MSTe NEWS

Summer 2020

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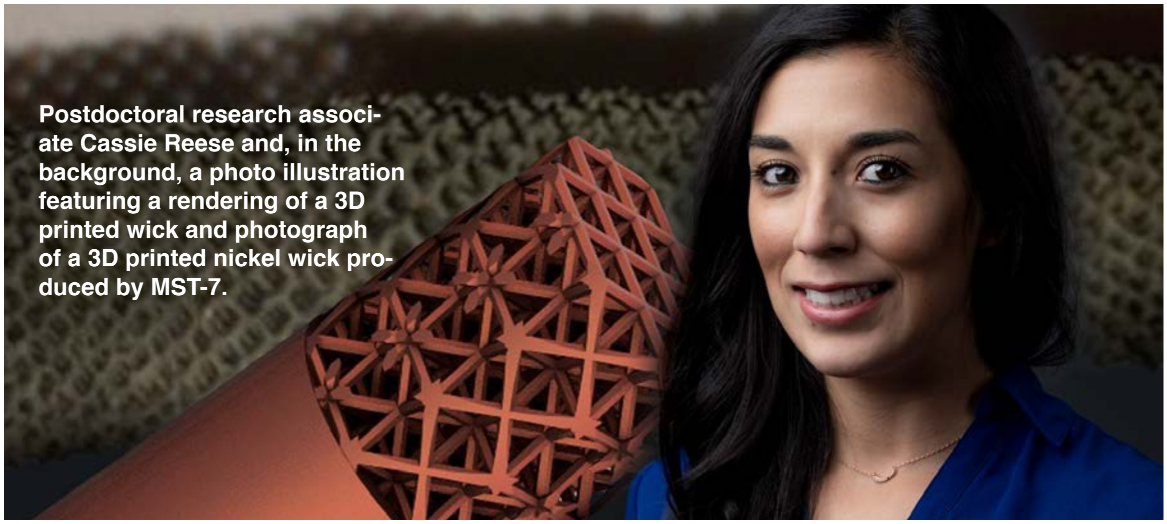
INSIDE



Postdoctoral research associate Cassie Reese and, in the background, a photo illustration featuring a rendering of a 3D printed wick and photograph of a 3D printed nickel wick produced by MST-7.

Leading by example

Cassie Reese to participate in ACS leadership development program

Cassie Reese is putting into practice her advice that anyone considering a postdoctoral position at the Lab should "do something different than your graduate work and network as much as possible!"

"I think it's important to expand your skills and don't be afraid to do something different," she said.

Reese, a postdoctoral research associate in Engineered Materials (MST-7) has been named to the 2020 class of CAS Future Leaders, a distinction awarded by the American Chemical Society (ACS). Selected from among hundreds of applicants, she is 1 of 30 PhD early-career scientists from 18 countries that will participate in the program aimed at developing emerging leaders.

"I'm very excited for this once in a lifetime opportunity to engage in network opportunities with young professionals and renowned leaders from all over the world and to learn versatile tools to become an impactful leader in science," Reese said. "Beyond learning leadership skills, I'm looking forward to creating strong friendships and close connections with other CAS future leaders."

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As part of the class, she will visit the ACS's Chemical Abstract Service (CAS) headquarters in Columbus, Ohio, to participate in a week-long program, with the opportunity to collaborate and network with peer scientists and academic and industrial leaders. She will also attend the society's national meeting in August.

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"I want to thank all of you for your patience in adjusting to our new normal and for your hard work as well as re-sourcefulness when it comes to meeting deliverables and maintaining a high standard of excellence in both what we do and how we do it."

From Ellen's desk . . .

Dear all,

I have been back in MST for nearly a year. While the time has gone by quickly, it amazes me to think about how much has been accomplished, even in spite of some significant hurdles—COVID-19 standing out amongst them. I think it is likely worth reflecting on some of that hard work and also sharing with all of you what is keeping the management team most busy.

When I first returned to MST, a number of oxygen alarm events across the Lab led to a work pause and an extent-of-condition for oxygen alarm response. So, while I was actively becoming reacquainted with MST's work and learning a new job, I also got to tour many of our spaces. I know each of the groups has worked hard to respond to the evolving guidance and corrective action planning due to the findings of the extent-of-condition. I believe that the work has heightened awareness for oxygen deficient atmospheres and the appropriate response. I also believe that it has caused us to be much more thoughtful with regard to mitigating the hazard. As we continue to work through corrective actions (Phase 1 is due August 11), I ask you to continue your questioning attitude and continue to learn how we can improve in this area of safety.

In November, I was officially named division leader and that made December and January busy months as I became better acquainted with some of our non-weapons stakeholders. After two years in the Weapons Program, I needed this crash course. Working closely with MST's leaders in applied energy programs, I traveled to Washington, DC, and Idaho National Laboratory and took part in two national workshops to enhance long-standing relationships with our trusted partners in Nuclear Energy and Fossil Energy programs. I am impressed by our work and leadership in this programmatic area and am even more excited to engage across the Lab as we work toward item 2.5 on the Laboratory Agenda: Develop and implement an integrated nuclear energy and materials initiative.

In February the MST management team kicked off strategic planning for the division. Your group offices have been working hard to set operational and technical directions for your groups. We are now working to roll that up into a document at the division level that is informed by our stakeholders and helps to set future investments and hiring plans. This has already motivated planning for significant infrastructure investment in the TFF and has led to some deeper partnerships with ALDWP to understand how best to support the 30 pits per year mission.

March was originally supposed to be a month dedicated to readiness for the 2020 Materials Capability Review—our first under Triad. Instead the month was a blend of that readiness and transition to a new normal as we adjusted to the challenges of COVID-19. Additionally, the division office staffing changed with Dianne Wilburn taking a position in STO-FOD and Phil Tubesing joining us as acting deputy division leader while Jon Bridgewater serves as acting division leader for Sigma. Since then, I have been gratified to see the division adjust to a work-from-home posture and then respond by learning how to mitigate for the COVID hazard. As of last week, we have 136 activities approved for limited resumption, 12 activities already closed out, and 20 more under review! This has been an outstanding amount of work from all of you that has also guided the ALD's thoughts on how we move to resuming work in a more holistic approach rather than activity by activity.

What is even more remarkable are the accomplishments by all of you during this period. I would like to celebrate a few:

- We have been able to meet important subcritical experiment and surveillance deliverables at TA-55.
- A successful proposal review cycle for the upcoming beamtime at Lujan has been finalized.
- In spite of COVID, we are ahead of schedule in target fabrication for NIF and Omega.
- We have watched our staff be recognized with numerous external awards.
- I am expecting this to be a very good year for MST's publication record.
- Excitingly, a new and rather large program for fuels development with NASA has been ushered into the division.
- We are preparing to declare success on PEI at TA-55.
- Last week, we saw the announcement that MST has leadership roles in three new start LDRD DRs and one new start LDRD ER.

So, as we look forward to the next few months, I expect there will continue to be many new hurdles for us while accomplishing our missions. I want to thank all of you for your patience in adjusting to our new normal and for your hard work as well as resourcefulness when it comes to meeting deliverables and maintaining a high standard of excellence in both what we do and how we do it. And while I miss seeing everyone on campus—I do want to be sure to encourage that all work that can be done from home is done from home. In doing so, you are keeping those that have to be on campus safer and this enables a broader range of our commitments to be met.

Ellen
MST Division Leader

Leading cont.

On MST-7's materials development team Reese uses digital light processing printing, a form of 3D printing, to design a variety of complex, functional materials. "In graduate school my work was very fundamental basic research, so being able to 3D print materials that have an end-use is really exciting," she said.

With mentors Matthew Lee and Kyle Cluff (both MST-7), and Nicholas Parra-Vasquez (Physical Chemistry and Applied Spectroscopy, C-PCS), Reese is developing a to-be patented 3D printing process for heat transfer applications. Her research interests include 3D printing/additive manufacturing, organic and polymer synthesis, surface chemistry, and lean six sigma design of experiments.

As part of her LANL postdoc experience Reese said she is enjoying "the unlimited resources that are available" and appreciates the opportunity to work "with very supportive and intelligent people who are always willing to help out." She credits the Los Alamos Postdoc Association with doing "a great job at having multiple career development opportunities" and is excited to participate in the Science in "3" event, "since I think it's a great experience practicing how to explain your research to a general audience in a few minutes," she said.

Reese received her PhD in polymer science and engineering from the University of Southern Mississippi (USM), investigating the design and synthesis of functional polymeric materials. In graduate school she took part in the National Science Foundation Research Traineeship program and volunteered as president and vice president of the USM Women in Science and Engineering program and president and vice president of the USM student chapters of the ACS divisions of Polymer Chemistry and Polymeric Materials: Science and Engineering. ■

Wang, Hattar edit issue on helium effects on materials in extreme environments

Yongqiang Wang (Materials Science in Radiation and Dynamics Extremes, MST-8) collaborated with Khalid Hattar (Sandia National Laboratories, SNL) to produce a special issue of *Materials,* which focuses on the effect of helium on materials in irradiation environments. Understanding radiation damage effects in materials is central to the Laboratory's mission to develop energy security solutions. The researchers were chosen as guest editors because of their extensive experience in radiation damage, ion-solid interactions, in situ characterization, and nanomechanics.

In "Radiation damage in materials—helium effects," Wang and Hattar describe how despite the scarcity of helium on earth, its effects on microstructure evolution and thermomechanical properties have a significant impact on the operation and lifetime of applications. These can range from alpha emissions in actinides and helium precipitation in tritium-containing materials to advanced structural steels in fast fission reactors and plasma-facing and structural materials in fusion devices. The issue included 13 articles, 6 of which are either led by or with contributions from Los Alamos researchers, on new irradiation material research activities and novel material ideas using experimental or modeling approaches.

Los Alamos researchers contributed the following articles.

- "The role of helium on ejecta production in copper," by Saryu Fensin, David Jones, Daniel Martinez, Calvin Lear (MST-8); and Jeremy Payton (Neutron Science and Technology, P-23)
- "In situ helium implantation and TEM investigation of radiation tolerance to helium bubble damage in equiaxed nanocrystalline tungsten and ultrafine tungsten-TiC alloy," by Osman El-Atwani, Kaan Unal, Saryu Fensin, Stuart Maloy (MST-8); William Streit Cunningham (Stony Brook University); and Jonathan Hinks, Graeme Greaves (University of Huddersfield)
- "An overview of recent standard and accelerated molecular dynamics simulations of helium behavior in tungsten," by Luis Sandoval, Danny Perez, Arthur F. Voter (Physics and Chemistry of Materials, T-1); and Blas P. Uberuaga (MST-8)
- "Effect of helium on dispersoid evolution under self-ion irradiation in a dual-phase 12Cr oxide-dispersion-strengthened alloy," by Hyosim Kim (MST-8); Jonathan G. Gigax (Center for Integrated Nanotechnologies, MPA-CINT); Tianyao Wang, Frank A. Garner, Lin Shao (Texas A&M University); and Shigeharu Ukai (Hokkaido University)
- "Swelling and helium bubble morphology in a cryogenically treated FeCrNi alloy with martensitic transformation and reversion after helium implantation," by Di Chen, Yongqiang Wang (MST-8); Feifei Zhang, Lumin Wang (University of Michigan); Lynn Boatner (Oak Ridge National Laboratory); and Yanwen Zhang (University of Tennessee)
- "Investigating helium bubble nucleation and growth through simultaneous in situ cryogenic, ion implantation, and environmental transmission electron microscopy," by Caitlin A. Taylor (formerly SNL, now MST-8); Samuel Briggs, Anthony Monterrosa, Joshua D. Sugar, David B. Robinson, Khalid Hattar (SNL); and Emily Aradi, Graeme Greaves, Jonathan A. Hinks (University of Huddersfield)

Reference: "Radiation damage in materials—helium effects," *Materials* 13 (9), (2020). ■

Technical contact: Yongqiang Wang

New capabilities for pit surveillance

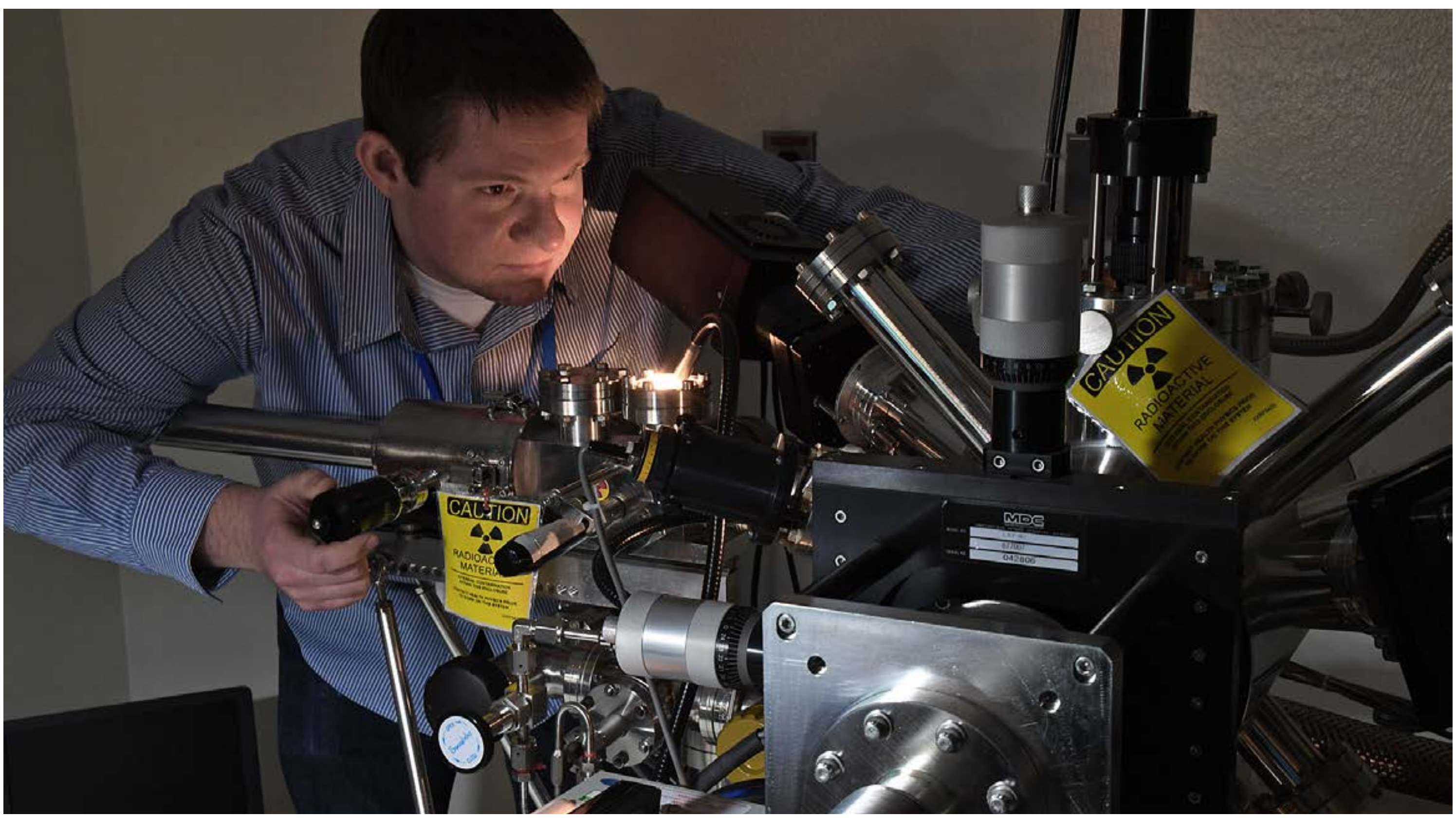
The plutonium surface science laboratory (PuSSL) in the Target Fabrication Facility (TFF) is providing new and expanded resources in support of the Laboratory's stockpile stewardship mission. Nuclear Materials Science (MST-16) researchers are supporting the Pit Surveillance program with spectroscopy and microscopy performed in the TFF. This work complements and provides depth to capabilities at TA-55 within the Lab's Plutonium Facility (PF-4) and is a direct step to having additional capabilities that will support the Plutonium Sustainment program as well, particularly pit manufacturing and the Lab's 30 pits per year mission.

The LANL Pit Surveillance program relies on a suite of destructive and non-destructive analytical techniques to assess the condition of pits with respect to their design specifications and to ensure the safety and reliability of pits within the nation's stockpile. The results of these studies are key to LANL's mission in assessing the current stockpile and important to LANL's pit manufacturing, plutonium aging, and fundamental plutonium science missions.

To execute this work, researchers use a highly adaptable, multi-technique system: the Physical Electrons VersaProbe III (VP3). This new, state-of-the-art instrument was acquired with support from the Plutonium Sustainment program and the first plutonium sample was introduced in October of 2017. Its "combination of spectroscopy—to identify elements and bonding configurations—coupled with microscopy—to identify surface morphology—provides a unique plutonium surface science capability," said MST-16 Acting Deputy Group Leader Alison Pugmire. Additional techniques that are available if desired in the future include time of flight secondary ion mass spectroscopy (ToF-SIMS), infrared spectroscopy, atomic force microscopy, ellipsometry, and profilometry.

These techniques complement the suite of tools available in PF-4 and have provided answers to questions vital to the Pit Surveillance program. Results provided to the program have led to key milestones and deliverables and serve as a great example of LANL's increased agility in standing up new capabilities supporting LANL's mission.

Technical contact: Alison Pugmire ■



Dan Olive (MST-16) uses a spectroscopic ellipsometer in the plutonium surface science laboratory to examine the surface of plutonium metal.

Simple hydrogen approach offers new opportunities to develop Ga_2O_3 as a material for bipolar transistors

With this change, Ga_2O_3 has improved potential for use in power electronics, with reduced energy consumption and cost

In research published in *Nature Scientific Reports*, scientists in Materials Science in Radiation and Dynamics Extremes (MST-8) and their colleagues at Bowling Green State University, with other partners in the United States and Germany demonstrate for the first-time p-type conductivity in Ga_2O_3 as well as increases in the n-type conductivity. With this change, Ga_2O_3 has improved potential for use in power electronics, with reduced energy consumption and cost.

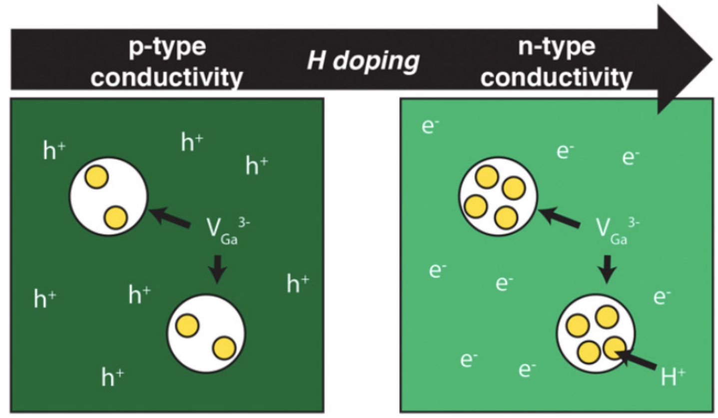
This is accomplished by changing the amount of hydrogen that is introduced into the material. By doing so, the team demonstrated they can shift not only the magnitude of the conductivity, but its very nature. With just a little hydrogen, the material is p-type, but adding more leads to n-type conductivity.

These results provide new opportunities to develop Ga_2O_3 as a material for bipolar transistors. This simple hydrogen approach could also provide a promising technology for developing other semiconductor materials.

Bipolar transistors are semiconducting devices that combine an n-type semiconductor (governed by electrons) and a p-type semiconductor (governed by holes or missing electrons) to create a junction where the current can be easily controlled via a small control current, enabling amplifiers and switches and other electronic components such as LEDs.

To create the two different regions, typically two different materials are combined to create these devices. However, using a single material opens up many opportunities and that is precisely what is done with silicon through various types of doping. If the same could be achieved with a wide-bandgap material such as Ga_2O_3, whole new types of high-power devices could be developed. This is because materials such as Ga_2O_3 don't lose as much energy when they are used in devices, making those devices much more durable and efficient.

As a result, Ga_2O_3 is being studied world-wide as a high-power device material that would transform power electronics, leading to drastic decreases in the energy consumption, cost, and size and weight of everyday devices. The problem is that no one has been able to make Ga_2O_3 a p-type conductor, said Blas Uberuaga, who leads FUTURE (Fundamental Understanding of Transport Under Reactor Extremes), an Energy Frontier Research Center funded by the DOE Office of Science. FUTURE supported the Los Alamos portion of the work.



New work from Los Alamos National Laboratory, Bowling Green State University, and other international partners using hydrogen to improve the potential of gallium oxide as a high-power device material would transform power electronics, leading to drastic decreases in the energy consumption, cost, and size and weight of everyday devices.

The work supports the Lab's Energy Security mission area and Materials for the Future science pillar.

Reference: "Chemical manipulation of hydrogen induced high p-type and n-type conductivity in Ga_2O_3," *Nature Scientific Reports* 10 (2020).

Researchers: Md Minhazul Islam, David Winarski, and Farida A. Selim (Bowling Green State University); Maciej Oskar Liedke, Maik Butterling, and Andreas Wagner (Helmholtz-Center Dresden-Rossendorf, Germany); Peter Hosemann (University of California, Berkeley); Yongqiang Wang and Blas Uberuaga (Materials Science in Radiation and Dynamics Extremes, MST-8).

Technical contact: Blas Uberuaga ■

Heads UP!

Using 5S + Safety gives SEM lab a new image

The scanning electron microscopy lab in Materials Synthesis and Integrated Devices (MPA-11) is a focal point of activity. Users from across the institution rely on the sophisticated equipment to crisply image materials as small as a few hundred nanometers—materials essential to the Lab's national security science mission.

Until recently, the lab was also a focal point for clutter. Facing overflowing file drawers, cabinets stuffed with dusty manuals, and disordered and outdated tools, Eric Brosha realized he had an ideal test subject for which to apply the 5S + Safety method.

Having recently completed 5S + Safety training, the MPA-11 materials chemist applied the straightforward approach for implementing order in the workplace. In each of the 5S steps, the primary focus is always safety. Brosha's goal was to make the space more efficient for users. "Sorting," he removed papers and equipment that were obsolete. "Setting in order," he procured storage bins and used them to organize equipment and accessories. He ordered new tools so users would no longer have to hunt them down outside the lab. "Shining," he cleaned the remaining equipment. "Standardizing," he now allows only up-to-date manuals and gear to occupy shelves. "Sustaining" this newly organized order, Brosha regularly patrols the area. He is planning to label all drawers and bins so users can conveniently return equipment and manuals to their proper storage spaces.

Brosha, who received immediate positive feedback from users who can now easily find what they need, said maintaining the 5S + Safety method requires a shift in mind-set, one that relies on taking ownership of the space. "5S is just a very good philosophy. Even if you will work there just three years, it's your lab," he said, referring to the postdoctoral researchers who frequently use the lab for their work. He said he encourages users to ask themselves, "Don't you want the lab to work well for you?"

To learn how you can apply the 5S + Safety method to your space, contact ALDPS 5S + Safety Champions Christie Davis (Sigma Division, Sigma-DO) and Jacki Mang (LANSCE Facility Operations, LANSCE-FO) and check out the 5S +Safety website via the ALDPS internal site for more information. ■

Celebrating Service

Angela Martinez, MST-8 .... 15 years
Daniel Martinez, MST-8 .... 15 years
Michael Cooper, MST-8 .... 5 years
Austin Goodbody, MST-16 .... 5 years

Left: Before receiving the 5S + Safety treatment the SEM lab housed clutter dating back 25 years.

Now, the lab is tidy and in order. Above: the entryway is clear of clutter and the cabinet stores only relevant materials. Left: tool drawers are organized for ease of use. Below: the SEM is ready for users.

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To submit news items or for more information, contact Karen Kippen, ALDPS Communications, at 505-606-1822 or aldps-comm@lanl.gov.

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