jackson was cited for exemplary leadership in communicating the innovative science and technology behind the Additive Manufacturing Integrated Energy Demonstration Project, a collaborative effort that integrates advanced systems for generating, storing and using electrical power for both buildings and vehicles. Jackson also received the Science Communicator Award.

A discovery that advances the understanding of quantum spin liquids in real materials received the Director's Award for Outstanding Team Accomplishment. The multidisciplinary team's efforts culminated in the observation of fractionalized quantum spin liquid excitations, which may represent a step toward solid-state technology for quantum computers.

The team, led by the Neutron Sciences Directorate's Arnab Banerjee, also includes Adam Aczel, Craig Bridges, Garrett Granroth, Mark Lumsden, David Mandrus, Stephen Nagler, Matthew Stone, Alan Tennant and Jiaqiang Yan. The team also received the team Research Accomplishment Award. Winners were selected by committees and approved by ORNL director Thom Mason. *—Bill Cabage* 🌿



Winners of the Director's Award for Outstanding Team Accomplishment were, from left, standing: Jiaqiang Yan, Alan Tennant, Craig Bridges, David Mandrus, Adam Aczel and Garrett Granroth. Seated: Matthew Stone, Arnab Banerjee, Stephen Nagler and Mark Lumsden. (ORNL Photo by Jason Richards)



Bill Strunk

Roderick Jackson

International association approves element 117 as tennesseine

The recently discovered Element 117 is now officially named "tennessine" in recognition of Tennessee's contributions to its discovery, including the efforts of ORNL, Vanderbilt and the University of Tennessee.

The International Union of Pure and Applied Chemistry (IUPAC)—which validates the existence of newly discovered elements and approves their official names—gave its final approval to the name "tennessine" following a year-long process that began Dec. 30, 2015, when IUPAC and the International Union of Pure and Applied Physics announced verification of the existence of the superheavy element 117, more than five years after scientists first reported its discovery in April 2010.

"The presence of tennessine on the Periodic Table is an affirmation of our state's standing in the international scientific community, including the facilities ORNL provides to that community as well as the knowledge and expertise of the laboratory's scientists and technicians," ORNL Director Thom Mason said.

ORNL had several roles in the discovery, the most prominent being production of the radioisotope berkelium-249 for the search. The berkelium-249 used in the initial discovery and subsequent confirmatory experiments for element 117 was produced by ORNL and the Department of Energy's Isotope Program, and was provided as a U.S. contribution to those experiments.

Superheavy elements, which do not occur naturally, are synthesized by exposing a radioisotope target to a beam of another specific isotope. In theory, the nuclei will in rare cases combine into a "superheavy" and heretofore unknown element.

In tennessine's case, the atomic recipe for element 117 required the berkelium-249 target, which was available only from ORNL's High Flux Isotope Reactor (HFIR), which produces radioisotopes for industry and medicine in addition to its neutron scattering research mission, and the adjoining Radiochemical Engineering Development Center (REDC) where the radioisotopes are processed. *—Bill Cabage* 🌿




 Service Anniversaries

September 2016

40 years: **Diana Malone**, Accounting Services; **Barry B. Spencer**, Nuclear Security & Isotope Technology

35 years: **Mary K. Strege**, Transportation & Waste Management; **Brian Damiano**, Electrical & Electronics Systems Research; **Terry R. Sharp**, Energy & Transportation Science; **Janice V. Hughes**, Laboratory Protection

30 years: **David L. Wilson**, Energy & Transportation Science; **Susan B. Lambert**, Nuclear & Radiological Protection; **Garfield W. Hedgecoth III**, Utilities; **Robert L. Hettich**, Chemical Sciences

25 years: **Wayne S. Underwood**, Safety Services; **Joann Wright**, Logistical Services; **Gabrielle D. Boudreau**, Scientific and Program Services Office; **Julia S. Kelley**, Energy & Transportation Science; **Sherry L. Cantrell**, Health Services; **Jeffrey Eugene Moody**, **Linda G. Kincaid**, **Jim Blankenship**, and **Terry W. Wright**, Nonreactor Nuclear Facilities; **Randall William Humphreys** and **Michael E. Day** and **Labe Alan Payne**, Facilities Management; **Jason Henry Taylor**, Transportation & Waste Management; **Ann H. Primm**, Research Reactors; **Regina H. Meredith**, Business Management Services; **James B. Treen**, Nuclear & Radiological Protection; **Seokho H. Kim**, US ITER Nuclear Systems; **Christopher Mckenzie Redmon**, Instrument and Source; **Sarah Holland Shaver**, International Security & Analysis; **Rhonda Katie Ward**, Accounting Services; **Mark Alan Johnson**, Transportation & Waste Management; **Jeffrey S. Harrison** and **James Edward Payne**, F&O Modernization Project Office; **Rodney Dale Hunt**, Nuclear Security & Isotope Technology; **Eric Allen Loy**, Laboratory Protection; **William Besancenez**, Acquisition Management Services

20 years: **Christopher M. Rouleau**, Center for Nanophase Materials Sciences

October 2016

40 years: **Larry E. Davis**, Instrument and Source; **William B. Whitten**, Chemical Sciences; **Susan E. Williams**, Energy & Transportation Science

35 years: **Sandy Glazier**, Internal Audit

30 years: **Patricia Gail Epperson**, Human Resources; **Eric T. Manneschmidt**, Materials Science and Technology; **Victor W. Pardue**, Communications; **Rick L. Dailey**, Environmental Protection Services; **Diane L. Ridge**, Accounting Services; **Steven R. Bolden**, Logistical Services; **Angela A. Blankenship**, Energy & Environmental Sciences; **Keiji G. Asano**, Chemical Sciences; **Mark Reeves**, Technology Transfer; **Anne Botkin**, Information Technology Services

25 years: **Pam B. Hale** and **D.A. Fye**, Information Technology Services; **Douglas Wayne Jones**, Instrument and Source; **Greg A. Strickland** and **Anthony Douglas McBee**, Integrated Operations Support; **Sherry E. Livengood**; EESD Safety and Business Operations; **David E. Hill**, Computational Sciences & Engineering; **Randy L. Hinton**, Logistical Services; **Jeffery Reasor**, Facilities Management; **Wesley D. Goddard**, Environmental Protection Services

20 years: **Dana C. Green**, Office of the Laboratory Director; **Michael E. Dunn**, Reactor & Nuclear Systems

November 2016

40 years: **Kathy F. Rosenbalm**, Office of the Laboratory Director; **Gerald L. Scott**, Office of Integrated Performance Management

35 years: **David A. Rasmussen**, US ITER Nuclear Systems

30 years: **Phyllis Philpot Young**, Biosciences; **Polly B. Ladd**, Nuclear Security & Isotope Technology; **Jaime A. Fernandez-Baca**, Quantum Condensed Matter; **Jeffrey O. Johnson**, Global Security; **Lindsay M. Long**, Utilities; **Joan F. Hughes**, Environmental Protection Services; **Randal E. Pudelek**, Transportation & Waste Management; **Michael D. Galloway**, Information Technology Services

25 years: **Harry L. Bailey Jr.**, US ITER Project Office; **Mike Bluford**, **Danny L. Castleberry**, and **Michael Wayne Jessie**, Integrated Operations Support; **Melissa G. Madgett** and **Jerry L. Underwood**, Utilities; **Sybil Hastings**, Facilities Management; **Jeff S. Fickey** and **Bruce F. Siefken**, Research Reactors; **Hilda Ruth Lawrence**, Logistical Services; **Tonia L. Mehlhorn**, Environmental Sciences; **Peter D. Lloyd**, Energy & Transportation Science; **Michael S. Whittenbarger**, Nuclear & Radiological Protection; **John B. Caughman**, Fusion & Materials for Nuclear Systems

20 years: **Paul W. Stankus**, Physics; **James A. Kolopus**, Materials Science and Technology; **Stacy L. Hall**, Health Services

ORNL media highlights available weekly online

A weekly listing of ORNL's mentions in the media is now available on the web at <http://fornl.info>.

Compiled by ORNL's Office of Communications from information provided by several media monitoring resources, the media highlights list all of the stories related to ORNL that appear in local and national media during a given week, along with a link to the stories when the links are available. The highlights are available along the left-hand side of the web site.

The media highlights are part of information submitted by ORNL contributing to DOE's weekly report covering all national laboratories.

THE NEWS

OAK RIDGE NATIONAL LABORATORY

A Publication for the ORNL Employees of Union Carbide Nuclear Company, a Division of Union Carbide and Carbon Corporation

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OAK RIDGE, TENNESSEE

Friday, October 26, 1956

'Neutron Physics by Time-of-Flight' Meet To Be Sponsored by ORNL at Gallinburg

A conference on "Neutron Physics by Time-of-Flight" is being sponsored by Oak Ridge National Laboratory at Gallinburg next week, November 1 and 2. Approximately 100 nuclear scientists from almost every laboratory in the country actively engaged in neutron studies are expected to attend the conference.

Time-of-flight spectrometry is a technique for measuring the energies of neutrons by producing narrow bursts of neutrons and measuring the elapsed time for a given burst to traverse a measured distance. Applications of this technique are being made to almost every aspect of neutron physics. The most successful and extensive use of the method so far has been in the neutron energy range 1-100 electron volts. However, progress in the last two or three years has extended the usefulness of this technique into the thousand and million electron volt range of energies.

ORNL Approach

At Oak Ridge National Laboratory two approaches of the time-of-flight technique are being employed. The new high flux research reactor under construction is being equipped with a rotating shutter which produces neutron bursts for application in the tens of thousands of electron volt range of energies. Actively participating in this work are J. A. Harvey, R. C. Block, and G. G. Slaughter.

Alternate Approach

The other approach of the time-

Continued on Page 3

Meets Are Attended By ORNL Members

Several members of the Laboratory's Solid State Division attended a number of conferences throughout the country this past week, and others are expected to participate in meetings in the near future.

M. F. Osborne and G. W. Keilholtz attended an ANP Conference sponsored by Pratt and Whitney at Hartford, Connecticut, on October 22 and 23. On October 24, 25 and 26, D. K. Stevens, E. Sonder, and H. C. Schweinler attended the Naval Research Laboratory-National Bureau of Standards-sponsored Semiconductor Symposium in Washington, D. C.

Two Conferences

J. H. Crawford Jr., R. H. Silsbee, C. M. Nelson, R. A. Weeks, and D. K. Stevens will attend the Office of Naval Research Color Center Symposium which is being held at Argonne National Laboratory, October 31, and November 1, and R. E. Jamison will attend the X-ray Diffraction Conference at Mellon Institute in Pittsburgh, Pennsylvania, October 30 through November 2.

M. C. Wittels will present a paper entitled "The Disorder of Minerals by the Action of Fission Spectrum Neutron" at the annual meeting of the American Mineralogical Society which is being held in Minneapolis, Minnesota, October 31 to November 1.

RESA to Hear Jones' Address

The Oak Ridge Branch of the Scientific Research Society of America will hear an address by Hardin Jones on Wednesday, October 31, at 8 PM in the Green Room of Ridge Recreation Hall. Dr. Jones' topic of discussion will be "Human Biology with Respect to Life Span."

Attended University of California

Professor Jones is the assistant director of the Division of Medical Physics, Donner Laboratory, University of California, Berkeley. He received his B.A., M.A. and Ph.D. degrees at the University of California, and has occupied the posts of assistant professor, associate professor, and professor at the school. He is a member of numerous biological and medical societies, having made diverse contributions to each of these fields. Most recently he has been engaged in statistical studies on factors affecting life expectancy, and it is with some of these findings that his talk will be concerned at the forthcoming RESA meeting.

The public is invited to attend.

Biology Hosts Meet By Bacteriologists

Daniel Billen, president of the Kentucky-Tennessee Branch of the Society of American Bacteriologists, will preside over the society's annual meeting which will be held in Oak Ridge on Friday and Saturday, November 2 and 3. Dr. Billen is a member of the Laboratory's

Biology Division.

The meeting, scheduled to be held in the Biology Division located in the Y-12 area, will feature sixteen papers to be presented by representatives of ORNL, the University of Kentucky, the University of Louisville, Vanderbilt University, and the University of Tennessee.

Three of the sixteen papers will be presented by members of the Biology Division: Alan K. Bruce will present a paper entitled "Changes in Potassium Leakage from Yeast Following X-Irradiation"; John Jagger will present a paper (co-authored by Raymond Latarjet) on "Action Spectra for Photorestitution in Escherichia Coli"; and Howard Adler will present a paper entitled "Some Objective Approaches to Problems of Bacterial Nuclear Cytology."



ROLF M. SIEVERT, chairman of the International Commission on Radiological Protection and director of the Radiophysics Institute, Karolinska Hospital, Stockholm, Sweden, visited the Laboratory last week to confer with members of the Health Physics Division. A leader in the field of radiological protection in Europe since 1921, he established a system of x-ray equipment inspection for Sweden which has served as a model for other European countries. He pioneered in the development of the whole-body counter and has had numerous publications in Sweden and abroad in the field of radiation measurement. He is the inventor of the Sievert ionization chamber.

Charpie Will Speak At Denver Meeting

Robert A. Charpie of the ORNL

George Gamow, Noted Atomic Physicist, Will Present ORNL Seminar Thursday

Visits Area to Attend Health Physics Meet Slated to be Held In Gallinburg Next Week

George Gamow, one of the world's most noted theoretical physicists, will visit Oak Ridge National Laboratory on Thursday and Friday of next week. Dr. Gamow will be in this area to attend the symposium on "Information Theory In Health Physics and Radiobiology" which is being held in Gallinburg on Monday, Tuesday, and Wednesday, November 29, 30, and 31. The three-day symposium is being sponsored by the Health Physics Division of ORNL.

ORNL Safety Mark Set Back by Injury

Oak Ridge National Laboratory's safety record suffered its second setback in three weeks last Friday, October 19, when a serious accident, resulting in a permanent partial injury, occurred in Building 3012.

An employee in the ORNL Metallurgy Division was helping roll uranium billets in a large rolling mill. The billets were covered with a heavy oil, making it difficult to get them started through the mill. In an attempt to increase the bite of the mill, the technician wiped oil from the roll with a cloth. The cloth and his asbestos glove (which was worn because the billets were hot) were caught, pulling his right hand between the rolls. The third and fourth fingers and part of the index finger will be lost.

To Present ORNL Seminar

On November 1 and 2, Dr. Gamow, professor of physics at the University of Colorado, will be at the Laboratory to present a seminar and to confer with Health Physics Division members and other interested technical personnel. His seminar, scheduled for 2:30 PM on Thursday, November 1, in the auditorium of Building 4500, will be entitled "Element Formation In Super Novae Explosions."

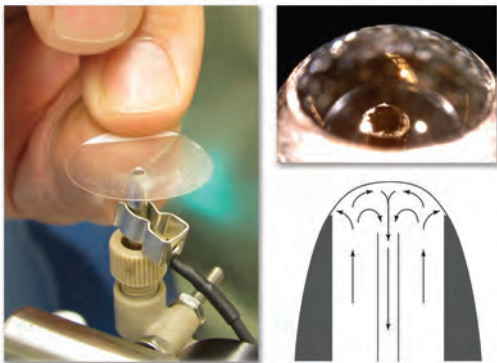
A native of Odessa, Russia, Dr. Gamow is well known for having presented the first theory of the nucleus of the atom. He was able to explain by his theory certain alpha particle systematics.

He came to this country as professor of theoretical physics at George Washington University, Washington, D. C.

Sixty years ago this quarter

Taken from ORNL "The News" for Fall 1956

- The ORNL Radioisotope Department placed in operation a new gamma irradiation unit. The new unit makes space available in the Cobalt 60 storage garden for irradiation of materials. An outstanding feature of the new unit was the ability to irradiate samples in a flowing air stream rather than under water as was previously done.
 - George Gamow, the world's most noted theoretical physicist, visited ORNL to attend a symposium sponsored by the Health Physics Division on "Information Theory in Health Physics and Radiobiology." A native of Odessa, Russia, Gamow was recognized during his visit for having presented the first theory of the nucleus of the atom based on certain alpha particle systematics.
 - ORNL Director Alvin Weinberg's State of the Laboratory address highlighted how research at ORNL evolved since the days of the original Hanford and Savannah River production reactors and how ORNL was helping to set standards for nuclear energy matters and policy on an international scale.
- prepared by ORNL History Room volunteers*



A close-up look at the Open Port Sampling Interfaces for Mass Spectrometry, one of ORNL's seven 2016 R&D 100 Award winners.

ORNL United Way campaign raises \$900,000

ORNL's 2016 United Way campaign raised \$900,000 – an increase of \$30,000 over the 2015 campaign.

“This is a fantastic and generous offer of support from our employees, management, volunteers and everyone who has been associated in one way or another with this year's United Way effort,” said campaign chair Sharon Kohler.

The \$900,000 total included a corporate contribution from UT-Battelle. Kohler credited the lab's Leadership Givers, who contribute a certain percentage of their salary per pay period, for providing 65 percent of the total designated by staff through payroll deduction. There were 22 new Leadership Givers joining this year.

“Since June 1 when this campaign started, there has been a lot of hard work from many people in helping to make this happen,” Kohler said. “During the campaign, we have talked to many people about what United Way does in our communities. We have had several events throughout the summer to raise awareness about United Way and encourage the spirit of giving.”

ORNL is one of the largest corporate contributors in East Tennessee to United Way. –Fred Strohl

ORNL earns seven R&D 100 Awards

ORNL earned seven R&D 100 Awards Nov. 3 during the 54th annual R&D 100 Conference sponsored by R&D 100 magazine. The awards honor innovative breakthroughs in science and consumer products.

Oak Ridge Graph Analytics for Medical Innovation (ORiGMI) was developed by a team led by Sreenivas Sukumar in collaboration with the National Library of Medicine. ORiGMI is an artificial intelligence system designed to search, collect and connect medical literature resources to improve medical research discovery. The team included Sreenivas Sukumar, Larry Roberts, Sangkeun Lee, Alexandra Zakrezewska (Yale University), Katherine Senter (University of Pennsylvania), Seokyoung Hong (North Carolina State) and Seung-Hwan Lim.

The Roof Savings Calculator Suite was developed by a team of researchers from ORNL, Jacksonville State University and White Box Technologies. The Roof Savings Calculator is a Web-based tool for simulating energy flow and loss in businesses and homes and predicting the cost-effectiveness of cool roofing and attic technologies based on building type and location. The team included Joshua New, William Miller, Aaron Garrett (Jacksonville State University) and Yu Huang (White Box Technologies).

G-Mode: Full Information Acquisition in Scanning Probe Microscopy and Spectroscopy was developed by a team led by Stephen Jesse. Scanning probe microscopy uses a rastering probe to map the shape of surfaces and capture physical and chemical properties of materials on the nanometer and atomic levels. G-Mode uses a custom controller to rapidly collect and thoroughly process the information flow from a microscope detector in its entirety, yielding all accessible information about minute changes sensed by the probe as it interacts with nanoscopic volumes of a sample. The team included Stephen Jesse, Liam Collins, Suhas Somnath, Sergei Kalinin and Alex Belianinov.

Virtual Environment for Reactor Applications (VERA) was developed by a consortium of researchers from ORNL,

the Electric Power Research Institute, Westinghouse Nuclear and Idaho, Sandia and Los Alamos national laboratories.

VERA is a physics simulation tool that visualizes the internal processes of commercial nuclear fission power plants and predicts reactor behavior in a number of potential scenarios.

The team consisted of 42 members. ORNL researchers were Jess Gehin, John Turner, Mark Baird, Kevin Clarno, Benjamin Collins, Gregory Davidson, Thomas Evans, Andrew Godfrey, Steven Hamilton, Seth Johnson, Kang Seog Kim, Douglas Kothe, Rose Montgomery, Tara Pandya, Robert Salko, Matthew Sieger, Srdjan Simunovic, Stuart Slattery and Shane Stimpson.

U-Grabber was developed by a team of ORNL researchers led by Sheng Dai in collaboration with the University of Tennessee and 525 Solutions. The U-Grabber is an adsorbent material designed to extract uranium and other metals from water inexpensively and efficiently. The material is made from polyethylene fibers, similar to PVC, woven into braids and grafted with chains of a uranium-attractive chemical called amidoxine. The free-floating uranium in the water binds with the fibers and can be extracted, purified and sold as nuclear fuel. The team included Sheng Dai, Suree Brown (UT), Robin Rogers (525 Solutions), Christopher Janke, Richard Mayes, Tomonori Saito and Ronnie Hanes (525 Solutions).

Open Port Sampling Interfaces for Mass Spectrometry were developed by ORNL's Gary Van Berkel and Vilmos Kertesz. The most difficult usability barrier for mass spectrometry is producing and transferring viable samples into the device. The Open Port Sampling Interfaces remove this impediment and allow easier, universal input of samples via accessible intake ports. The ports, one a shallow swirling vortex, the other a conical solvent dome, use constantly flowing liquid streams to convey the sample into the ionization source of the spectrometer. They accept many types of samples, from organic oils to

(continued on page 7)

From the Lab Director

Kudos. We have a rush of new honorees from professional societies, including six new American Physical Society Fellows: **John Galambos, Robert Grzywacz, Ho Nyung Lee, Satoshi Okamoto, Athena Sefa Sefat, and Don Spong.** We have seven new Fellows of the American Association for the Advancement of Science: **Brian Chakoumakos, David Dean, Baohua Gu, George Ostrouchov, Brian Sales, Tjerk Straatsma, and Brian Wirth.** **Jeff Chapman** was elected a Fellow of the Health Physics Society, joining health physics pioneer K.Z. Morgan in those ranks. **Alan Icenhour** and **Jess Gehin** have been elected Fellows of the American Nuclear Society. More recently, **Bob Jubin** was elected Fellow of the American Institute of Chemical Engineers and **Lonnie Love** has been elected to the SME College of Fellows. Five staff members have achieved Senior Member status of the Institute of Electrical and Electronics Engineers: **Chad Steed, Rajasekar Karthik, Dilip Patlolla, Olufemi Omitaomu, and Satyabrata Sen.** **Nicholas Peters** has achieved the Senior Member designation of the Optical Society of America. ORNL came away from R&D Magazine's ceremony with seven R&D 100 Awards and a Special Recognition Award. Next year's R&D 100 submissions process is already under way.



Science Culture Initiative. Throughout 2016, we have undertaken efforts to strengthen ORNL's science and innovation culture. Led by Deputy for Science & Technology Thomas Zacharia, the Science Culture initiative is now formally part of our FY17 Lab Agenda and includes four key elements: positioning the Laboratory's science and technology (S&T) core capabilities to address emerging challenges, emphasizing Lab-wide expectations for S&T productivity, providing staff with the resources needed to succeed, and ensuring that we recognize and reward staff members who achieve their goals. After consulting with the Corporate Fellows, Thomas has asked Associate Laboratory Director for Physical Sciences Michelle Buchanan to lead an effort to engage research group leaders in developing the strategies toward defining and attaining our science culture goals.

BSQs. The Big Science Questions program is closely associated with our drive toward a stronger culture of science at ORNL. A committee led by Clarina dela Cruz and Alan Tennant worked closely with Thomas Zacharia to identify grand S&T challenges for ORNL, with an emphasis on thinking beyond the immediate demands of our research. Five BSQs were selected from nine candidate proposals presented at a symposium in June and featured in a day-long symposium conducted in the JICS Lecture Hall. The five BSQ teams are Transforming the Development of the Nuclear Energy System, led by **Jess Gehin** and **Jeff Powers**; The Quantified Human, led by **Gina Tourassi** and **Arvind Ramanathan**; The Nitrogen Economy, led by **Brian Davison** and **Gabriel Veith**; Directed Matter, led by **Bobby Sumpter** and **Olga Ovchinnikova**; and Beyond Moore's Law, led by **Jeff Vetter**. In his keynote talk, Thomas Zacharia reminded us that forward thinking and creative ideas carry us through times of change.

Thomas Mason

Thom

ORNL earns seven R&D100 Awards (continued from page 6)

biological tissue, and produce results almost instantaneously.

Mass spectrometers modified with these new sampling interfaces combine speed, ease of use, and high imaging resolution to serve as a valuable tool in materials science, biology, chemistry and more. This technology is licensed to SCIEX.

Waste Tire Derived Carbon was developed by a team of ORNL researchers led by Parans Paranthaman and the RJ Lee Group. ORNL material chemists devised a proprietary process for repurposing discarded car tires as a source of carbon powder, a sooty hydrocarbon byproduct that can be modified to incorporate into anodes of lithium-ion batteries. The recycled tires are shredded, cryogenically

pulverized to powder and soaked in sulfuric acid, then roasted in a furnace to recover the carbon composite powders with a yield of more than 50 percent of the original mass.

The team included Parans Paranthaman, Richard Lee (RJ Lee Group), Amit Naskar, Yunchao Li (UT), Kokouvi Akato (UT) and Alan Levine (RJ Lee Group).

ORNL also received a special recognition award from R&D Magazine for the Wireless Power Transfer Based Electric and Plug-In Vehicle Charging System, submitted by Toyota Motor Engineering & Manufacturing North America and co-developed by a team of ORNL researchers with support from Cisco Systems and the International Transportation Innovation

Center. The team developed the world's first 20-kilowatt wireless charging system for passenger cars and achieved 90 percent efficiency at three times the rate of the plug-in systems commonly used for electric vehicles today.

The high-power wireless charging system relies on a unique architecture that includes an ORNL-built inverter, isolation transformer, vehicle-side electronics and coupling technologies. The ORNL researchers on the development team were Steven Campbell, Paul Chambon, Madhu Chinthavali, Omer Onar, Burak Ozpineci, Larry Seiber, David Smith, Lixin Tang, Cliff White and Randy Wiles as well as retired staff members Curt Ayers, Chester Coomer and John Miller. —Sean Simoneau 🌱



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Vice commander at McGhee Tyson Air Base talks Air National Guard during ORNL Veterans Day program

ORNL's Veterans Day ceremony Nov. 11 was highlighted by a keynote address delivered by Col. Lee Harley, vice commander of the 134th Air Refueling Wing of the Tennessee Air National Guard at McGhee Tyson Air Base. Harley thanked ORNL's Global Security Directorate and other ORNL directorates in developing and testing technologies that have benefitted the military, noting that McGhee Tyson has had a strong working relationship with Oak Ridge over 74 years and one of the air base's missions is to provide security support to Oak Ridge. Harley also told the standing-room audience in the Conference Center the Tennessee Air National Guard not only provides air-refueling support to the U.S. military, but is also involved in defense support of civil authorities. This includes participation during the summer of 2016 in an exercise simulating a response to a seismic event in the New Madrid zone in West Tennessee – basically an earthquake. The Air National Guard partnered with about 150-plus state, local and federal agencies during the response exercise. Harley is pictured with ORNL retiree and World War II veteran Ernest Shepherd. (ORNL photo by Rachel Brooks) –Fred Strohl 



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