SANDIA LABNEWS
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SANDIA HELPS FIGHT COVID-19

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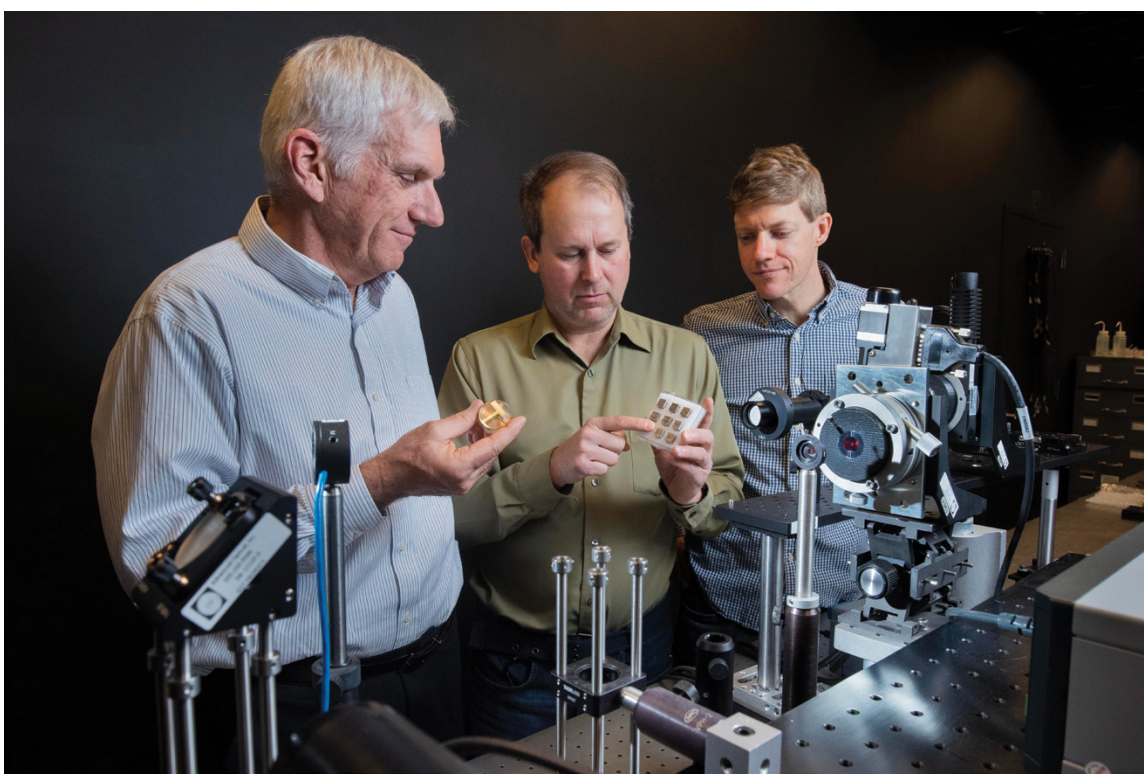
Titanium imaging advances

With help from Sandia, NM company cuts metals characterization from hours to minutes



TECHNICAL ASSISTANCE — From left, Sandia materials scientist Joe Michael worked with Advanced Optical Technologies scientist Brian Hoover and engineer Jonathan Turner through the New Mexico Small Business Assistance Program. The company developed a way to quickly characterize metals. **Photo by Randy Montoya**

By ***Manette Newbold Fisher***

When a small business needed help proving that its invention, a tabletop laser system, could characterize metals faster and more easily than current equipment, they turned to Sandia's expertise in metals characterization.

Sandia's testing verified that Albuquerque-based Advanced Optical Technologies' patented Crystallographic Polarization-Classification Imaging, or CPCI, process reduces time spent on characterization from hours to minutes. The new imaging process has applications in the aerospace, automotive, energy and medical industries and for 3D printing.

Sandia and Advanced Optical Technologies were matched through the New Mexico Small Business Assistance program, which offers expertise to help solve technical challenges faced by small companies in New Mexico. This includes projects that require testing, design consultation or access to special equipment or facilities that are not available to small businesses.

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Battling COVID-19 with CRISPR

Sandia scientists race to find deployable antiviral countermeasure

By ***Michael Ellis Langley***

Two Sandia researchers are using genetic resequencing tools to find a way to stop the COVID-19 pandemic in its tracks.

Biochemist Joe Schoeniger and virologist Oscar Negrete are working on genetically engineering a deployable antiviral countermeasure for COVID-19 using CRISPR-based technology.

"The goal is to find new 'reloadable' countermeasures for viral outbreaks that do not have to be re-invented every time," Joe said. "CRISPR is a technology which allows us to address specific sequences of DNA and RNA, safely editing genes or controlling gene expression, to target viruses and improve the body's ability to resist infection."

Once their research is complete, the antiviral will be customizable to respond to many different viruses, including coronavirus.

"We are developing safe CRISPR-based technologies that send temporary reprogramming codes to your body that will inhibit virus infection," Oscar said. "We're also developing nanoparticle delivery systems to protect the CRISPR constructs until they get to the right cells and tissues to modulate the body's response."

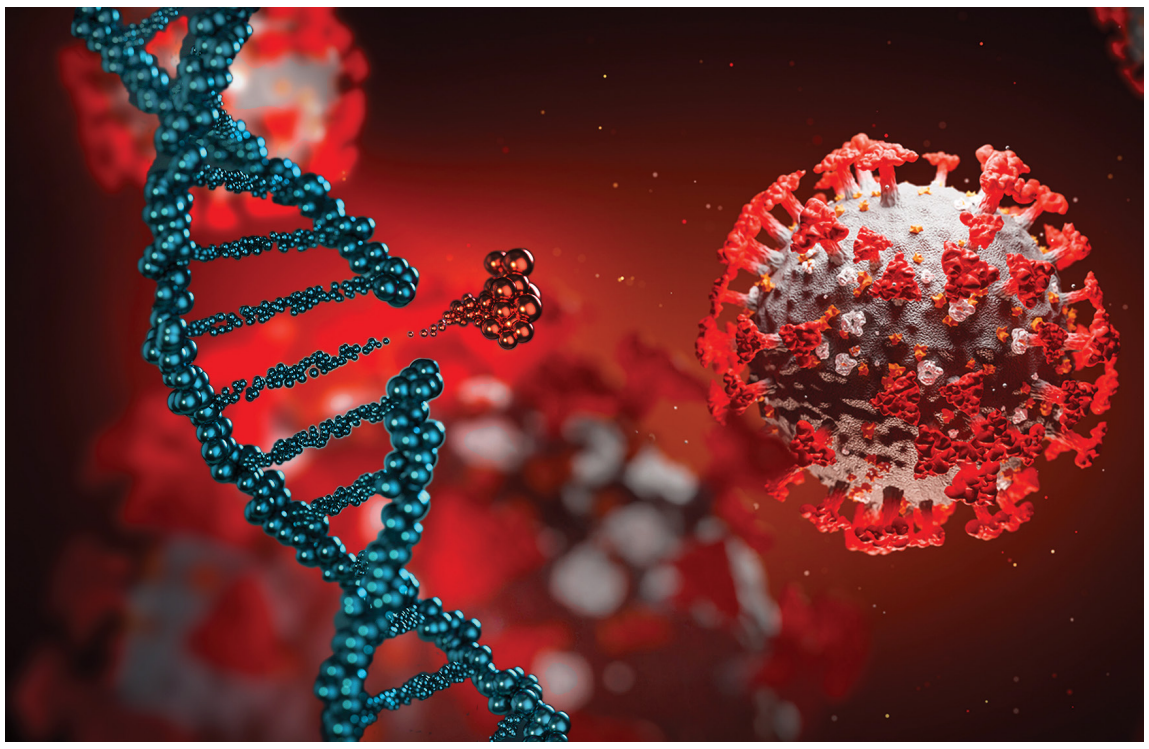
This CRISPR-based research is funded by the Biological Technologies Office at the Defense Advanced Research Projects Agency.

Not just a health problem

"I think this current pandemic shows that we have a vulnerability to this and that this is more than a health problem. It is a national security problem," Joe said. "Coronavirus was already on our radar. When the new strain called SARS-CoV-2 emerged and it was clear this was not a local problem in China, we started to pivot to that research pretty early. We've added on more institutional work since then."

The team is conducting proof-of-concept trials now, after which other institutions involved in the research will conduct animal testing of the modified genes. Joe said the work will continue even if this outbreak is controlled.

"There's a long tail that's going to be around for a while," he said. "Things can happen during that tail that we can't know. We want to help reinforce that response to not only a new outbreak of COVID-19, but outbreaks of all kinds."



BREAKING THE CHAIN — Sandia biochemist Joe Schoeniger and virologist Oscar Negrete are conducting research using CRISPR-based technology to genetically engineer a deployable antiviral countermeasure for COVID-19. Their goal is to create an antiviral that will be customizable to respond to many different viruses, including coronavirus. **Image by Loren Stacks**

LABNEWS Notes

Walk MS: 2020 goes virtual

Sandians participate in annual fundraiser to support multiple sclerosis research

By **Stephanie Holinka**

Abilities Champions of Sandia, formerly the Disability Awareness Committee, organized Labs workforce members to participate virtually in Walk MS: 2020 at both the Livermore, California, and Albuquerque, New Mexico, sites.

The Sandia teams **Walk MS: Sandia Disability Awareness Committee** in Albuquerque and **Walk MS: Tri-Valley** in Livermore raised funds and showed support for those affected by multiple sclerosis by taking a walk around the block or hopping on a treadmill.

The annual MS walk helps raise awareness and funds to research the cause of MS and a cure, both of which are currently unknown.

"The walk supports individuals with MS by demonstrating that no one has to go through MS alone because we are stronger together," said Abilities Champions of Sandia co-chair Victoria Newton.

Multiple sclerosis is a disease of the central nervous system that disrupts the flow of information in the brain and between the brain and body. It is the most common neurological disorder affecting those ages 20 to 50, and strikes two to three times more women than men.

Currently, about 1 million Americans are living with the disease. Progression of the disease is unpredictable and can include a wide range of symptoms such as chronic pain, memory issues and even paralysis.

Staying apart, working together

Due to the pandemic, this year's MS walk shifted to a virtual environment. Members of Abilities Champions of Sandia and their families participated using safe social-distancing practices and personal protective equipment.

"To participate, members had to walk/exercise on their own using proper social distancing restrictions and PPE, or find other creative ways to show their support: chalk the sidewalks with information about MS, wear orange, post a Plug article or tell family and friends about MS," Victoria said.

Twenty people from Sandia participated virtually in the April 18 event and raised just shy of $500. Those interested in supporting MS research or participating in future events can visit the **National Multiple Sclerosis Society** website for more information.

LEADING BY EXAMPLE — Abilities Champions of Sandia co-chair Victoria Newton, left, and her sister Sarah Luce, a registered nurse at Southwest Women's Oncology, participated in the virtual Walk MS: 2020 at Albuquerque's Elena Gallegos Open Space on April 18. The event is an annual fundraiser supporting research to determine what causes multiple sclerosis and how it can be cured. **Photo by Randy Montoya**

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LABNEWS Notes

EDITOR'S NOTE: Lab News welcomes guest columnists who wish to tell their own "Sandia story" or offer their observations on life at the Labs or on science and technology in the news. If you have a column (500-800 words) or an idea to submit, contact Lab News editor Tim Deshler at tadeshl@sandia.gov.

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Converting respiratory machines for COVID-19 patients

Sandia develops 100 conversion kits for distribution to New Mexico hospitals

By ***Kristen Meub***

In less than a month, Sandia has converted 100 respiratory machines already on hand at New Mexico hospitals into machines that can safely be used as ventilators to help treat patients with severe cases of COVID-19.

BiPAP and CPAP machines are non-invasive ventilators that use masks instead of tubes. They cannot normally be used to treat patients with COVID-19 because they expel a patient's breath into the room, contaminating the area with virus droplets and putting medical staff at risk of exposure.

To mitigate the limitation, a team of Sandia researchers developed pathogen management kits. The kits attach to respiratory machines and use ultraviolet light to disable COVID-19 and other pathogens before a patient's exhaled breath is circulated back into the room.

"Our local hospitals told us that they need solutions now," said project lead and senior manager Ryan Haggerty. "Based on conservative models of ventilator availability in Albuquerque during this pandemic, there will not be enough ventilators to meet the projected need. We are trying to address the gap between now and when large companies that are producing high-end ventilators will be ready to ship machines to hospitals."

The team partnered with Presbyterian Healthcare Services and the University of New Mexico Hospital to make sure they were working to address the biggest needs of local hospitals. The hospitals provided information about the type and amount of equipment they had available for conversion, and what modifications would be most helpful for safely treating patients with COVID-19.

Rapid response

The project progressed from the idea phase to design, testing and validation within about three weeks. After a prototype of the kit was built and attached to a non-invasive ventilator, the team conducted biological and aerosol testing to ensure the design was safe and effective.

Sandia is ready to deliver its first round of pathogen management kits for non-invasive ventilators for distribution to New Mexico hospitals, effectively increasing the state's ventilator count by 100.

The team plans to transfer the pathogen management kit technology to a regional manufacturer through a Cooperative Research and Development Agreement to increase the production rate substantially.

Future developments

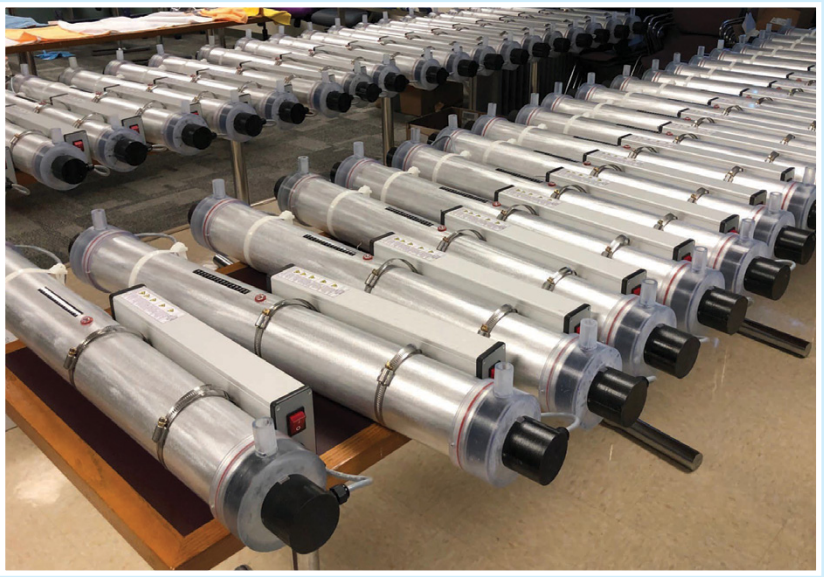
The team also is designing an alarm system that can be added to any ventilator to help keep patients safe when non-standard equipment is being used. The alarm will help relieve some of the stress of a high patient-to-caregiver ratio by alerting healthcare workers to any problems.

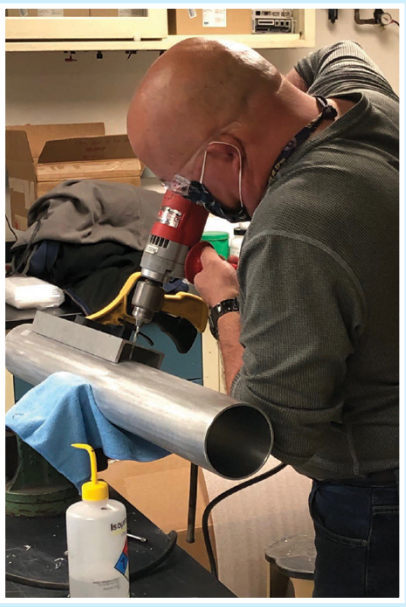
"This approach can be used to help many other hospitals in New Mexico and throughout the country," Ryan said. "We are working to transfer the technology to industry to make the systems more broadly available."

Ryan said many Sandia researchers and engineers have offered to work on the project. His team is grateful for their scientific and engineering expertise, and to be able to contribute in a meaningful way to help the public during the pandemic.

"Thanks to the team's hard work, Sandia is able to provide significant relief and help keep our medical workers safe," Ryan said.

This project is one of about 50 that Sandia is currently working on to help fight COVID-19. Research and development for the kits was funded through Sandia's Laboratory Directed Research & Development program. The state of New Mexico purchased the completed pathogen management kits.





PATHOGEN MANAGEMENT — Sandia researchers developed pathogen management kits that can be attached to respiratory machines. The kits use ultraviolet light to disable COVID-19 and other pathogens before a patient's exhaled breath is circulated back into the room. **Photos by Adam Cook**

Eubank gate construction ahead of schedule

Crews working on the Eubank gate project have been taking advantage of light traffic to expedite the construction schedule. The entire project team, including AUI, Global GRAB Technologies, and Guzman contractors are dedicated to finishing the project safely and ahead of schedule.

While construction continues, the Eubank gate is currently closed, but is expected to open in early June. The Eubank contractor gate is still open from 5:30-10:30 a.m. inbound and 11 a.m.-6 p.m. outbound. Project completion is targeted for early July 2020, three months ahead of schedule.

MOVING FORWARD — The Eubank gate construction project at Kirtland Air Force Base is continuing ahead of schedule. Shown here, Global GRAB Technologies construction crews augur a hole for a large vertical M-50 barrier post, part of an anti-vehicle barrier being installed on lanes eastbound on G Avenue from 20th Street. Guzman and AUI are preparing subgrade on G Avenue eastbound, along with touch-up of curbs and gutters. **Photo by Randy Montoya**

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NM distillery partners with Sandia on hand sanitizer

Wayward Sons Craft-Distillery adapts product line to address national shortage, donates products to nonprofits

ELBOW BUMP — Sandia chemist Jessica Kruichak tested hand sanitizer to make sure it meets standards set by the World Health Organization and the U.S. Food and Drug Administration.

NMSBA SUCCESS — Sandia chemists worked with Wayward Sons Craft-Distillery in Santa Fe through the New Mexico Small Business Assistance program that pairs scientists with companies facing technical challenges.

TECHNICAL ASSISTANCE — Sandia analytical chemist Curtis Mowry conducted gas chromatography on materials used for the hand sanitizer. That process involves vaporizing a small sample in an instrument that separates and measures each ingredient.

*Story by **Manette Newbold Fisher***
*Photos by **Lonnie Anderson***

Distillery-developed hand sanitizer is leaving a New Mexico warehouse as quickly as other brands disappeared from grocery stores after Sandia helped confirm that the product meets all federal requirements for distribution.

In response to the widespread shortage during the COVID-19 pandemic, Wayward Sons Craft-Distillery in Santa Fe reconfigured its operations to produce a hand sanitizer they named Elbow Bump, and worked with Sandia to test and confirm that their product meets standards set by the World Health Organization and the U.S. Food and Drug Administration.

"They needed someone with a technical background to help them figure out how to make this product and test its effectiveness," said Sandia chemist Jessica Kruichak, who worked with the company. "Because there has been a shortage, it's humbling that I was able to help them with that."

Sandia worked with Wayward Sons through the New Mexico Small Business Assistance program that pairs Sandia and Los Alamos national laboratories with small businesses facing technical challenges. The program provides access to the labs' expertise and capabilities at no cost to the company.

Jessica and Sandia analytical chemist Curtis Mowry provided technical consulting and resources to help the company determine correct quantities of materials for the hand sanitizer and whether manufacturing of the product could be scaled up while maintaining its effectiveness.

Finding the right recipe

Even though the WHO and the FDA distributed guidelines for making the sanitizer, Jessica said producing it wasn't a simple, straightforward process. She, Curtis and Wayward Sons co-owner Byron Rudolph researched materials and differing alcohol proofs to make sure the combination would work.

Jessica said she also studied how to denature alcohol, which involves adding one or more chemicals that make it unfit for human consumption. She said the guidelines also presented the hand sanitizer recipe in volume measurements, but Wayward Sons' commercial scales measure by mass.

"When you go from volume to mass, it changes things. You have to look at density, the proof of the alcohol, initial ingredient percentages and avoid diluting it too much," Jessica said. "Even with the guidance, it's not as easy to make hand sanitizer as you might think."

In doing research on how to make the product, Rudolph talked to other distilleries that used different tools.

"It was a matter of deciding what tool works best for Wayward Sons, and the ability to test the product helped us make that decision," Jessica said.

Racing to meet demand

In addition to research and testing, Curtis said another challenge was the turnaround time because product demand was already high. He provided lab time and expertise by conducting gas chromatography on the materials. That process involves vaporizing a small sample in an instrument that separates and measures each ingredient.

This was important in making sure the final product had the right percentages of alcohol to kill the virus, Jessica said.

"Having the quality-control testing and analysis was phenomenal," Rudolph said. "We appreciated having minds and equipment that could help make sure everything was going the way it was supposed to."

Rudolph said the distillery already had the equipment to make Elbow Bump; the same pumps, hoses and tanks are used to make the company's craft coffee spirits.

Supporting workers and the community

Wayward Sons co-owner Tom Wolinski said hand sanitizer production not only benefits the public, it also helps the company provide work hours for office and delivery staff who package and distribute the distillery products.

"When bars and liquor stores shut down, most deliveries weren't taking place," Wolinski said. "Not only has the whole process been truly inspiring, it also enabled our company to provide many extra hours to the warehouse and delivery personnel as they have stepped in for bottling and packaging. Without the hand sanitizer, that wouldn't be happening."

Substantial donations of Elbow Bump have already been made to food banks, shelters and medical organizations, and more are planned, Rudolph said.

"It's very rewarding to feel that we have the ability to contribute in some way to the medical front-liners and consumers who can't get hand sanitizer," he said.

Sales have exceeded the distillery's expectations, Wolinski said, with stores in New Mexico, Colorado, Utah, Kansas, Texas and Missouri placing orders.

"Every market able to purchase seems to be doing so," Wolinski said.

Jackie Kerby Moore, manager of technology and economic development at Sandia, said it has been gratifying to see the NMSBA program address issues associated with the COVID-19 pandemic.

"We are proud that Sandia helped a local company create a new product line and retain employees," she said.

NMSBA at Sandia

Through the New Mexico Small Business Assistance program, Sandia can provide up to $2.4 million in technical assistance to companies per year. For more information about the program, visit **nmsbaprogram.org**.

Four Sandia leaders honored among 40 Under Forty

By **Meagan Brace**

Amid the challenges New Mexico is facing, 40 outstanding young professionals are bringing enormous optimism to the state — and four Sandia leaders are a part of that cohort. Jim Cleary, Emily Gaffney, Bernadette Gallegos and Johnathon Huff have joined the ranks of Albuquerque Business First's 40 Under Forty honorees, recognized for their professional achievement, leadership and the critical roles they play in the community.

The four Sandia leaders are part of the 19th group of young professionals under the age of 40 honored by Albuquerque Business First. They will be featured in a special May 15 Business First publication and honored at a dinner and reception in September.

Jim Cleary: Leading teams on and off the field

Jim Cleary is the acting senior manager for Sandia's nuclear deterrence business operations. He joined Sandia in 2011 and worked in various project management roles before becoming a manager in 2016. Prior to Sandia, he was the co-owner of a commercial construction management company where he oversaw company finance, preconstruction and project management for the small company that grew to earn $3 million in annual sales.

When he isn't managing teams at the Labs, he's leading teams on the field. He spent 11 years as a high school football coach and currently coaches his children's soccer teams. He also is involved in the Prince of Peace catholic community and helps with fundraising activities for his neighborhood's grade school.

"While my career and the success of Sandia are vitally important to me, I prioritize my life to ensure that those efforts do not come at the expense of my faith, family, community and personal growth. This focus, and its alignment to Sandia's culture, are the major reasons Sandia has been a great fit for me in my career to date," he said.

Jim holds an MBA with a focus in project management and a bachelor of science degree in technical systems management, both from the University of Illinois.

CLEAR PRIORITIES — Jim Cleary is the acting senior manager of nuclear deterrence business operations at Sandia.
Photo by Lonnie Anderson

QUALITY VISION — Emily Gaffney is the senior manager for Sandia's Laboratory Operating System.
Photo by Lonnie Anderson

Emily Gaffney: Making things better than she found them

Emily Gaffney is the senior manager for Sandia's Laboratory Operating System. Since joining the Labs in 2012, she has been a manager, executive strategy professional and quality engineer.

"To me, leadership combines inspiring the heart and bringing vision to life. The best indicator of leadership is how you teach and enable others to become leaders themselves," she said.

Emily credits her success to the people and institutions that have invested in her through time, scholarships, opportunities and encouragement, and she wants to do the same for others. She volunteers in her kids' classrooms and afterschool program, teaches Sunday school, serves on the board of the New Mexico Museum of Natural History Foundation, participates in Leadership New Mexico, actively mentors professionals and advocates for women at the Labs through the Sandia Women's Action Network.

"My goal in all I do is to make things better than I found them, so my community — my children, my family, our schools, my employer, my city, my state and my country — can be the absolute best they can be," she said.

Emily holds an MBA from the University of New Mexico and a bachelor's degree in marketing from New Mexico State University.

Bernadette Gallegos: Advocating for diversity and inclusion

Since starting her career as a Sandia intern in 2011, Bernadette Gallegos was a project controller and solutions architect before becoming a manager in 2018.

"I greatly value the role that a leader plays in an organization and the significant impact it can have on the dynamics of a team and the success of an organization," she said. "Each day I am honored to be able to provide leadership to work that has a significant impact on the national security of our country."

Bernadette's parents instilled in her early on the importance of giving back to the community. She grew up with a sister born with cerebral palsy and noticed a significant gap in the community for supporting those who were disabled or elderly. She began volunteering her time to bring these individuals joy by reading with them and performing ballet folklorico dances for them.

Bernadette's dedication to the community continued in high school as she became involved with the Big Brothers, Big Sisters organization, where today she continues to mentor children and young adults. She also co-led the Sandia Women's Action Network, advocating for diversity and inclusion efforts in the workplace.

In addition to her work and volunteer efforts, Bernadette leads a busy life. She enjoys spending time with her boyfriend and their two dogs, traveling to national parks, running, photography and watching sports.

"Giving back to both the Sandia community, as well as the larger Albuquerque community is something I greatly value," she said.

DYNAMIC LEADERSHIP — Bernadette Gallegos is a manager in project management integration at Sandia.
Photo courtesy of Bernadette Gallegos

Bernadette holds an MBA in management information systems and marketing and a bachelor's degree in marketing and operations, both from the University of New Mexico.

Johnathon Huff: Encouraging the next generation of STEM leaders

Johnathon Huff is the director of Sandia's environment, safety and health center. He came to Sandia in 2011 as a contractor and was a senior member of technical staff, R&D manager and both an R&D and ES&H senior manager prior to his current role. He is an active mentor for managers and staff members and a speaker in Sandia's Leading with Excellence program.

As the only African American executive at Sandia, Johnathon said, "I relish the opportunity to share my path with other minorities in hopes that we will increase the representation of minorities in senior technical and management roles at Sandia."

Johnathon is passionate about helping the next generation of science, technology, engineering and math leaders achieve their goals. He has created a goal-setting workshop for students from elementary to high school.

Working tirelessly to support his community, Johnathon volunteers with Sandia's Hands on Minds on Technology and Dream Catchers summer programs, has held leadership roles with the National Society of Black Engineers Albuquerque chapter pre-college initiative, mentors students and encourages college students to reach their goals.

Johnathon enjoys spending time with his wife and three sons, coaching his sons in soccer, flag football and basketball and continuing his research in mathematical modeling and optimization.

Johnathon earned his doctorate in industrial and systems engineering from Mississippi State University, a master's degree in electrical engineering from Drexel University and a bachelor's degree in electrical engineering from the Georgia Institute of Technology.

PASSION FOR STEM — Johnathon Huff is the director of Sandia's environment, safety and health program.
Photo by Lonnie Anderson

Recent Patents

Oct.-Dec. 2019

Note: Patents listed here include the names of active Sandians only; former Sandians and non-Sandia inventors are not included.

Following the listing for each patent is a patent number, searchable at the U.S. Patent and Trademark Office website (uspto.gov).

- **Harumichi A. Kariya and Jeffrey Koplow:** Heating and cooling devices, systems and related method. Patent #10429105
- **Nicolas Argibay and Brendan L. Nation:** In situ environmentally isolated wear tester. Patent #10429284
- **Sapan Agarwal, Elliot J. Fuller, Farid E.G. Marquez and Albert A. Talin:** Tunable ionic electronic transistor. Patent #10429343
- **Jason Hamlet, Ryan Helinski and William A. Zortman:** Integrated circuit authentication from a die material measurement. Patent #10429438
- **Steven F. Glover and Gary Pena:** Control of polarization switching via nucleation in ferroelectrics. Patent #10431280
- **Michele L. Denton and Shawn M. Dirk:** Switchable antifouling coatings and uses thereof. Patent #10435568
- **Sung N. Choi and Susan Washburn:** Identity management using ephemeral biometrics. Patent #10439817
- **Cy Fujimoto:** Functionalization of diels-alder polyphenylene polymers. Patent #10442887
- **James B. Aimone, Ojas D. Parekh and Cynthia A. Phillips:** Constant depth, near constant depth and subcubic size threshold circuits for linear algebraic calculations. Patent #10445065
- **Kyle Merry:** Efficient track-before-detect algorithm with minimal prior knowledge. Patent #10445862
- **Steven N. Ball, Brian S. Phillips, Gregory P. Salazar and Randy J. Shul:** Systems and methods for interferometric end point detection for a focused ion beam fabrication tool. Patent #10446369
- **Nedra Bonal and Leigh Preston:** Muon detectors, systems and methods. Patent #10451745
- **Alejandro J. Grine, Darwin K. Serkland and Michael Wood:** Optomechanical gyroscope utilizing the sagnac effect. Patent #10458795
- **Tu-Thach Quach:** Vehicle track detection in synthetic aperture radar imagery. Patent #10467474
- **Nathan A. Davey, Dennis J. De Smet, Andrew L. McCourt, WVenner Saul, Lawrence R. Shapnek and Charles A. Walker:** Multi-dimensional cable shorting tool. Patent #10468788
- **Brad Boyce, Audrey Morris-Eckart and Ronald L. Wild:** Systems and methods for miniaturized drawbar extension springs. Patent #10473175
- **Nicolas Argibay and Nicholas Leathe:** Test artifact for non-destructive evaluation. Patent #10473552
- **Thomas A. Friedmann, Brian D. Homeijer, Paul J. Resnick and Michael Wiwi:** High sensitivity single-axis mems accelerometer with bilateral flexures. Patent #10473687
- **Armin W. Doerry:** Waveform warping for general frequency-modulated radar waveforms. Patent #10473755
- **Robert Meagher:** Check valves for microfluidic systems and methods thereof. Patent #10478818
- **Cy Fujimoto:** Block copolymers including poly(phenylene) and methods thereof. Patent #10479866
- **Fred P. Doty, Pin Yang and Xiaowang Zhou:** Stabilized scintillator. Patent #10479934
- **Jack Heister, Evan P. Johnson, Dennis J. Kenney, Marlene E. Knight, Thomas L. Martinez and Bo Song:** Mechanical testing equipment for material characterization. Patent #10481057
- **Michael D. Henry, Brian D. Homeijer, Robert W. Reger, Michael Wiwi, Sean Yen, Andrew I. Young and Travis R. Young:** Low-power mems wakeup system. Patent #10481672
- **Andrew D. Baczewski, Noah T. Jacobson, Ryan M. Jock, Andrew Mounce and Wayne Witzel:** Spin-orbit qubit using quantum dots. Patent #10482388
- **Kurt O. Wessendorf:** Non-inverting multi-mode oscillator. Patent #10483912
- **Giorgio Bacelli, Ryan G. Coe and David G. Wilson:** Multi-resonant feedback control of multiple degree-of-freedom wave energy converters. Patent #10488828
- **Sapan Agarwal and Matthew Marinella:** Circuit arrangement and technique for setting matrix values in three-terminal memory cells. Patent #10489483
- **Matt Eichenfield:** Evanescently coupled piezoelectric acoustic devices. Patent #10491190
- **David Robinson:** 3D-printed apparatus for efficient fluid-solid contact. Patent #10493693
- **David Robinson:** Electroless deposition of metal on 3D-printed polymeric structures. Patent #10494721
- **Douglas L. Bickel and Richard M. Naething:** Spectral replacement to mitigate interference for multi-pass synthetic aperture radar. Patent #10495750
- **Sapan Agarwal, Elliott J. Fuller and Albert A. Talin:** Ionic floating-gate memory device. Patent #10497866
- **Travis M. Anderson, Harry Pratt and Dorina F. Sava Gallis:** Metal-organic framework electrodes for sodium ion batteries. Patent #10497971
- **Jonathan Chavez and Dale L. Huber:** Direct formation of metal nanoparticles using ultrasound. Patents #10500643 and #10518330
- **Ryan R. Anderson, Kenneth M. Armijo and Clifford K. Ho:** Magnetic field falling particle solar receiver systems and methods. Patent #10502459
- **Christian L. Arrington, Patrick S. Finnegan, Andrew E. Hollowell, Eric Langlois, Albert G. Baca, Erica A. Douglas, Michael D. Henry and Shahed Reza:** High current density, low contact resistance wide bandgap contacts. Patent #10505031
- **Joseph Carlson and Patrick L. Feng:** Mixed compound organic glass scintillators. Patent #10508233
- **Clifford K. Ho:** Falling particle solar receivers. Patent #10508834
- **Todd Monson and Jamin R. Pillars:** Magnetoelastically actuated mems device and methods for its manufacture. Patent #10510945
- **Stephen J. Bauer, Timothy J. Boyle and Khalid M. Hattar:** Tattletale ion-implanted nanoparticles. Patent #10514361
- **Fred P. Doty, Pin Yang and Xiaowang Zhou:** Thallium bromide semiconductors and devices with extended life apparatus, methods and system. Patent #10516068

Mileposts

New Mexico photos by Michelle Fleming
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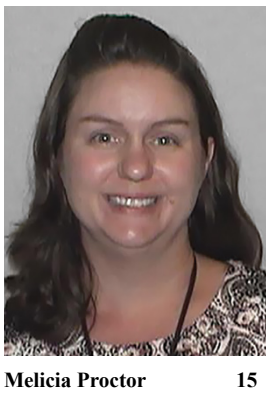
Brenda Ochoa 15

Rus Payne 15



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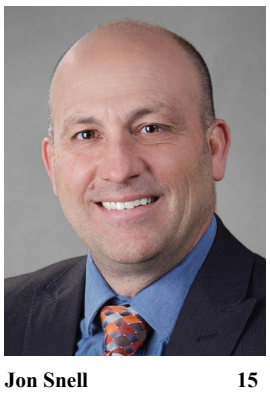


Jon Snell 15

Titanium imaging

CONTINUED FROM PAGE 1

Due, in part, to the results of Sandia's study, AOT received funding to build the system for the U.S. Air Force, where it primarily will be dedicated to titanium crystallography. CPCI can also characterize other metals, including beryllium, magnesium, cobalt, zinc, tin and zirconium.

The company also received New Mexico Economic Development and Office of Economic Adjustment grants with support from the New Mexico Manufacturing Extension Partnership. In addition, the partnership was recognized at a 2019 NMSBA Innovation Celebration.

Malini Hoover, the company's CEO, said they are interested in marketing CPCI to companies, national labs and universities that characterize metal crystallography. Titanium is lightweight, corrosion-resistant, and can withstand extremely high temperatures — qualities that make the metal a popular choice for the aerospace industry.

Streamlining quality control

As the need for titanium increases with the high demand for newer, lighter military and commercial planes, manufacturers must continue to verify the metal for stress and maintain parts, Hoover said, adding that the company's technology could streamline the quality control process.

Sandia materials scientist Joseph Michael was paired with AOT for the project and conducted a test using a scanning-electron microscope, current technology that can be difficult for small businesses to access because the microscopes are large, expensive and require experts to run. Metals characterization is one of Sandia's strengths — we have been doing this for many years, Michael said.

"We use scanning-electron microscopes in very sophisticated ways here, and I think that's what was attractive to AOT," he said.

Through partnering with AOT, Michael said he was able to think about metal characterization in new and exciting ways.

"It's been energizing to me to see other techniques that can do some of the things that we do in the lab in a faster, higher-throughput way," he said. "It's been more than neat — it's been exciting to see it all happen. If you can generate data that gets you 90% of the solution and do it quickly from an unprepared sample, that's a great place to be."

Improving a destructive process

A current process for characterizing titanium is a method called electron backscatter diffraction, the test Michael provided. The process involves inserting a small sample of titanium into a scanning electron microscope that can produce images at the nanoscale, helping scientists determine a material's melting point, color, strength and chemical reactivity.

Scanning-electron microscopes scan samples with a focused beam of electrons that interacts with the atoms in the material. This produces various signals that contain information about the surface, composition and crystallography of the sample. That information produces highly magnified images of the metal, and skilled metallurgists can make decisions about final properties of the part.

Electron backscatter diffraction is currently a gold standard in metals characterization, Michael said, but it can't be completed during live production because the metal must be prepared using highly trained technologists and specialized equipment. This process is time-intensive and destructive because scientists have to cut a small piece of the metal to fit inside the microscope, something you can't do to large sheets of metal or to the side of an aircraft.

Benefits of non-destructive imaging

With AOT's process, a titanium billet, sheet or finished part can be placed in front of the sensor to image the surface with an eye-safe laser. Because the sample doesn't need to be inserted into a small chamber, it doesn't need to be cut; the original piece of titanium remains whole. This makes CPCI non-destructive.

The system also produces a larger image than a scanning-electron microscope can, and because the process is standardized and operates simply by pushing a button, experts aren't necessarily needed for the initial imaging. The process reduces labor costs and allows experts to better spend their time analyzing the images and making decisions.

This technology could potentially characterize titanium while a part is being produced, Hoover said, and the larger field of view makes it easier for experts and manufacturers to make critical decisions rapidly. It also could be used to analyze aircraft parts in service during maintenance checks. The sensor is portable enough to set up outside the plane and provide crystallographic images of parts in real time, improving flight safety.

"Currently, there is no way to check crystallography on the ground during maintenance," Hoover said.

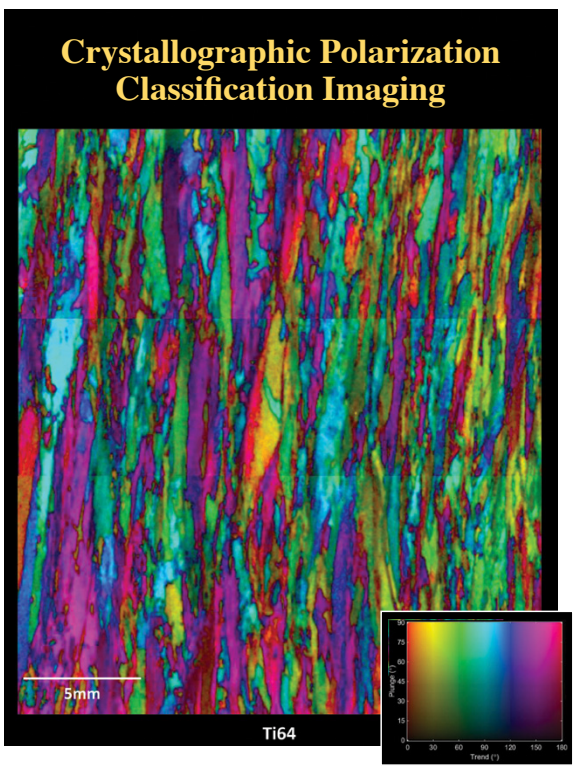
Applications for many industries

The technology could also benefit companies and labs working with 3D printers, something that Michael has expressed interest in.

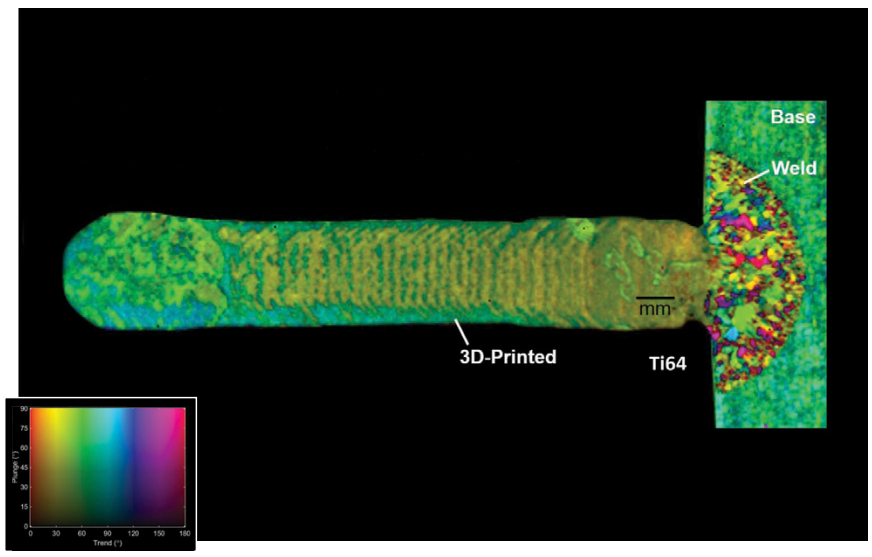
"Currently, 3D-printed parts require frequent inspection. Sandia is interested in inspecting 3D-printed parts." Hoover said. "There is interest in putting a CPCI sensor in a 3D printer and inspecting layer by layer, so as soon as something is wrong, the build can be stopped or corrected."

Hoover said this technology also could benefit the medical field for prosthetics.

"Everything in our body — spine, plates, knees, hip replacements — can be made out of titanium," she said. "So this technology could also be utilized in the medical field along with the other industries."



CRYSTALLOGRAPHIC ORIENTATION — This image shows a piece of titanium imaged using a Crystallographic Polarization-Classification Imaging process patented by Advanced Optical Technologies. Sandia researchers worked with the company to prove the process provides quick, accurate metal characterization. **Image courtesy of Advanced Optical Technologies**

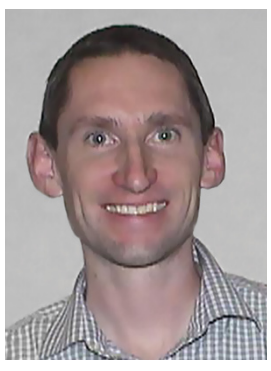


QUICKER CHARACTERIZATION — Advanced Optical Technologies used the company's Crystallographic Polarization-Classification Imaging process to analyze a 3D-printed titanium alloy part supplied by Sandia. The company's method is faster than the traditional approach using a scanning-electron microscope. **Image courtesy of Advanced Optical Technologies**

Recent Retirees

New Mexico photos by Michelle Fleming
California photos by Randy Wong

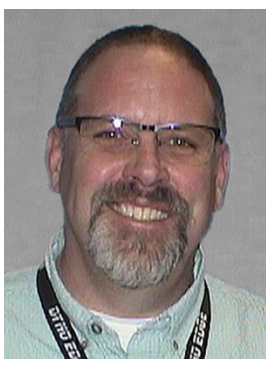
Jeremy Goold 15



Ben Hamlet 15

Jim Heise 31

Lori Mann 27



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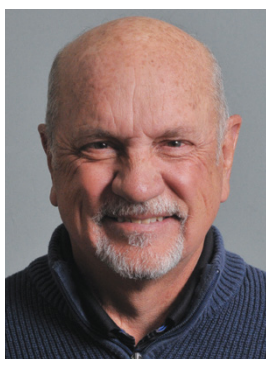
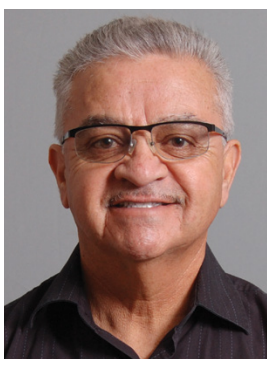
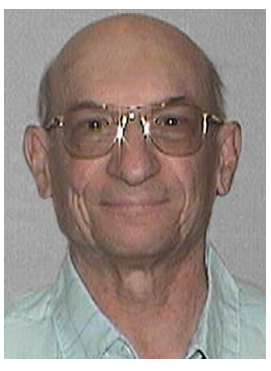
Jessica Vanderburg 15



Frank Dempsey 21



Alex Gonzales 18



Dave Sevougian 16

Cindy Graham 15

Radiation-detecting plastic gets ingredient to stay in the clear

Sandia develops new formula to easily replace fogged detectors at ports

By ***Melissae Fellet***

Sandia researchers have identified a straightforward change to the formula for radiation-detecting plastic. The change prevents "fogging," which reduces the lifetime of the plastics used to detect nuclear material transiting through the U.S. Department of Homeland Security's radiation detectors.

The change also fits well into existing manufacturing processes for the plastic, so manufacturers have been able to scale up production rapidly to make large sheets capable of replacing fogged detectors.

These radiation detectors are sheets of polyvinyltoluene, or PVT, plastic that measure 2 inches thick and 6 to 8 feet high. The detectors are deployed in traffic lanes at ports of entry.

The detection component in the plastic is a fluorescent molecule that glows when radiation hits the material. Light collectors mounted on the top of the sheet gather light from the glowing molecules; the amount of light they register reflects the amount and energy of radiation that hits the material, the number of light particles coming from the fluorescent molecule and the efficiency of light transport through the plastic.

"For reliable radiation measurements, it's of the utmost importance that the material is optically transparent and remains that way for decades," Sandia materials scientist Nick Myllenbeck said.

However, analysts who use PVT noticed that the radiation detection performance of the plastic was starting to degrade after the plastic had spent a few years in the field. By eye, they saw what appeared to be fog droplets forming inside the material. These droplets scattered light from the glowing molecules and prevented some of the light from reaching the detector, reducing its sensitivity over time.

Microscopy reveals fog source

To figure out how to prevent this fogging, Sandia researchers, working with colleagues at Lawrence Livermore, Pacific Northwest and Oak Ridge national laboratories, first needed to know how the fog formed. They suspected it appeared in the material much like it does in air — by water condensing as the air temperature drops overnight.

The researchers put small samples of the radiation-detecting PVT plastic in a humid chamber and cycled the temperature from warm to cool to mimic daytime and nighttime temperatures. The samples absorbed only about 0.03% water by mass, but during cooling cycles, the researchers saw the fog-like droplets appear in the material.

When they examined the material under an optical microscope, however, they realized the droplets were microscale defects in the plastic caused by condensed water absorbed from the air.

They eventually realized that the defects formed in two phases. During the first few warm and cool cycles, the fog-like defects appear to be completely reversible upon heating or drying out the plastic. However, if the water remains in the plastic and the material experiences enough temperature cycles, the defects grow and become permanent. Both defect types can adversely affect the performance of plastic scintillators in the field, Nick said.

New formula easy to produce at scale

Once the researchers knew how the fog formed, they hypothesized that they could add a chemical component to the plastic to keep water from forming defects inside. Materials scientists from Sandia and Lawrence Livermore, sharing funding from the Department of Homeland Security Countering Weapons of Mass Destruction Office, experimented with various additives to stabilize water by means of hydrogen bonding to the additive.

PERFORMANCE PLASTIC — Sandia materials scientist Nick Myllenbeck examines glowing plastic used to detect radioactive material. **Photo by Lloyd Wilson**

At Sandia, Nick and his colleagues started with the current PVT formula and added one ingredient: a commercially available additive that can interact favorably both with water and the plastic matrix. When they tested the new material under accelerated temperature and humidity conditions, the researchers did not see any sign of fogging after numerous cycles.

In contrast, the standard plastic would fog severely after just one cycle. Nick suspects that the water inside the plastic clings to the additive rather than to other water molecules, which prevents droplet formation and thus, light-scattering defects.

"This one ingredient change is a huge advantage to manufacturers," he said. "They only have to add a small amount of this compound to their existing formula, with minor process modifications, to produce a nonfogging material that performs identically to the existing plastic."

As a demonstration of scalability, a property that had previously eluded the multilab team, a PVT manufacturer working with the team has produced numerous 2/3-scale parts with the new formula. Nick said they plan to make full-scale panels suitable for field deployment in the next several months.