LA-UR-22-24105

Approved for public release; distribution is unlimited.

Title:	MST e-News Spring 2022
Author(s):	Kippen, Karen Elizabeth
Intended for:	Newsletter Web
Issued:	2022-05-03

MST e NEWS

Spring 2022

INSIDE

Jeremy Mitchell is shown outside the Radiological Laboratory Utility Office Building, where he performs some of his research.

Jeremy Mitchell

Rock hound turned plutonium sleuth

> "I have had incredible opportunities to build exciting and important projects with many colleagues ... "

For Jeremy Mitchell, a scientific career grounded in a passion for geology has morphed into a decades-long fascination with plutonium.

Just as a geologist investigates a rock's structure and its history to unlock its secrets, so too does Mitchell gather facts and weigh evidence to crack the code of a material not readily accessible to most scientists—and at the core of the Lab's national security mission.

Mitchell joined the Lab as a postdoctoral researcher intrigued by the prospect of applying his knowledge to studying radiation effects in minerals. Then, his work aimed to identify new synthetic ceramics for potential applications in nuclear reactors.

Today, Mitchell's research furthers understanding of the fundamental aspects of plutonium metallurgy. His work, as a member of the Nuclear Materials Science (MST-16) Materials Properties Team, is essential to improving the critical manufacturing processes needed to successfully execute the Lab's 30 pits-per-year mission.

"The opportunities for career exploration are incredible at LANL," said Mitchell, who has served in numerous plutonium science and capability leadership roles. "I've had the chance to

continued on page 3 ▶

Los Alamos NATIONAL LABORATORY

From Ellen's desk . . .

Dear MST,

I know that so many of you have been working very hard, under conditions which can be stressful. So in this letter from my desk, I want to take the time to focus on a few of the recent accomplishments within the division, which at least for me, make the hard work seem worth it. As you know, as a division, we have been strategically working toward building capability and facilities to support materials needs in the future, partnering with our support organizations to enable more agile work, and growing program in places of strategic importance in the Laboratory Agenda. In what follows, I want to point to specific successes in these areas.

"Please join me in celebrating these achievements and please keep the Division Office up to date on your successes so that I can celebrate those in future highlights and newsletters."

Program growth in support of Lab mission

• Paul Peterson in MST-7 has been funded for a few years by DTRA to develop shuttles for therapeutic delivery across the blood-brain barrier and the success of his work has just been recognized in two important ways. He has been awarded a second DTRA project to expand his research and he has been asked to serve on the NNSA subcommittee for bioassurance, where his job will be to identify core agenda issues for the DOE.

• Kim DeFriend in MST-7 has been successfully partnering with Q Division on a series of workshops with designers, materials scientists, and the production agency (Kansas City) to enable readiness for multiple materials options to be advanced for future systems. MST-7, MST-16, Sigma-1, E-1, Q-5, and Q-18 are working closely together to examine development of new materials and new processing techniques for traditional materials for the future stockpile. Her efforts have already led to fruitful discussions that are accelerating the advancement of a number of materials options through the TRL schedule. These achievements will be highlights at the upcoming Weapons Capability Review in May and the Director's assessment in June.

Building capability

• In MST-8, as an important part of the DOE Basic Energy Sciences FUTURE Energy Frontier Research Center, Blas Uberuaga (FUTURE center lead) and Yong Wang (Ion Beam Lab director) have partnered with Bowling Green University to build a positron annihilation spectrometer at the Ion Beam Materials Laboratory in MST. This unique capability enables nondestructive examination of damage as a material is being irradiated, providing direct quantification of the transient defects that drive mass transport in harsh environments. This past month, their hard work to build this capability was realized with the insertion of the ^{22}Na source into this spectrometer. This is a big achievement for this team and represents an important partnership with the isotope production staff at TA-53 to load the source.

• Also in MST-8, construction (or perhaps I should say, the needed demolition to enable construction) has begun at TA-35 for the Low Enriched Fuel Fabrication Facility. This facility will enable pilot-scale fuel production for demonstration and prototype reactor designs. Tim Coons, Ken McClellan, and Tarik Saleh (long-standing leaders within LANL'S DOE Nuclear Energy Program) have partnered with Capital Projects to first, obtain Congressional approval for this facility, and then design it. It is slated to be complete in April 2023 and will expand the pilot-scale materials production capability that MST already possesses for soft materials (primarily in MST-7) to now be inclusive of pilot-scale production of actinide materials. It will also leverage MST's long-standing excellence in actinide conduct of operations in MST-16 to ensure we are the right organization to do this work.

• For the last year, MST-16 has been steadily working toward obtaining Hazard Category 3 operations in its new Plutonium Science Facility in the RLUOB, and with the Federal Operational Readiness Review underway this milestone is within sight. Recently, Terry Holesinger (team leader in MST-16) and the greater TA-55 family, had a big achievement in that the first Pu work was performed on the new FIB installed within the RLUOB. This is an advanced characterization capability to support both surveillance and modernization missions at LANL and a necessary capability for a Pu Center of Excellence. Adding to the excitement, MST recently has been successful in obtaining funding from Pu Modernization for a new TEM in the MSL to enable training and non-actinide work in support of the production mission. Note, this will be a widely available capability as Modernization has chosen to situate it within the EML user facility in the MSL. Stay tuned for updates regarding this important investment.

continued on page 5

Mitchell cont.

work on applied and fundamental aspects of plutonium metallurgy, mixed-oxide fuel forms, the physics of plutonium compounds, and nuclear facility laboratory design and equipment installation—including the world-class actinide capabilities at the Lab's TA-55 area."

The materials scientist's inquisitive nature has enabled him to work alongside physicists, chemists, theorists, and metallurgists across the Laboratory who all share the same interest, something he described as "one of the best parts of my career."

"I have had incredible opportunities to build exciting and important projects with many colleagues, and these relationships are what keeps me here."

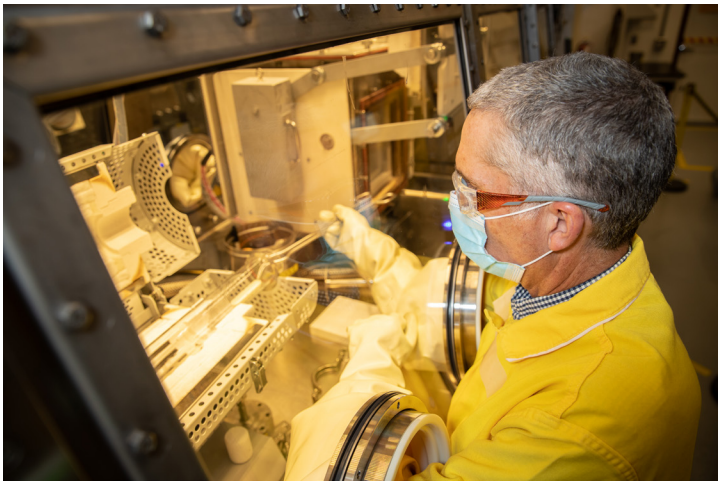
Unlocking plutonium's secrets

Mitchell's most exciting current project delves into a decades-old enigma: differences in the US and Russian plutonium-gallium phase diagrams. These charts, developed by US and Russian researchers independently following WWII, disagree regarding the stability of the delta-phase of this alloy.

Delta-phase plutonium is one of the most important materials for the nation's nuclear stockpile, yet fundamental aspects of its metallurgy and evolving properties with time are still poorly understood.

In this Laboratory-Directed Research and Development project, Mitchell and colleagues Eric Bauer (Quantum, MPA-Q) and Sarah Hernandez (MST-16) will probe the mechanisms and kinetics of delta-plutonium stabilization so these differences can be fully understood.

"Experimental reproduction of the Russian work eluded our scientific predecessors, including renowned LANL plutonium metallurgists Sig Hecker and Del Harbur," Mitchell said, "but we have new and unique tools that will provide different experimental and theoretical approaches."



Jeremy Mitchell loads a sample into one of the new glovebox plutonium furnaces in the Radiological Laboratory Utility Office Building.

Using these state-of-the-art tools, the team is generating data that will play a critical role in pushing the science of plutonium aging and manufacturing into the future. As well, the project provides opportunities for training early career staff to become the next generation of leaders in plutonium science.

"In addition to pushing new experimental frontiers in plutonium science, a key part of my work now is to educate our newer staff on the rich unclassified and classified historical plutonium database," Mitchell said. "Although we have amazing new research tools that couldn't be dreamed of 50 years ago, our predecessors had synthesis and processing resources that will probably never be replicated."

By Karen Kippen, ALDPS ■

Jeremy Mitchell's favorite experiment

What: Dilatometry is the tool I use to study phase stability and phase transformations in plutonium. Although this technique had been used previously, this was the first new plutonium dilatometer that LANL had purchased in several decades. My favorite experiment is the first time I observed in situ the cryogenic delta-to-alpha prime phase transformation.

Why: I was starting to study aging effects in plutonium, something I still do today, and was interested in how aging may impact this phase transformation.

When: February 13, 2001

Where: Wing 2 of the CMR Building

Who: I was alone.

How: I prepared a small sample of a Pu-Ga alloy in a glovebox. I then transferred it across the hall to an open-front radiological hood that housed the dilatometer, a configuration that is not possible now.

The "a-ha" moment: Up to this point, my work on phase transformations had been on rocks and minerals that had transformed at geological conditions over thousands to millions of years. The delta-to-alpha prime transformation is martensitic, so it happens in a matter of seconds to minutes, and watching it take place in a brand-new instrument that I had recently installed was incredibly exciting. I still get excited when doing similar experiments and make it a point to watch my samples transform whenever possible.

Cady recognized for professional society service

For his outstanding contributions to The Minerals, Metals & Materials Society (TMS) Carl Cady (Materials Science in Radiation and Dynamics Extremes, MST-8) is the recipient of its 2022 Alexander Scott Distinguished Service Award.

Named for the TMS executive director who served from 1973 to 2008, the annual award recognizes a member's devotion of time, effort, thought, and action to further TMS's mission through administrative and functional activities. TMS cited Cady for "dedicated and sustained service to TMS and its members, particularly to improvements in the quality of programming at TMS Annual Meetings and at Materials Science & Technology conferences."

He is also the recipient of TMS's Structural Materials Division Distinguished Service Award, for his "generosity, community focus, work ethic, and respect for others—all characteristics of spirit of service." For more than two decades, Cady has volunteered as both an active member and a dedicated leader on a variety of TMS committees and on the TMS Board of Directors. This includes his decade-long tenure on its Programming Committee, where, as TMS programming liaison to the Materials Science & Technology conference, he engaged with members of partner societies in organizing this wide-ranging international technical forum. He has also been a consistent advocate for member interests as changes in programming policy have been implemented.

Cady was also recently named to the TMS Foundation board of trustees. The foundation raises funds and administers grants, scholarships, and awards supporting the development of professionals in the field.

And it's not just to his professional duties that Cady is dedicated. In 2020, the New Mexico High School Coaches Association named Cady Coach of the Year for swimming and diving. Cady has coached the Los Alamos girls and boys teams for 20 years. He has also volunteered his time as association president at one of the town's community pools.

Cady earned a PhD in materials science and engineering from the University of California, Santa Barbara. He is a member of the MST-8 Dynamic and Quasi-Static Loading (Experimental) Team, where his research focuses on mechanical behavior of materials under extreme conditions.

Technical contact: Carl Cady ■

Developing innovative materials technology to advance state of the nation's stockpile

In support of the Lab's national security science mission, a multidisciplinary team of researchers in Engineered Materials (MST-7) is crafting novel materials synthesis and manufacturing technologies to enable novel weapons design and agile modernization of the nation's current and future nuclear stockpile.

In the past three years, MST-7's Advanced Materials and Processes Team has filed eight US patent applications on various materials advances and led several new research endeavors with collaborators across the Laboratory. These range from simple and scalable routes to porous silicone materials with controlled properties, to additively manufactured wicking materials for heat transfer applications, to novel scintillating composites and dissolvable ceramics for metal investment casting in complex architectures.

"As the US continues the transition into the era of 'great-power competition,' it is important for the nuclear security enterprise to rapidly respond to unforeseen threats and technical surprise," said Program Director Jon Rau (Engineering and Technology Maturation, ETM). "The discoveries made in Engineered Materials, specifically within the Advanced Materials and Processes Team, are important pieces of that puzzle. Proactively developing new, easily manufactured materials with tailored properties enables the rapid delivery of new capabilities to the warfighter, while ensuring the viability of the current deterrent," he said.

Much of this work has been facilitated by the team's leadership in Laboratory Directed Research and Development projects—both Exploratory Research and Mission Foundation endeavors. These include projects focused on engineering functionality and structural hierarchy in additively manufactured materials, integrating additive manufacturing and investment casting for complex metal architectures with predictable mechanics, and creating an acoustic-optical transducer.

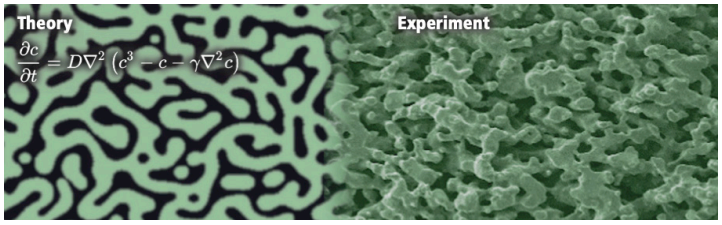
Capitalizing on the success of these fundamental science projects, the team has adapted these advances toward solving key technical problems for the weapons program at the Lab.

In their research, team members strive to adhere to Da Vinci's principle that "simplicity is the ultimate sophistication," according to Team Leader Matthew Lee (MST-7). "In my view, a simple solution to a complex problem compels the deepest possible understanding," Lee said. "This is especially true for our weapons materials research." For example, a new material or process must not only fulfill an array of technical requirements, but also be manufacturable, reproducible, and possess predictable longevity and compatibility.

To meet that goal, Lee calls on the multidisciplinary expertise of his team, which includes engineers, chemists, physicists, and polymer/materials scientists. "It's incredibly fulfilling to work alongside

continued on next page ▶

Developing innovative cont.



Left: Theoretical prediction of a porous foam material formed by a spinodal decomposition process. Right: Microscopy image of a silicone foam fabricated by the Advanced Materials and Processes Team in Engineered Materials.

such creative and passionate people in service to the nation," Lee said.

Members of the Advanced Materials and Processes Team include Diego Aubert-Vasquez, Kyle Cluff, Matthew Crall, Cordell Delzer, Alexander Gomez, Amanda Graff, Luke Kruse, Matthew Lee, Martin Oltmanns, Cameron Richards, Emily Tew, and Brenden Wiggins (all MST-7). The work supports the Lab's Stockpile Stewardship mission and Materials for the Future science pillar.

Technical contact: Matthew Lee ■

From Ellen's desk cont.

Partnering with our support organizations to enable more agile work

• In MST-16, the group came out of the PF-4-wide inventory three weeks early, enabling re-engagement in programmatic work that supports NNSA's 30 pits per year, Pu surveillance, and stockpile assessment missions—three weeks early! This was a success that was enabled not only by the hard work of MST-16 staff but through their partnerships with NMCA, RP, TA55-FOD, etc. It is truly a praiseworthy success and a demonstration that it is possible to have deliberate operations and be agile at the same time.

With these examples described here, please note this list is not inclusive of all of our achievements and it certainly does not reflect those in the pipeline about to happen, but I wanted to share—not just to celebrate these accomplishments—but also, to perhaps provide encouragement that the hard work is paying off and being recognized. Please join me in celebrating these achievements and please keep the Division Office up to date on your successes so that I can celebrate those in future highlights and newsletters.

Stay safe,
Ellen ■

Inclusivity tip

Did you know an estimated 300 million people are affected by some form of color blindness? You can make your presentations more accessible by including both different shapes as well as different colors in your charts/graphs.

HeadsUP!

Sandy Morello receives Laboratory WESST Star Award

Sandy Morello (Materials Science and Technology, MST-DO) received a Worker Environment, Safety, and Security Team (WESST) Star Award in recognition of her "outstanding involvement to organize, discuss, and solve problems with members—contributing to a more inclusive, safe, and engaging MST WESST." Star Awards recognize Lab staff who regularly put safety and security into everything they do.

Celebrating service

Congratulations to the following MST employees who recently celebrated service anniversaries.

Isaac Herrera, MST-7	25 years
Derek Schmidt, MST-7	20 years
Miles Beaux, MST-7	10 years
Kevin Love, MST-7	5 years
Kurt Sickafus, MST-8	25 years
David Andersson, MST-8	15 years
Erofili Kardoulaki, MST-8	5 years
Aaron Kohnert, MST-8	5 years
Michael Ramos	35 years
Scott Richmond MST-16	35 years
Georgette Maestas, MST-16	25 years
Joseph Reynolds, MST-16	20 years
Fritzgerald Sandoval, MST-16	20 years
Ryan Fulcher, MST-16	5 years
Matthew Janish, MST-16	5 years
Todd Martinez, MST-16	5 years
Michael Middlemas, MST-16	5 years
Mark Ortega, MST-16	5 years

MST e-NEWS

Published by the Physical Sciences Directorate.

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

For past issues, see www.lanl.gov/org/ddste/aldps/mst-e-news.php.

Los Alamos NATIONAL LABORATORY

NNSA National Nuclear Security Administration

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is managed by Triad National Security, LLC, for the National Nuclear Security Administration for the U.S. Department of Energy under contract 89233218CNA000001.