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Materials Physics and Applications

We develop new technologies that solve pressing national energy and security challenges

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

MPA Innovations win R&D 100 Awards

Clean-Energy Catalysts Without Precious Metals uses inexpensive, Earth-abundant and easily sourced precursor materials for the synthesis of electrocatalysts for hydrogen-based fuel cells. The fuel cells produce electrical energy and emit one byproduct: water. Conventional fuel cells rely on costly precious metal catalysts, such as platinum. The new precious-metal-free electrocatalysts generate performance approaching that of precious metal catalysts but at a fraction of the cost.

Los Alamos submitted the joint entry with Pajarito Powder, LLC based on technology that Pajarito Powder licensed from the Lab. **Piotr Zelenay led the Los Alamos team** of Hoon Taek Chung, Edward Holby and Ulises Martinez. Pajarito Powder collaborators include Barr Zulevi, Alia Lubers, Geoff McCool and Sam McKinney.

Zirconia Electrochemical Hydrogen Safety Sensor makes filling up hydrogen-fueled vehicles a lot safer. Hydrogen gas is highly flammable, colorless and odorless and propagates very quickly if released into the air. The Hydrogen Safety Sensor is made of safe, durable and long-lasting ceramic sensor elements of the type used in automotive oxygen sensor technology. The safety sensors can be placed anywhere in the hydrogen supply chain, from hydrogen production and distributions to a critical component of the hydrogen pump at a filling station to a functioning safety component of the consumer product itself.

Los Alamos submitted the Hydrogen Safety Sensor as a joint entry with Lawrence Livermore National Laboratory and Hydrogen Frontier, Inc. **Eric Brosha led the Los Alamos team** of Christopher Romero, Rangachary Mukundan and Cortney Kreller. Collaborators include Amanda Wu and Robert Glass of Lawrence Livermore National Laboratory and Daniel A. Poppe of Hydrogen Frontier, Inc.

MPA researchers are fellows of:

NEUTRON SCATTERING SOCIETY OF AMERICA
NSSA
1992

APS

ACS
Chemistry for Life®

The American Ceramic Society

ECS®

OSA®
The Optical Society

Science
AAAS

MRS Materials Research Society

Los Alamos
NATIONAL LABORATORY
EST. 1943

AIChE
The Global Home of Chemical Engineers

MPA's new APS Fellows

The criterion for election is exceptional contributions to the physics enterprise; e.g., outstanding physics research, important applications of physics, leadership in or service to physics, or significant contributions to physics education.

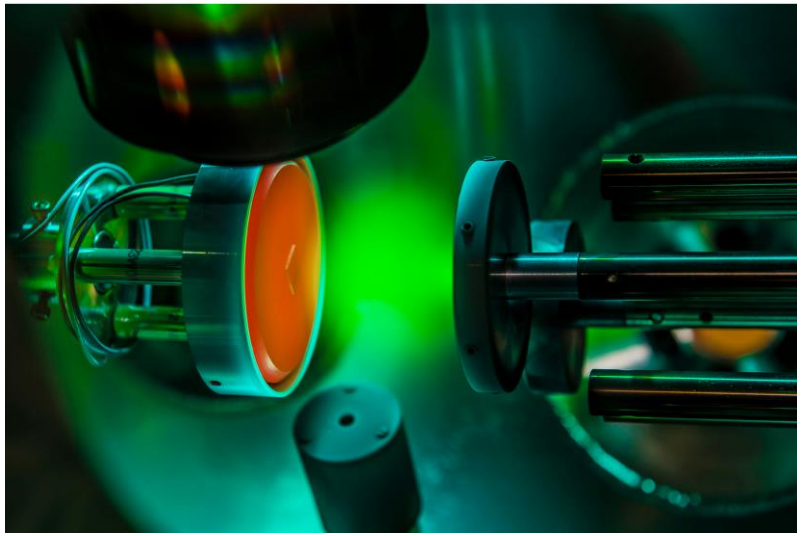
Han Htoon

Han Htoon, MPA-CINT, was nominated in the Division of Chemical Physics or pioneering accomplishments in development of single nanostructure, optical spectroscopy/imaging techniques, elucidating fundamental/quantum optical processes of quantum dots and single wall carbon nanotubes, and device integration of optical nanomaterials.

Vivien Zapf

Vivien Zapf, MPA-MAG, was nominated for seminal contributions to the understanding of quantum mechanical properties of superconductors, quantum magnets and multiferroic systems at low temperatures and in extreme magnetic fields to 100T. She was nominated in the APS Topical Group on Magnetism.

New CINT Capability: **Dual Laser PLD**



In this demonstration of CINT's new dual-pulsed laser deposition system, a green plume of plasma is ejected onto a square substrate, which is mounted to a non-braze heater of Dowden's invention. The system will advance research vital to the Lab's quest for controlled functionality by making thin films with finely controlled properties.

Contact Dowden at dowden@lanl.gov

Paul Dowden oversees all pulsed laser deposition (PLD) operations for MPA-CINT. He has recently designed and built an innovative system featuring dual-pulsed lasers and novel inventions that is exceptionally good at making thin films with finely controlled properties. Researchers and users can customize films using multiple targets, gases, wavelengths, laser pulse rates, and energies. Materials manufactured across multiple length scales are expected to have novel controlled chemical compositions and structures.

- A stabilized beamline. Patented in 2016, this piece was key to overcoming the drawbacks of the traditional single-lens focus for repeatable PLD film growth.
- An ultraclean heating device. This patent-pending device reaches 1000°C and operates without any braze materials, which are common in commercial products but can contaminate films.
- A one-of-a-kind dual laser system. Rather than one laser to deposit materials, this system employs two, each with different wavelengths. An excimer laser that grows matrices works in tandem with an ultrafast, tripled titanium sapphire laser that produces nanoparticles from metals to oxides and nitrides.

Vamshi Chillara

Postdoc Experimental Publication Prize

Contact Chillara at vchillara@lanl.gov

LANL's 2017 Postdoc Experimental Publication Prize was awarded to ***Vamshi Chillara***, MPA-11, for his paper entitled "Low Frequency Ultrasonic Bessel-Like Collimated Beam Generation From Radial Modes of Piezoelectric Transducers" published in ***Applied Physics Letters***. The paper presents a very novel and simple method to produce an ultrasonic "Bessel beam."

Waves having the form of a Bessel beams are important due to their very low divergence, which greatly extends the range over which they can be used as diagnostic probes. Previously, ultrasonic Bessel beams could only be created with complicated and expensive parametric arrays of electrodes on a piezoelectric disk.

MPA's Newest LANL Fellow

Stephen Doorn of the Laboratory's Center for Integrated Nanotechnologies (MPA-CINT) has been named one of the Laboratory's 2017 Fellows.

Doorn is a world leader in the field of carbon nanotube spectroscopy, establishing the first spectroscopic structure assignments that are universally used today and, more recently, pioneering the development of doped carbon nanotubes as tunable and bright quantum emitters in the near-infrared. In addition to authoring or co-authoring 130 publications with more than 6,500 citations, Doorn has also made important contributions to the leadership of nanoscience at Los Alamos and played a critical role as a mentor to young scientists.

Cortney Kreller garners Electrochemical Society's Wagner Award

Contact Kreller at ckreller@lanl.gov

Cortney Kreller, MPA-11, was granted The Electrochemical Society's High Temperature Materials (HTM) Division J. Bruce Wagner, Jr. Award. This award recognizes a young ECS member who has shown exceptional promise for a successful career in science or technology in the high temperature materials field.

Kreller's research interests include electrochemical sensors, electrosynthesis of fuels, intermediate temperature fuel cells, and the interplay of crystalline disorder and iconic transport.

Mohite Named 2017 Resonate Award Winner

Aditya Mohite, MPA-11, has been named a Resonate Award recipient for developing two-dimensional and thin-film materials for high-performance solar electricity generation. The goal of the awards is to shine a light on up-and-coming innovators under the age of 40 with new contributions to the field of sustainability science.

Mohite received the Resonate Award for developing two-dimensional and thin-film materials for high-performance solar electricity generation. He is the PI of the Light to Energy team and directs an energy and optoelectronic devices lab working on understanding and controlling charge and energy transfer processes occurring at interfaces created with organic and inorganic materials for thin-film clean energy technologies at LANL.

Contact Mohite at amohite@lanl.gov

Joe Thompson named IOP Reviewer of the Year

Contact Thompson at jdt@lanl.gov

IOP Publishing selected ***Joe Thompson*** (MPA-CMMS) for a 2016 Reviewer of the Year Award in recognition of his work assessing manuscripts for publication in ***Reports on Progress in Physics***. The publisher's selection is based on review quality, quantity, and timeliness for each of its affiliated journals.

Thompson is a fellow of the American Association for the Advancement of Science, American Physical Society, and Los Alamos National Laboratory. He received the 2014 Frank H. Spedding Award for outstanding contributions to the physics of f-element materials. Thompson is a member of the Institute for Scientific Information's inaugural group of the 250 most frequently cited physicists in the world and from 2012-2013 held the honorary title of Distinguished Visiting Chair Professor of Physics at Sungkyunkwan University, South Korea.

Baker garners fellowship and other awards

Andrew Baker, MPA-11, is the recipient of the Bill N. Baron Fellowship from the University of Delaware. Fellowship recipients must perform exceptional supervised research in engineering, science, or energy policy in the renewable energy field.

Baker works as part of the Fuel Cell Consortium for Performance and Durability project. Baker's role involves understanding mechanisms of cerium radical scavenger migration in order to enhance fuel cell durability and mitigate performance losses.

Baker won a 2017 Los Alamos Distinguished Student Award for his ability "to generate and execute a variety of research-related tasks, both inside and outside the laboratory setting, with very little oversight."

Additionally, at the 2015 Fuel Cell Seminar and Energy Expo in Los Angeles, Baker won a Best Poster Award for his research into cerium migration during PEM fuel cell operation and a second-place Bernard Baker Student Award for fuel cell research.

Contact Baker at baker@lanl.gov

Mukundan named Electrochemical Society Fellow

Rangachary (Mukund) Mukundan of MPA-11 was selected as a 2017 Electrochemical Society (ECS) Fellow. The distinction, granted to no more than 15 people annually, was established in 1989 to recognize advanced individual technological contributions in electrochemical and solid-state science and technology.

Mukundan's research focuses on fuel cells, electrochemical gas sensors, and energy storage devices. He is a steering committee member for the Department of Energy's Fuel Cell Consortium for Performance and Durability (FC-PAD), where he coordinates the thrust area Operando Evaluation—Benchmarking, Accelerated Stress Testing, and Contaminants. He is the co-inventor of six U.S. patents, has authored more than 125 papers, and is the principal investigator of a 2017 Los Alamos Laboratory-Directed Research and Development project titled "Flow Cells for Scalable Energy Conversion and Storage."

Contact Mukundan at mukundan@lanl.gov

Copp receives UC President's Postdoctoral Fellowship

Contact Copp at smcopp@lanl.gov

Stacy Copp (MPA-CINT) has been chosen for a University of California (UC) President's Postdoctoral Fellowship. The Fellowship was established in 1984 to encourage outstanding women and minority Ph.D. recipients to pursue academic careers at the University of California.

The program offers postdoctoral research fellowships, professional development, and faculty mentoring to outstanding scholars in all fields whose research, teaching, and service will contribute to diversity and equal opportunity at UC.

Copp completed her Ph.D. in physics at the University of California – Santa Barbara, studying the optical properties and nanoscale arrangement of DNA-stabilized silver clusters.

Mentoring Café Gives Students Taste of Science

Contact Crooker at crooker@lanl.gov

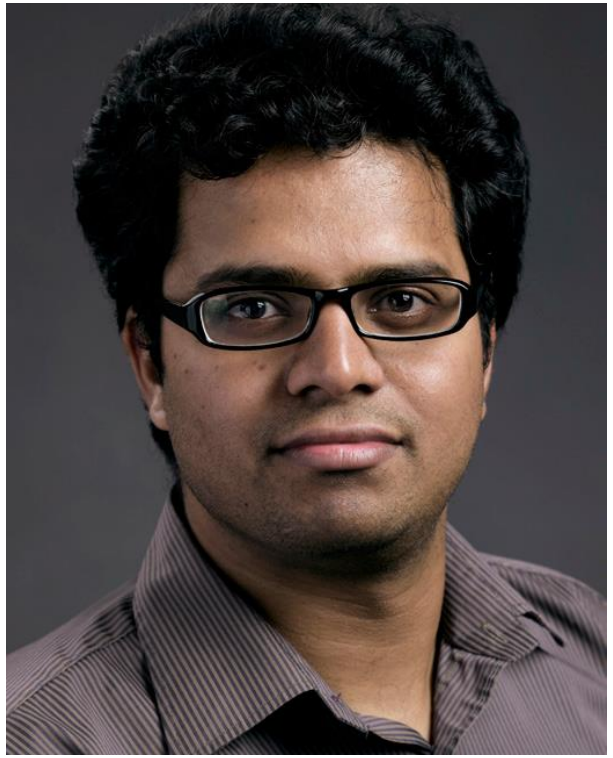
Scott Crooker from MPA's High Magnetic Field Laboratory demonstrates magnetic principles to students from Santa Fe Indian School at the recent STEM Mentoring Café at the Bradbury Science Museum. In this DOE initiative, middle schoolers try hands-on demonstrations, learn about how the scientists got their start, and find out what they are working on.

Thompson wins Postdoctoral Distinguished Mentor Award

Joe Thompson (MPA-CMMS) was nominated for being an example of leadership, kindness, and exceptional dedication to his postdocs. Over the last 40 years, his outstanding mentorship has guided 25 postdocs to successful careers. An exceptional role model due to his scientific integrity, hard work, broad technical knowledge, and ability to guide his mentees into becoming independent scientists, he is very generous with his time and knowledge makes himself available both to his direct mentees and other postdocs in the group, whether on Monday morning or Sunday afternoon.

Thompson also stands out for his effort on career development and personal well being of his postdocs. Quoting one of his postdocs “I would consider myself lucky if I become as successful as he is in guiding my future postdocs to successful careers in science.”

Chillara recognized for exceptional presentation



Contact Chillara at vchillara@lanl.gov

Vamshi Chillara's proposal to use ultrasound to power medical implants was recognized with the "Most Fundable" award among postdoctoral researchers at Los Alamos's third annual DisrupTECH event.

Chillara, MPA-11, holds a PhD in engineering science and mechanics from The Pennsylvania State University. His research broadly encompasses the development of ultrasonic sensors and sensing systems for structural, chemical, and biomedical applications; damage prognosis and health management; soft and smart sensing/actuation schemes; acoustic metamaterials and nonlinear phononics, and wave propagation in complex media. He is keen on applied research that enables technology transfer and product development. He is a member of MPA-11's Acoustics and Sensors team.

Pound receives Los Alamos Distinguished Student Prize

Contact Pound at bpound@lanl.gov

Benjamin Pound (MPA-CINT) is the recipient of a 2017 Los Alamos Distinguished Student Award. The annual awards, sponsored by the Student Programs Advisory Committee and the Student Program Office, recognize outstanding performance by Lab students.

Pound was nominated by his mentor Richard L. Sandberg who credited him with having “native curiosity about scientific and technical problems, the mathematical and physical intellectual depth, and the persistence and doggedness necessary to make him a first-rate experimentalist.”

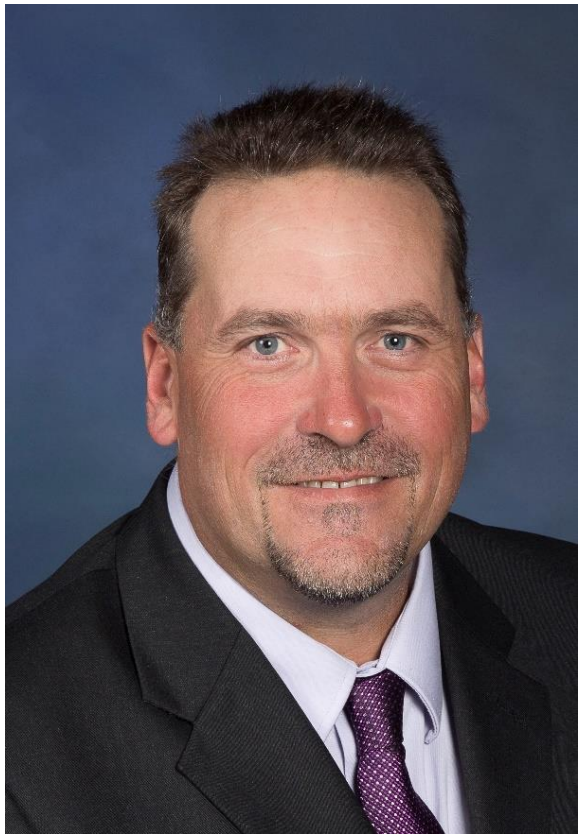
During his time in CINT, Pound has developed ptychography into a rapid nanometer-scale imaging technique at the Linac Coherent Light Source at SLAC National Laboratory, contributed to an Intelligence Advanced Research Projects Activity-funded imaging project, and aided development of x-ray lensless imaging microscopes using coherent diffractive imaging.

Ramshaw selected for Lee Oscheroff Richardson Prize

Oxford Instruments has chosen ***Brad Ramshaw*** (formerly of MPA-CMMS and currently at Cornell University) to receive the 2017 Lee Oscheroff Richardson Science Prize. The honor recognized him “for his outstanding contributions to the exploration of correlated electron systems in extreme magnetic fields.”

Oxford Instruments presents the award annually to young scientists conducting low temperature, high magnetic field, or surface science research in North and South America. A committee of leading physicists from North and South America selected Ramshaw, who will be recognized during a special event by the United Kingdom manufacturing and research company at the American Physical Society (APS) March Meeting.

NNSA Defense Program Awards of Excellence Presented



Jon Rau (MPA-11) is part of the ALT 940 Design Team led by Larry Brooks (Q-15) that won an award of excellence for an innovative approach for the ALT 940 Integrated Surety Architecture. The design reached an advanced stage in a matter of months, including prototype demonstrators, a detailed qualification plan, a product maturation plan, and a budgetary cost estimate.

Contact Rau at jrau@lanl.gov

Lashley appointed to Physical Review Materials Editorial Board

Physical Review Materials has chosen ***Jason Lashley***, MPA-11, to serve as an associate managing editor on the editorial board. The broad-scope international journal was launched recently for the growing multidisciplinary community engaged in materials research. Published by the American Physical Society, it is part of the ***Physical Review*** family of journals.

Lashley will referee articles that are at the intersection of physics and chemistry. The journal selected him for his broad scientific background, which ranges from condensed matter physics to synthetic organic chemistry.

Contact Lashley at j.lash@lanl.gov