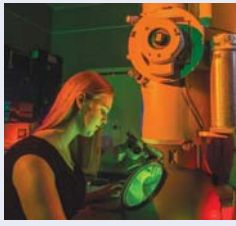


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Sandia LabNews

Vol. 66, No. 9

May 2, 2014



Managed by Sandia Corporation for the National Nuclear Security Administration

Studying materials at the breaking point

By Sue Major Holmes

Humans have been using metals for thousands of years, but there's still a lot about them that isn't fully understood. Just how much stretching, bending, or compression a particular metal will take is determined by mechanical properties that can vary widely, even within parts made of the same material.

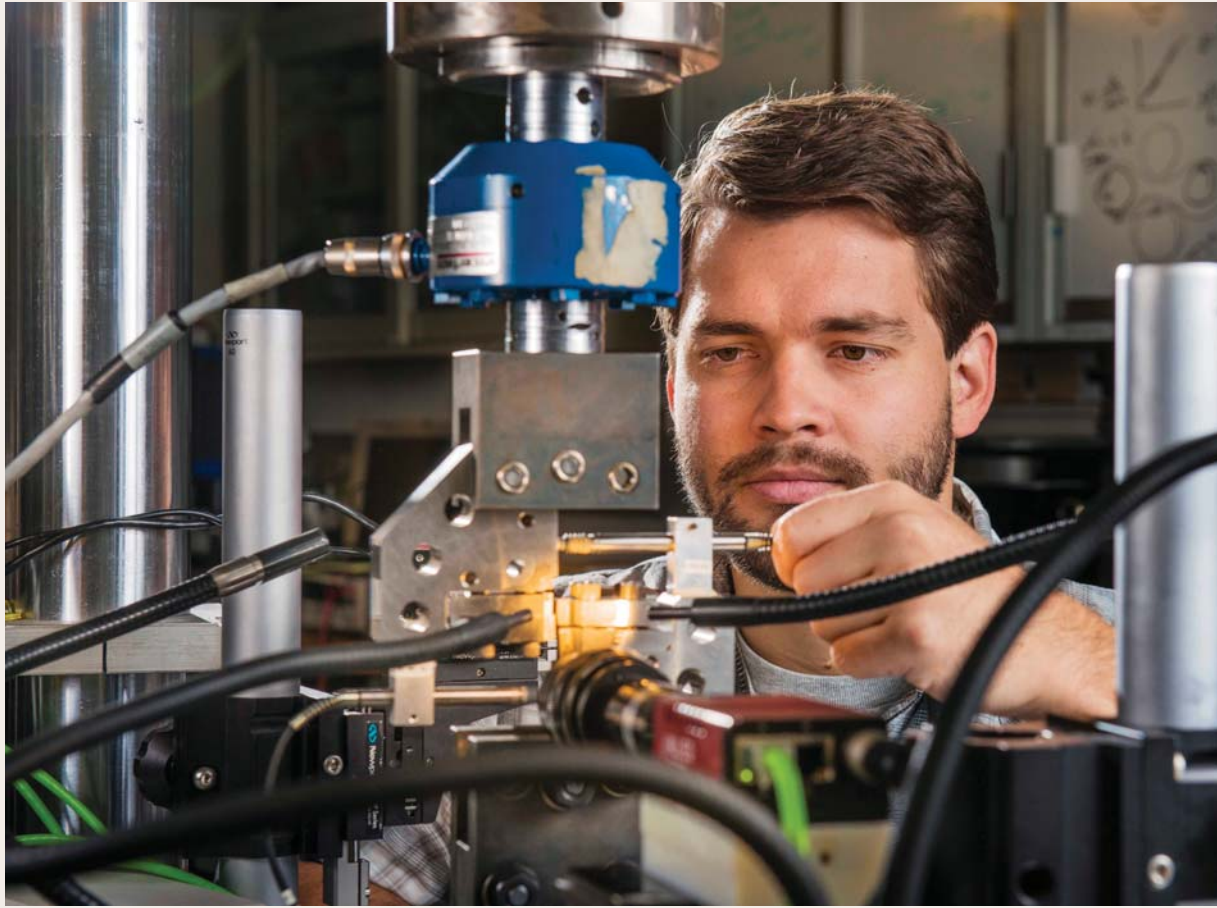
Sandia is working to fill gaps in the fundamental understanding of materials science through an ambitious long-term, multidisciplinary project called Predicting Performance Margins or PPM. From the atomic level to full-scale components, the research links variability in materials' atomic configurations and microstructures with how actual parts perform.

PPM aims to identify how material variability affects performance margins for an engineering component or machine part. The goal is a science-based foundation for materials design and analysis — predicting how a material will behave in specific applications and how it might fail compared with its requirements, then using that knowledge to design high-reliability components and systems. Materials

(Continued on page 4)

LASER WELDS — Researcher Brad Salzbrenner (1831) tests laser-welded objects in pure tension, shear, and mixed tension-shear loading. One pilot study in Sandia's long-term Predicting Performance Margins program involves laser welds, which are widely used in engineered systems.

(Photo by Randy Montoya)



TODSTWD

Almost 1,500 kids visit Sandia during Take Our Daughters and Sons to Work Day/Earth Day. For photos and more details about the day's activities, see [page 5](#).



Mark your calendar for first Labs-wide Family Day in New Mexico since 2009

New Mexico Family Day set for Sept. 20

Planning seeks to improve on 2009 event

Most current members of the Albuquerque-based Sandia workforce weren't born back in 1959 when the Labs held its first Family Day. In fact, about 2,500 of the current workforce weren't even on the payroll for the most recent Albuquerque-based event, held on a sunny, but super-windy spring day in 2009.

The time has come now for Family Day 2014. So, mark your calendars. It's set for Saturday, Sept. 20, 9 a.m.-3 p.m.

The Family Day 2014 planning team, led by Pam Catanach of Sandia's Community Involvement Dept. 3652, began work early this year and it's already clear that the main attraction of these periodic events remains the same.

Simply put, it's a rare chance for family of Sandia workers to actually see their mom's, their dad's, their sister's, even their grandparent's work place.

A number of improvements based on the 2009 experience are in the works. For example, a simplified online pre-event registration system is planned for this year's event. Available later this year, it is designed to expedite check-in



(Continued on page 4)

Paul Hommert takes a look back at his earliest Family Day memories

Paul Hommert came to work at Sandia back in 1976, a year that offered a fall-Family Day in Albuquerque.

As this year's Family Day approaches, Paul got the chance to offer up thoughts of his keenest memories about Family Day events when he was new to the Labs.

"I remember with great fondness those Family Days when our children, Jennifer and Kevin, were young and they could visit Sandia," he recalls.

"It was a special occasion. At that time the event was truly family oriented and I'm eager for that spirit to be rekindled this year.

"In those early days I was working in the energy area, and seeing any weapons work was interesting because it wasn't where my work was centered. It was a great opportunity for Elizabeth, my wife, and the children to see Sandia's diverse sites," he says.

Some of those highlights Paul singled out recently were his family seeing the Area III Rocket Sled Track, which during those days had received some network TV news coverage, the old Cray 1 supercomputer, and "sticky foam," another national news hit, which was developed in the late 1970s for security applications.

Most fall-season Family Days have enjoyed family-friendly weather. Paul and the already-active Family Day 2014 planning team look at weather statistics and see a high likelihood of that being the case this year.



PAUL HOMMERT

That's that

As I write this, it is Administrative Professionals Day, the day that asks us to pause, reflect on the contributions made by our admins, and to say "thank you" for the support they provide. I am very happy to do so and while I'm at it would like to specially thank our own tireless OAA, Michelle Fleming, who has been invaluable to our department for better than a decade now. I am always discovering yet another skill at which Michelle excels. Her talents are boundless and her commitment to the team is complete.

I'll bet all of us have worked with a Michelle or two during our careers. They make us look good and don't generally get near enough of the credit. And I guarantee you that every single day, they are doing things behind the scenes and under the radar that we don't even know about, doing a thousand things we never dreamed of, keeping us functioning as a team.

I'm afraid in talking about the support they provide, I'm selling our admins short. "Support" sounds to me too much like something peripheral; I think it's sometimes viewed that way, too. In fact, their contribution is essential, indispensable. They provide "support" in the way a foundation "supports" a house; without that foundation, the house collapses into a pile of rubble at the first ill wind that blows. Have you ever noticed how the good admins — like Michelle — can keep their cool as the rogue wave breaks over the departmental bow, focused on the task, keeping us on a straight heading? They hold chaos at bay.

So on Administrative Professionals Day I'm very happy to say "thank you" to Michelle individually and collectively to all the admins who play no small part on making us the world-class organization that we are.

* * *

A while back, I wrote about The Associated Press Stylebook mavens changing the rule on the use of the word "hopefully." In short, it's okay now to use the long-forbidden, oft-ridiculed word in AP news stories, which means it's okay in most newspaper around the country, as AP style is the gold standard for language usage in the news media. That change generated lots of huffing and puffing and angst-riddled outcries from old media hands.

Well, now they're at it again, those experts of style. And the predictable response by the usual suspects confirms the observation that the less consequential the issue at hand, the more heated is the debate about it. So what have they done this time? Well, it seems the high priests of usage have up and changed the guidance on the use of the term "over" when referring to a quantity.

According to the old AP rules, "over" was reserved for referring to something above something else in physical space. Thus the previous usage dictated that you would write "'More than' 15,000 fans attended the game" or "I spent 'more than' \$500 on this suit." Not "over" \$500. Emphatically not! This usage was probably the very first thing that was drilled into you at journalism school. So deeply ingrained was this rule that if you retained nothing else from your training, if you forgot everything else a cadre of frustrated profs tried to drill into you, you remembered this. It truly became part of your professional identity. So when the rule change came down, the journalism blogs were aflame with outrage, best summarized by the phrase "More than my dead body!"

You have to understand why this change was a big deal: As an editor, you could take smug satisfaction in "correcting" all the amateur submissions that came across your desk, striking the word "over" and replacing it with an all-knowing "more than." Thank all the powers that be that we editors could catch stuff like that!

Over the past couple of weeks since this rule came down, I've found myself grabbing the wrist of my editing hand, looking like Dr. Strangelove trying to stifle an involuntary stiff-armed salute, staying myself from striking an "over" from a sentence. It's hard. The habits of a lifetime don't break easy. But hopefully I'll get over it.

Over and out . . .

— Bill Murphy (505-845-0845, MS0148, wtmurph@sandia.gov)

A letter to members of the NNSA workforce NNSA Administrator Frank Klotz spells out priorities, vision

Note: Secretary of Energy Ernest Moniz swore in Frank G. Klotz as DOE's Undersecretary for Nuclear Security and NNSA Administrator on April 17. After officially assuming his new role, Gen. Klotz issued the following letter to all NNSA federal and contractor employees:



NNSA ADMINISTRATOR Frank Klotz, his wife Nancy Klotz, and Energy Secretary Ernest Moniz at a swearing-in ceremony on April 17. (Photos courtesy NNSANews)

On my first day at NNSA, I want to, first and foremost, reach out and introduce myself to all who work within the NNSA and the nuclear security enterprise. I hope to meet many of you over the next several weeks as I travel to each lab, plant, and site. I'm especially interested in learning from you how we can best fulfill our mission and best take care of our people.

I am already working to put in place a leadership process that inspires openness, trust, and confidence at all levels and across all boundaries within our common endeavor. I thought it would be helpful at the outset to share with you my own views on the work that lies ahead.

The nuclear security enterprise has responsibility for an enduring and critically important national security mission. The United States is committed to maintaining a safe, secure, and effective nuclear arsenal, as long as nuclear weapons exist. Our nation is also committed to leading international efforts to limit and reduce nuclear arsenals, prevent nuclear proliferation and nuclear terrorism, and secure nuclear materials across the globe.

NNSA and the entire nuclear security enterprise are at the very center of all of these national security objectives. Moreover, the unique talents and skills we bring to each aspect of our mission enable success in all the others. What you do, what everyone in the enterprise does — regardless of organization, job, rank, or seniority — is vitally important.

For that reason, taking care of people must always be a top priority. Supervisors at every level should be unrelenting champions for the professional development, safety, and welfare of their people. Every individual deserves to be treated with utmost respect and dignity, and to be given the opportunity to achieve her or his fullest potential.

We also have a special responsibility to recruit and mentor the next generation of leaders in the nuclear security enterprise. Since they will carry on the mission for many years to come, we must proactively seek out opportunities to deepen and broaden their skills.

At the end of the day, every organization must deliver on the commitments it makes in order to succeed and to thrive. We are no different. We have made promises we must keep: to sustain the nuclear weapons stockpile, to conduct leading-edge scientific research, to help prevent nuclear materials from falling into the hands of terrorists, to support the Navy's nuclear reactor program, to repair and modernize our aging infrastructure, and to protect the safety and security of our sites, our employees, and the public. And, we must do all this with a laser-like focus on managing requirements and costs to provide needed capability with less expense to the American taxpayer.

That's a tall order. But, I am absolutely convinced that we are up to the task. The women and men of the nuclear security enterprise are extraordinarily talented and innovative. I've already seen first-hand the impressive work you do, much of which goes unnoticed. I'm extremely honored to have the opportunity to work with each of you.

Mission First, People Always,
— Frank Klotz, NNSA Administrator

Sandia LabNews



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Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corp., for the US Department of Energy's National Nuclear Security Administration.

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Lab News fax **505/844-0645**

Classified ads **505/844-4902**

Published on alternate Fridays by Media Relations and Communications Dept. 3601, MS 1468

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Take Note

Retiree deaths

Blanche I. Matter (age 75)	Nov. 8, 2006
Margaret Furman 64	Jan. 17
Robert Clem 81	Jan. 26
Leo White 93	Jan. 28
Charles W. Ray 91	Feb. 2
John McGurn 67	Feb. 3
John McKinley Hart 89	Feb. 4
Willard Schmidt 93	Feb. 5
Walter Murfin 88	Feb. 6
Morgan Kramm 87	Feb. 13
Lillian Jewel Pickens 73	Feb. 14
William Lynwood Schrader 77	Feb. 15
James Albert Van Den Avyle 67	Feb. 19
Daniel Craig Jones 76	Feb. 26
Howard Ray Shelton 89	Feb. 27
Betty J. Malpas 81	Mar. 3
Fredrick Snyder 84	Mar. 3
Robert T. Sylvester 88	Mar. 3
Foster Tennant 88	Mar. 10
Joseph Lackey 88	Mar. 11
William C. Jacoby 80	Mar. 13
Lawrence Allen 85	Mar. 23
Ramon Lamberson 84	Mar. 23
Marian Moorman 93	Mar. 24
Billy N. Yates 81	Mar. 29
Brian Wade Dodson 60	Apr. 5

Sandia, Hawaii Hydrogen Carriers partner on hydrogen storage system for forklifts



ADRIAN NARVAEZ of Hawaii Hydrogen Carriers (HHC) observes a metal hydride storage tank, part of a project led by Sandia. The tank will be combined with a fuel cell system to make a fuel cell power pack to power a forklift. Hydrogen fuel cell technology could have a significant advantage over batteries for a large slice of the \$33 billion US forklift market. (Photo by Dino Vournas)

By Holly Larsen

Zero-emission hydrogen fuel cell systems soon could be powering the forklifts used in warehouses and other industrial settings at lower costs and with faster refueling times than ever before, courtesy of a partnership between Sandia and Hawaii Hydrogen Carriers (HHC).

The goal of the project is to design a solid-state hydrogen storage system that can refuel at low pressure four to five times faster than it takes to charge a battery-powered forklift, giving hydrogen a competitive advantage over batteries for a big slice of the clean forklift market. The entire US forklift market was nearly \$33 billion in 2013, according to Pell Research.

"Once you understand how these forklifts operate, the fuel cell advantage is clear," says Joe Pratt (8366), who is leading the project for Sandia. Refueling hydrogen fuel cell-powered forklifts takes less than three minutes compared to the hours of recharging needed for battery-powered forklifts. Consequently, forklifts are able to operate continuously for eight or more hours between fills.

"If hydrogen refueling is short enough to occur during normal downtimes, such as during operator breaks, then a single hydrogen forklift can do the work of three battery packs over the course of 24 hours. That translates into a direct cost savings," Joe adds.

Currently, companies using battery-powered forklifts need to purchase three battery packs for each forklift to ensure continuous operation. They also need to set aside warehouse space for battery recharging.

Sandia has worked with the fuel cell forklift industry for several years to help get clean, efficient, and cost-effective fuel cell systems to market faster. Standards developed by Sandia soon will be published so industry can develop new, high-performing hydrogen fuel systems for industrial trucks.

Department of Energy grant leads to collaboration

Intrigued by the potential benefits of fuel cells over the electric batteries that now power most forklifts, HHC obtained a grant from the Energy Department's Fuel Cell Technologies office and asked Joe to help improve the design of a hydrogen storage system for fuel cells.

Joe has spearheaded other Sandia efforts to introduce hydrogen systems into the marketplace. He served as technical lead, for instance, for studies on the use of fuel cells to power construction equipment, personal electronic devices, auxiliary equipment, and portable

generators. Most recently, he led a study and subsequent demonstration project on commercial use of hydrogen fuel cells to provide power at ports (see the Feb. 21, 2014, issue of *Sandia Lab News*).

For its part, HHC is developing technologies for the fuel cell forklift market and expects cost reductions and performance improvements that will help the market grow. The company is developing a low-pressure hydrogen storage system that can be refueled at standard industrial gas pressures. That should reduce fuel system cost and expand the market to facilities that can't accommodate conventional high-pressure fueling systems.

To solidify the forklift collaboration, HHC sent Adrian Narvaez to Sandia's Combustion Research Facility in California for several months. "Joe and I work together every day on the design, so it's a huge advantage to be able to work on site at Sandia," says Narvaez.

Technical, economic barriers to overcome

Today's hydrogen storage units require high pressure (5,000 pounds per square inch, or psi) to achieve a short refueling time — and high-pressure refueling requires an on-site compression system. "That can be a big expense, especially for a small company," Narvaez explained. "If we can provide a storage system that meets the target refueling time at, say, 500 psi, companies can get a break in the up-front costs. Plus, they no longer have to purchase battery rechargers or dedicate space for recharging. Instead, companies can simply purchase and store hydrogen tanks as needed."

Designing a storage system that meets HHC's specifications and can be integrated into a fuel cell power pack requires overcoming some key challenges. Among these are identifying optimal metal hydride materials, determining an optimal shape and size for the storage tank and ensuring thermal management to achieve and maintain the temperatures required for fast refueling and supply of the hydrogen.

Work to identify the right metal hydride for the system has focused on Hy-Stor 208, a misch metal-nickel-aluminum alloy that meets targets for hydrogen storage capacity, density, and thermal conductivity. The material also provides sufficient hydrogen pressure for refueling at an operating temperature of 60 degrees Celsius.

While this type of metal hydride is heavy, the weight acts as needed ballast and thus is a benefit in forklifts. To increase thermal conductivity, the team also explored adding to the metal hydride two forms of expanded natural graphite, flakes and so-called "worms" because of their tubular shape.

Joe and Narvaez drew on modeling and simulation

Sandia California News

results from an earlier project led by Sandia engineer Terry Johnson (8366) to identify a small-diameter tube as the best design for storing the metal hydride (see the May 22, 2009 issue of *Sandia Lab News*). They then varied several tube characteristics, such as the hydrogen distribution channel and the amount and type of thermal enhancement material used. Next, they conducted experiments to evaluate the effects of these variations on a range of performance parameters, including hydrogen storage capability, refill time, durability, discharge ability and residual capacity at a minimum discharge point.

"As the models predicted, we saw only minor differences in performance when we varied the graphite types. Likewise, the presence or absence of the hydrogen distribution channel had little effect on performance," says Narvaez. "These findings show that this application is not aggressively pushing the performance of the metal hydride storage to the point where these variations would make a difference. In fact, this is good, because it means we can use the lowest-cost solution and still expect good performance."

Using findings from their experiments, Joe and Narvaez developed an optimized storage-system design.

More incentives to switch to fuel cell technology

During this time, the team also began to conceive of a tube array that would allow efficient thermal management, to be achieved via water flows around the tubes.

With Sandia's and HHC's design complete, project activity will transfer to Hawaii, where HHC will produce the first prototype metal hydride storage system. HHC will work with Canadian fuel cell company Hydrogenics, which will integrate the new storage system into its proton exchange membrane (PEM) fuel cell power pack, designed to fit into a forklift.

"DOE catalyzed the market for fuel cell forklifts, using industry cost-sharing to deploy more than 500 units through the American Reinvestment and Recovery Act," says Joe. "The private sector recognized the advantages of fuel cell forklifts, and deployed more than 5,000 additional units since then without government funding. If successful, the HHC project will lead to lower cost, improved-performance fuel cell forklift systems that will lead to even greater market growth."

Get Ready for Family Day 2014

(Continued from page 1)

when workers and their families and guests arrive.

Another change from five years ago involves non-US citizen members of the workforce (MOWs) and their family members. This year non-US citizen MOWs and their family members will be able to attend. Security requirements will have to be met and special paperwork will be necessary for both non-US citizen MOWs and families.

More details about those requirements will be available soon.

A key to remember for Family Day 2014 is just who is "family." Here are the guidelines from Labs' Corporate Policy Dictionary for bringing guests to this year's event:

"As a Member of the Workforce host, you may escort up to eight family members. This includes the employee's spouse, children, parents, siblings, grandparents, grandchildren, father-in-law, mother-in-law, son-in-law, daughter-in-law, brother-in-law, sister-in-law, step children, foster children, step parents, foster parents, and any relative who is a dependent of the employee. If there are no family members present, a single non-family (US citizen only) guest will be permitted."

Also, for this year's event, due to the DBIDS verification process at Kirtland Air Force Base entrance gates, the total number of people a worker may host and escort will be the capacity of a single vehicle being driven on base, but limited to a total party of eight.

Individuals — including Labs' student interns — who are interested in volunteering to work at Family Day 2014 in some capacity should contact Patty Zamora, Sandia Serves volunteer coordinator, at 844-2146 or pgzamora@sandia.gov.

A Family Day 2014 website, which will contain registration instructions, a Q&A document, lists of activities, maps, and the like will be available in mid-July.



MORE THAN 12,500 SANDIANS and their families and friends came out to enjoy Family Day 2009, visitings offices, laboratories, and other facilities around the Labs including the solar tower, where visitors were amazed by a thick steel plate melted by the power of focused solar energy. (Photo by Randy Montoya)

Predicting

(Continued from page 1)

include such things as alloys, polymers, or composites; components are switches, engines, or aircraft wings, for example, while systems can be entire airplanes, appliances, or even bridges.

Safer, more reliable vehicles, machines hinge on how materials perform

Understanding materials reliability and performance at the fundamental materials science level isn't important just to Sandia's national security missions. Performance is crucial to safety and reliability in spacecraft, bridges, power grids, automobiles, nuclear power plants, and other complex engineered systems.

The PPM approach has become a prototype for tackling other difficult materials issues. Materials science researchers recently used the approach in a proposal to understand brittle materials, establishing a multidisciplinary project that develops the fundamental science while delivering improvements to those who use these materials during the life of the project. That way, they don't have to wait years to reap benefits from the fundamental work. Future studies that could benefit from the approach include the aging of polymers and foams, friction between electrical contacts, and failures in glass-to-metal seals and in solders and interconnects.

"Too often, we are unable to predict precisely how a material will behave, and instead we must rely on expensive performance tests," says program manager Amy Sun (1814). "Capturing variability by tests alone is too expensive and not predictive."

PPM simultaneously tackles fundamental materials science issues at the atomistic and microstructural scale and engineering problems at the macroscopic scale.

Success requires connecting the two extremes. "The research focuses on where the scales connect — where the atomistic level and a single crystal intersect and where the crystal level and the component level intersect — to predict collective behavior," says lead investigator Brad Boyce (1831).

Researchers examine how and why metals deform so they can predict that behavior and ultimately make metals stronger. Better understanding could lead both to better materials and improvements in processing

materials. "It's one thing to predict failure. It's another to make metals better so they don't fail," Brad says.

PPM draws on expertise Labs-wide

Sandia's core mission of nuclear weapons stewardship and national security requires it to meet the highest standards. "Few places in the world are asked to guarantee lifetime performance of complex engineering systems," Amy says. But at Sandia, "we have to put a label on, 'Best used by,' and when we do, what are the scientific data that back our claims? We have to support our results with sound, quantitative evidence."

PPM draws on expertise across Sandia's campuses in New Mexico and California to study materials' behavior at different scales, applying materials science, engineering science, and physical, chemical, and nanoscience. PPM researchers use such advanced characterization techniques as 3-D microscopy and focused ion beam and digital image correlation, as well as quantum and atomistic simulations and mesoscale material mechanics.

From the bottom up, the program studies how atoms undergo rearrangement that initiates defects in response to mechanical stresses and strains (nanoscale); how these crystalline defects evolve, multiply, and interact (mesoscale); and finally, how an ensemble of polycrystals works in concert to govern deformation and failure of a component (macroscale).

At the top end, PPM looks at how manufacturing processes determine the microstructure of a material and examines test data and failure statistics to better understand the relationship between microstructures and how engineering materials perform.

Laser welds better understood through pilot study

One pilot study involves laser welds, widely used in engineered systems. Weld performance can be unpredictable because a weld's microstructure isn't homogeneous and geometric imperfections such as cracks and pores can be introduced in the welding process. The aim is to understand a basic engineering question: how the microscopic variability of a weld impacts the mechanical reliability of a welded component.

"We could say, 'If you weld it with this margin of overdesign, you're probably OK, you're probably safe.'" Amy says. "But as a materials scientist, you're not going to be happy with that answer."

Instead, material scientists and system designers want to predict the effects of porosity on such weld

properties as strength, ductility, and toughness. "How do these little microscopic pores or any kind of imperfections in your microstructure affect the actual material properties?" Amy asks. "How do we measure that? What is that fundamental mechanism for the pore to start failing?"

PPM studies pure metal. Knowing how atoms in crystals interact allows researchers to calculate interatomic forces. The calculations are used to predict how single crystals of the metal will respond to external stresses, and in turn, the how engineering materials, such as aggregates of small single crystal grains, will perform. While it's not possible to model every atom in engineering-scale codes, "if you understand the atomistic effects well, you can approximate it very accurately in the high-level codes," says senior manager Rick McCormick (1110).

Researchers use such tools as transmission electron microscopy to view individual atoms while bending and breaking tiny components or parts. "They can see what's happening to these grains and these boundaries, how the stresses build up. They can see it at a microscale, where they're looking at aggregates of grains," Rick says.

Atomic-size crystals to large-scale testing covered by PPM

Then they scale up, running experiments on bigger components at Sandia's large engineering science test facilities.

When PPM began in 2010, it didn't take long to assemble a core multidisciplinary team of about 20 staff members and postdocs augmented by a large network of people doing interrelated projects, the "friends of PPM."

"Everyone wanted to work on this problem," Amy says. "It was so interesting and relevant to pretty much everything we do."

The work is part of Sandia's science-based nuclear stockpile stewardship mission, Rick says.

PPM already has had an impact. On the engineering side, nuclear weapons programs are using PPM expertise to help component engineers understand how to better design and qualify structural components and modify material processes such as recrystallization to achieve improved performance. In fundamental science, 20 PPM articles have been published in peer-reviewed scientific journals. PPM team members have given more than 100 presentations and international conferences have had sessions on PPM-related topics.



TODSTWD

Take Our Daughters and Sons To Work Day

Photos by Randy Montoya

Last week more than 700 Sandians brought 1,496 kids to work to celebrate Take Our Daughters and Sons to Work combined with Earth Day. Visitors observed or participated in 47 activities around the Labs and even some activities at Kirtland's Special Operations Wing.

Students enjoyed visiting the Robotics Vehicle Range, and visited venues where they learned about systems thinking, high-performance computing, space communications, electromagnetic launchers, and solid state lighting, to mention only a few of the activities that Sandians presented to show their sons and daughters, nieces, nephews, and friends about the wide range of work at Sandia.

"We couldn't plan such a great day without the support of those putting on the activities," says Pam Catanach of Community Involvement Dept. 3652, which coordinated the event. "Sharing a day in their work life, showing their kids what they do, and even seeing a part of the Labs they never see means a lot to our workforce."

Over the lunch hour on Hardin field, the kids got a chance to do lots of hands-on activities and have lunch with their parents and mentors. The Schiff Auditorium was full of informative Earth Day displays.

As the day wound down Dee Brock (2726) summa-

ri- zed the feelings of many when she said, "Thank you for this very special day with my children. I make sure they come here and learn something to take back to school with them."



Expert on Afghanistan develops system to help US better understand corrupt government systems

By Heather Clark

A senior associate with the Carnegie Endowment for International Peace who spent nearly a decade in Afghanistan called for a new, more systematic approach to thinking about corruption.

In the latest National Security Speaker Series presentation, Sarah Chayes, a former National Public Radio correspondent, gave a talk, "From Afghanistan to Ukraine: Why Corruption Is an International Security Problem." By thinking about corruption in a more systematic way, the US might discover that at times providing technological security solutions — or more broadly, cooperation or bilateral assistance — may be unhelpful or even counterproductive to US national security interests, she said.

Chayes was an eyewitness to the fall of the Taliban in 2001 and lived in Kandahar for eight years among the populace working for a non-governmental organization until 2009, when she joined the International Security Assistance Force (ISAF) as a special adviser to commanders Gen. David McKiernan and then-Gen. Stanley McChrystal. In 2010, she was tapped by Chairman of the Joint Chiefs of Staff Adm. Mike Mullen to serve in a similar capacity.

In Kabul, she helped build a comprehensive anticorruption policy for ISAF and assisted the US embassy in developing an integrated approach to Afghan kleptocracy. The effort was essential, she believed, to defeating the Taliban insurgency.

"We had a tendency to think of corruption as a flaw, a failing, or an aberration," she said. "What I came to understand was that no, corruption was the system and



SARAH CHAYES, a senior associate with the Carnegie Endowment for International Peace, told a National Security Speaker Series audience that the US needs a more systematic approach to thinking about corrupt government systems. (Photo by Randy Montoya)

it was operating effectively."

Over a number of years, Chayes used her knowledge to develop a systematic approach to explaining corruption in Afghanistan using a diagram that she shared with the audience. The diagram depicted the Afghan government as a set of overlapping criminal organizations and showed how money and resources are funneled upward from the population to those with power through kickbacks, gifts to superiors, customs duties, bribes for services, or bribes in return for carte-blanche permission to extract resources and protection from repercussions from those at the top — or

else to avoid punishment.

In Afghanistan, Chayes said, the system of government was effective at extracting resources for personal gain, but actions associated with governing were merely a front activity designed to occupy the US, which, at times, unknowingly reinforced the system.

At an international conference in 2009, Chayes discovered that her analysis of Afghanistan's system of corruption resonated with military and law enforcement officers from a variety of countries. In each of them, extremist insurgency was active. She realized that the connection between acute corruption and insurgency was not unique to Afghanistan. Since 2011, she has been systematically examining the serious threats to international security that flow from acute government corruption — insurgency, revolution with unpredictable spin-offs, symbiosis with transnational criminal organizations, intellectual property theft, and others — in places from Ukraine or the Arab Spring countries to Nigeria.

Her objective, she says, is to help provide a more accurate understanding of the security trade-offs in dealing with these countries, and help generate alternatives to the worst option for civilian and military officials, as well as private industry, operating in them.

"As we think of how we interact with these countries, we need to think about interacting at least in ways that are not going to re-enforce the control of the kleptocratic system over both its population and the resources that ought to be benefiting that population," she said.

"Because not doing so too often leads to profound security repercussions."

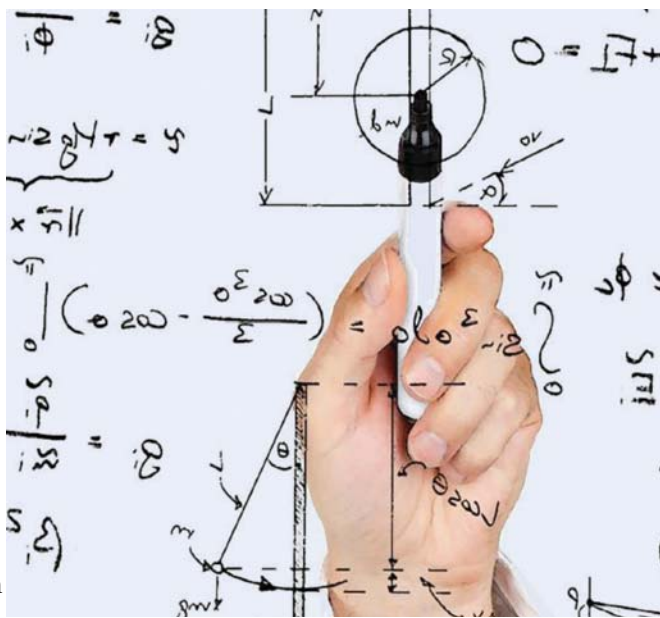
Research Quality Standards

Don't be fooled by the data or your tools

Some high pressure physics experimental data were taken during experiments at Sandia and at another research institution with very different results. A theoretical physicist at Sandia then did extensive first principles calculations that agreed with the Sandia data to within 5 percent, while the other institution's data differed with Sandia's by 50 percent. In trying to understand the 5 percent difference, the Sandia scientist noted that previous calculations had not included the quantum mechanical quantity known as spin.

In setting out to redo the calculations with spin included, the scientist discovered that the computer code he was using had a hard-wired limitation that required that the spin calculations use 1/6 fewer atoms than his earlier simulations. This seemed like a small difference so he went ahead with the computer runs. To his astonishment the new simulation results tracked right through the Sandia experimental data with a difference well under 1 percent. These remarkable results suggested that the prevailing thought in the community, that spin would have a negligible effect, was fundamentally wrong.

Fortunately this scientist had enough wisdom to resist the urge to publish the astonishing result and to think about it more deeply. It bothered him that the simulations with spin didn't have the same number of atoms as the earlier calculations. It wasn't really an "apples to apples" comparison. So, he reran the no-spin calculations with fewer atoms and he modified the code to allow spin calculations with more atoms. The inclusion of spin made no difference after all. The prevailing thought that spin had a negligible effect appeared correct after all, but it was now clear that simulation size effects could be very significant. Establishing, with yet more atoms, that the larger simulations converged with respect to size, he published his results. A decade later, after experimental techniques were considerably refined, the data were revised and now agree with the scientist's published results within 1 percent.



Moral of the story

There may be more than one explanation for how you got the results you did and only one of them is the one you were hoping for. Challenge your own results. Ask yourself, "How could the data or my tools be fooling me?" Make sure your comparisons are really "apples to apples" and that you are not changing multiple parameters at the same time. Develop concepts, theories, or models that could provide an alternate explanation for the results you acquired and test the most likely ones out to validate that the one you expected is the most likely explanation. In some cases you may be able to test your understanding by "turning off" the phenomenon, then "turning it on" again.

For more information about Sandia's Research Quality Standards or to download the entire document with its 50 case studies, go to the Chief Technology Officer website at cto.sandia.gov.

Congressional staff members tour Sandia



PICTURED HERE outside Sandia's Weapons Display Area are, left to right: Jim Handrock, Sandia director of New Mexico Weapon Systems Engineering; William Todd, staff member for Sen. Thad Cochran, R-Miss.; Stacy Oliver, staff member of the Senate Foreign Relations Committee; Lowell Schwartz, staff member of the Senate Foreign Relations Committee; Matt Padilla, staff member for Sen. Tom Udall, D-N.M.; Peter Schirtzinger, staff member for Sen. Deb Fischer, R-Neb.; Jerry McDowell, Sandia Deputy Labs Director and Executive VP for National Security Programs; and Jason Rauch, staff member for Sen. Claire McCaskill, D-Mo.

A congressional staff delegation, including Senate Foreign Relations Committee and member staff, recently completed a visit to Sandia. The delegation's briefings and tours included a Sandia Nuclear Weapons Mission Area overview presented in the Weapons Display Area, the Microsystems and Engineering Sciences Applications complex, US Nuclear Weapon Detonation Detection System, and a high energy density physics overview at the Z machine's pulsed power facility.

Sandia annually conducts more than 150 hosted VIP visits to further understanding of and communication about the Labs' exceptional service in the national interest, including briefings on specific projects and programs. Visits such as those of the congressional staff delegation emphasize the importance of mission work underway at Sandia, and Sandia's broader role on behalf of US national security.

Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads

MISCELLANEOUS

REFRIGERATOR, excellent condition, \$300; beautiful framed prints, originally \$60, \$25; other furniture. Brown, 232-2626.

HOLIDAY DINNERWARE, Nikko Christmastime, many sets/pcs., call for list & photos. Plummer, 301-3457.

VERIZON IPHONE4 CAR CHARGER, protector screens, \$25. Wiese, 505-506-7936.

BASSINET, Kolcraft Cuddle 'n Care, bottom storage, musical mobile, w/light/bears & vibration, excellent condition, \$60. Pacheco, 505-508-6442.

MICROWAVE, under cabinet, Frigidaire, 1.7-cu. Ft., 1000-W, \$200; dishwasher, Frigidaire Gallery, 24-in., E-star, both stainless, \$275. Garasi, 908-7982.

COMPUTER DESK, oak, w/hutch, Oak Express, 56" x 25" x 66", \$375. Kirk, 281-6668.

IPHONE 5, T-Mobile, white, 16 GB, used 3 mos., \$350; TV stand w/glass doors, \$250. Scott, 505-301-6554.

MOVING, bedroom set, \$350; chaise chairs, \$60; treadmill, \$200; patio table w/4 chairs, \$75; air hockey, \$100. Mehler, 400-5908.

JEWELRY BOX, 5 drawers, like new condition, photos available, \$25. Sandoval, 505-238-8998.

CONVERTIBLE CRIB TODDLER BED, w/mattress, light wood, changing table w/cushion, dresser, excellent condition, \$150. Menke, 688-4106.

FREEZER, Sears, 3.0-cu. ft., 34"H x 24"D x 21"W, model 564.24501100, \$40. Shaw, 980-7491.

FUTON, medium oak, sleigh arm rest, inner spring, w/3 matching tables, photos available, \$600. Ward, 292-1618.

DVD PLAYER, Sony DVP SR500H, w/remote, \$20. Hennessey, 505-269-6243.

GAS STOVE, Kenmore, white, \$75. Gonzales, 505-296-8006.

BARBERSHOP EXTRAVAGANZA, New Mexichords annual show, May 16-17, www.newmexichords.com for info & tickets. Taylor, 323-6435.

CAMP HUMANE, Animal Humane's summer camp, now accepting online registration, kids 8-11, www.animalhumanenm.org. Witt, 565-0028.

DISHWASHER, '96 Kitchenaid Superba, works well, \$50. Paquette, 505-366-4391.

WASHER & DRYER, Whirlpool, \$160/both. Brewster, 238-4704, ask for Julie.

DOG RUNS, 2, 6' x 10', chain link, Cabezon, Rio Rancho, \$100 ea. OBO. Griego, 505-980-2755.

YOUTH SWIM TEAM FORMING, ages 5-18, May-July season, KAFB Aquatic Center, Wall, 252-3431, robwall83@gmail.com.

CRAFT FAIR, Saturday, May 3, 9 a.m.-4 p.m., La Cueva high school, 150 vendors, email questions. Bullington, 220-7113, lacuevacraftshow@hotmail.com.

HOME GYM, Bowflex Ultimate 2, all-in-one, total body workout machine, 95 different exercises, \$325 OBO. Holt, 350-7868.

BATTERY CHARGER/STARTER, Cen-Tech 10/2/5 amp, \$45; iPhone 5 case. w/stylus, \$20; Duro shatter guard screen protector for iPhone 4, \$15. Garcia, 280-5815.

DINING SET, solid oak, 42-in. round table, extends to 60-in. w/leaf, 4 chairs, excellent condition, \$225. McDonald, 554-2048.

PATIO SWING, new seat & cushions, \$100; toy box w/building blocks & many small toys, \$25. Drebing, 293-3335.

SOFA & LOVESEAT, solid oak, mission frame, Southwest design fabric cushions, excellent condition, \$460. Martinez, 702-6767.

TRANSPORTATION

'08 CADILLAC CTS-4, AWD, 3.6L, tri-coat red, beige heated leather interior, all upgrades, gorgeous, 84K miles, \$19,400 OBO. Goodson, 505-407-1688.

'09 HONDA CIVIC LX, 4-dr., AT, PL, PW, AC, CD, >38-mpg, 83K miles, well maintained, excellent condition, \$10,900 OBO. MacDonald, 505-948-9014.

'73 MGB, restored, wire wheels, roll bar, tonneau cover, spare parts, super fun to drive, \$8,250. Bendure, 280-3324.

'08 MITSUBISHI LANCER GTS, 80K miles, great condition, \$11,500 OBO. Grassham, 489-0931, ask for Johanna.

'12 FORD FOCUS SE, manual, ceramic tint, 41K miles, 39-mpg highway, premium wheels, nice stereo, \$11,500. Georgievski, 520-610-0001, ask for Jason.

'06 TOYOTA RAV4, 4WD, very clean, 1 owner, 61K miles, excellent condition. Gorman, 505-269-2969.

'93 FORD EXPLORER EDDIE BAUER SPORT XL, V6, PS, PB, AM/FM/CD, 99,456 miles, very good condition. Guerra, 252-0024.

'09 SUBARU IMPREZZA WRX, only 48K miles, still in very good condition, \$19,000 OBO. Naegle, 505-400-7366.

'99 FORD F150, 4x4, V8, camper shell, tow pkg., 150K miles, excellent condition, \$6,400. Tebo, 238-9253.

'93 TOYOTA T100, V6, 2WD, regular cab, long bed, <50K miles on rebuilt motor, 200K miles on body, \$5,200 OBO. Wolfgang, 505-414-1483.

How to submit classified ads
DEADLINE: Friday noon before week of publication unless changed by holiday. Submit by one of these methods:
 • EMAIL: Michelle Fleming (classads@sandia.gov)
 • FAX: 844-0645
 • MAIL: MS 1468 (Dept. 3651)
 • INTERNAL WEB: On internal web homepage, click on News Center, then on Lab News link, and then on the very top of Lab News homepage "Submit a Classified Ad." If you have questions, call Michelle at 844-4902. Because of space constraints, ads will be printed on a first-come basis.

- Ad rules
1. Limit 18 words, including last name and home phone (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)
 2. Include organization and full name with the ad submission.
 3. Submit ad in writing. No phone-ins.
 4. Type or print ad legibly; use accepted abbreviations.
 5. One ad per issue.
 6. We will not run the same ad more than twice.
 7. No "for rent" ads except for employees on temporary assignment.
 8. No commercial ads.
 9. For active Sandia members of the workforce, retired Sandians, and DOE employees.
 10. Housing listed for sale is available without regard to race, creed, color, or national origin.
 11. Work Wanted ads limited to student-aged children of employees.
 12. We reserve the right not to publish any ad that may be considered offensive or in bad taste.

'01 MERCEDES CLK430 CONVERTIBLE, every option except navigation, blue w/charcoal leather, 22/28-mpg, 114K miles, excellent condition, \$6,800 OBO. Dwyer, 271-1328.

'99 DODGE DAKOTA, V6, custom bed cover, silver, only 83K miles, excellent condition, \$5,800 OBO. Martinez, 916-662-3705.

'87 OLDSMOBILE CUTLASS CRUISER WAGON, V6, power everything, cold AC, everything works, seats 7, great condition, \$2,300 OBO. Morgan, 505-452-6137.

RECREATION

'04 KAWASAKI VULCAN 2000, light blue, 8,500 miles, garage-kept, very clean, photos available, \$4,500 OBO. Gallegos, 463-1553.

'01 EXCEL 5TH WHEEL, 28-ft., w/slide out, fully loaded, fiberglass, great condition, \$12,500. Chavez, 505-898-9252.

'05 HYOSO ALP MOTORCYCLE, 250 cc, 7670 AM, good condition, \$1,100. Finley, 514-1083 or 293-1961, nights.

'09 HARLEY FLSTSB CROSSBONES SPRINGER SOFTAIL, low miles, V&H pipes, S&S cams, many extras, \$12,250. Anderson, 681-5825.

'10 KZ SHREE 318BHS TRAVEL TRAILER, sleeps 9, 2 slide outs, many extras, excellent condition, \$17,000 OBO. Saiz, 379-4351.

'05 KYMCO PEOPLE 250 SCOOTER, silver, 12K miles, well cared for, \$1,500 OBO. Verley, 410-9885.

REAL ESTATE

4-BDR. HOME, 1-3/4 baths, 1,920-sq. ft., 2-car garage, fireplace, refrigerated air, many new upgrades, Taylor Ranch area, FSBO, \$180,000. Abrams, 898-3769.

3-BDR. HOME, 2-1/2 baths, 1,410-sq. ft., north of Manzano Community Center, \$159,500. Wright, 505-332-0073.

4-BDR. HOME, 2-1/2 baths, 2,777-sq. ft., formal living & dining, 2-story, landscaped, pond, MLS#806686, will consider REC. Maestas, 505-459-7650.

ACRE, vacant land, Brazos Canyon, Chama, trees, wildlife, driveway, home site, electricity on property line. McClellan, 847-669-1827.

4-BDR. HOME, 2-1/2 baths, 2,733-sq. ft., 2-car garage, refrigerated air, end lot, cul-de-sac, Glenwood Hills, city view, \$315,000. Armstrong, 271-8302.

3-BDR. HOME, 4-1/2 baths, 3,489-sq. ft., game room, sauna, courtyard, 10 acres, San Pedro Creek Estates. Cunningham, 505-280-3065.

4-BDR HOME, 2,093-sq. ft., new home, never lived in, must sell, I 40 & 98th, \$269,000 OBO. Sanchez, 293-7246.

WANTED

JOGGER STROLLER, swivel wheel, good condition, single preferred, but double OK. Haltli, 306-6031, ask for Jenny.

HELP WANTED, looking for a few teenagers for part-time landscaping work, near Rio Grande & Candelaria. Hunt, 681-9960.

Meet Sandia's 2014 STAR interns



THE STAR HIGH SCHOOL INTERNSHIP PROGRAM was created to encourage students entering their last year in high school to pursue careers in STEM and to foster excellence in those fields. At a recent "Meet & Greet" with the 2014 STAR students and their Sandia mentors, the students took a moment to sit for an informal photo. This summer's program is scheduled to run for eight weeks beginning on Monday, June 9, and ending on Friday, Aug. 1. (Photo by Rachel Baros)

Mileposts

New Mexico photos by Michelle Fleming



Larry Yellowhorse 40 6913



Keith Meredith 35 2734



David Bailey 30 4870



Cory Ottesen 30 5333



David Humble 25 4824

Recent Retiree



Roy Jorgenson 25 1352



Daniel Ramirez 25 1384



Amy Tapia 25 3652



Jean Pena 20 5564



Greg Tipton 20 1523



Renee Mueller 15 9543



Michael Williams 15 2154

Katie Jungjohann feels lucky (but perhaps there's more to it?)

By Neal Singer

Katie Jungjohann (1132) received her doctorate in materials science little more than three years after receiving a bachelor's degree in chemistry — an enviably short time to ascend the academic ladder.

After only a year as a postdoctoral appointee at Brookhaven National Laboratory, she came to Sandia in March 2013 as the staff scientist responsible for the Center for Integrated Nanotechnology's (CINT) transmission electron microscope (TEM) laboratory.

CINT is operated by Sandia and Los Alamos national laboratories for DOE's Office of Science as a national user facility to develop scientific principles that govern the design, performance, and integration of nanoscale materials.

In addition to her own research, Katie collaborates on some of the most important user projects that come from outside CINT, maintains the ultra-modern instrument, and trains doctoral and post-doctoral students in its use.

Asked how she progressed so rapidly in her career — she is already a senior member of Sandia's technical staff, with 11 technical publications to her credit — Katie attributes her success in part to growing up in a family with high academic expectations.

"Just lucky, I guess," she says.

She didn't follow her family's primary focus, medicine, because she failed to meet her own expectations on the MCAT exam — the prerequisite test for medical school. Her self-assessment was that she had terrible English skills: "awful grammar, and I can't spell for the life of me." Luckily, her future was already shaped in part by her work under three very good high school teachers in physics, math, and chemistry.

She received her doctorate from the University of California, Davis so rapidly because her adviser left for a job at Pacific Northwest National Laboratory after Katie had helped advance a new TEM technique.

"The idea [of imaging liquids in a TEM] had been around since the 1930s but it proved a hard task to prepare a sample that could survive the experience," she says. "Researchers tried to contain the liquid by encasing the sample between little windows made of carbon films, but to survive electron beam exposure, the films had to be so thick that the imaging radiation could barely pass through them."

In 2003, a research article suggested silicon nitride windows might be made thin enough to transmit electrons, yet mechanically robust enough not to break inside the microscope.

In 2008, a company commercialized this instrumen-



SANDIA'S KATIE JUNGJOHANN (1132) sends electrons through materials to analyze their structure at the Sandia/Los Alamos-run Center for Integrated Nanotechnology. (Photo by Randy Montoya)

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tation with a better device to hold the ultrathin windows. "My adviser was collaborating with the company," Katie says. "They gave us their product for a reduced fee, and we gave feedback on how it operated. I was fortunate to be one of the first students working on this holder for liquid-cell TEM. I spent my time in grad school learning how to perfect the technique."

It seemed that the harder she worked, the luckier she got.

She was invited to test her samples on a dynamic TEM (DTEM) at Lawrence Livermore National Laboratory, at the time the only DTEM in the world. This instrument is capable of achieving 15-nanosecond images at 10-nanometer resolution.

"Looking at transient states in irreversible processes, you need high temporal resolution," she says.

One reason the DTEM could image samples so frequently was because it used a reduced electron beam current that damaged samples less. "I'd love to have one of those machines at CINT," she says.

But she's happy at Sandia using spectroscopy to locate specific energy losses on nanomaterials suspended in a liquid. The losses reveal chemical composition as well as information about electronic structures.

Helping in the quest to improve battery efficiency, she uses the TEM to study how lithium ions enter an electrode. "Batteries transport lithium ions from cathodes to where they insert themselves in the atomic lattices of the anode, a process called intercalation. For optimal electrical storage capacity, manufacturers would like to engineer the solid-electrolyte interface to improve ion transport and reduce the products causing

degradation. To this end, our characterizations are used as feedback to people in modeling, or to the synthesis people to re-engineer new materials.

"Also, our users tell me how they synthesized a material. I tell them my results, and then suggest varying the structure to see if it works better. Some people," she says, smiling slightly, "get upset because they think the TEM is wrong."

She loves understanding the fundamental properties of materials, and feels fortunate to be in the right place to do it. "I like TEM work at CINT because we're not investigating the same structure every day. We use our tools to help other people answer their materials questions, so there's something new to be learned all the time.

"We have limited resources, but we do pick the most impactful science. We're trying to build fundamental structures and methods to test them more efficiently so we can excel in other areas of research."

Asked about her hobbies, the former national backstroke swimming competitor deflects the question. "It takes time to get grounded. I spend a lot of hours here — Sundays less than Mondays," she says wryly.

Fortunately, her self-employed husband — the proverbial childhood sweetheart she met in Oregon — can keep pace with her rapid career moves because he makes indoor climbing holds to sell online. His craftsman job dovetails with the upcoming need for an at-home parent for their expected baby. Several Sandia TEM experts will seamlessly manage the lab during Katie's absence.

"I stay very busy, and I'm very happy to be here," she says. "I guess I'm just lucky."