Sandia researchers create nanocrystals nature’s way

\[ \text{Diatoms, seashells provide lessons for development of complex nanomaterials} \]

By Michael Padilla

Sandia researchers are developing complex nanomaterials that look strikingly similar to the microstructures of diatoms and seashells. Such materials may have potential for a wide range of applications. Jun Liu (1846) says the ultimate goal is to develop general science and technology for reliable and scalable production of nanoscale materials based on environmentally benign chemical processes.

The research team currently includes Jim Voigt, Zhengrong (Ryan) Tian (1846), Matt McDermott (1846), Randy Cygan (6118), Louise Criscenti (6118), Dianna Moore (1846), Jessica Bickel (1846), and Tom Souarn (1141). The team’s intent is to be able to predictively and precisely control a wide range of materials properties that are critical for the materials and device performances. These include composition, particle size and shape, crystalline structure, orientation, particle morphology, surface, and interface chemistry.

Jun says the biochemical processes involved in biomaterials are too complicated for synthetic materials. The team is learning from the physical and chemical principles behind the formation of natural materials, and is developing synthetic routes to achieve similar structural control for the production of nanomaterials.

The project intention is that such extended and oriented nanostructures will find applications in microelectronic devices, chemical and biological sensing and diagnosis, catalysis, and energy conversion and storage including photovoltaic cells, batteries, capacitors, and hydrogen storage devices. These structures could also have potential for light-emitting display, drug delivery, and optical storage.

“We have already demonstrated superior photocatalytic properties and new chemical sensor devices with our new materials,” Jun says. The team has demonstrated complete control of where and how crystals are formed by selectively activating the specific surface they desire to grow and spontaneously producing complicated three-dimensional structures that cannot be formed by other means.

Understanding nature’s strategies

“We are not interested in duplicating the mechanisms in natural materials,” Jun says. “Nor are we interested in reproducing biominerals.” However, Jun adds, an understanding of nature’s strategy is necessary to comprehend how to create similar structures.

The strategies nature uses to produce biomaterials are drastically different from synthetic approaches. Natural materials are produced at low temperature — mostly room temperature — and do not produce significant waste. Seashells and diatoms extract calcium and silicate ions from ocean water to form hard tissues to protect the living organisms.

Natural systems use sophisticated protein molecules to precisely control the orientations and morphologies of the biominerals in order to optimize the material’s properties such as the mechanical strength. As a result, very complex architectures are formed, such as in diatoms from low temperature — mostly room temperature — and do not produce significant waste. Seashells and diatoms extract calcium and silicate ions from ocean water to form hard tissues to protect the living organisms.

The journey toward improved business systems continues at Sandia

Two more Sandia departments become ISO-certified

By Chris Burroughs

The journey toward improving business continues at Sandia as two more organizations become ISO (for International Organization for Standardization) certified.

Certified in May was Telecommunications Operations Dept. 9334. In July the International Contracts and Import Export Control Dept. 10257 received notice it has been recommended for ISO 9001:2000 certification.

Two other organizations have been certified in the past several years — Manufacturing Enterprise Departments 14181, 14186, and 14111 and the Material Processing and Coatings Laboratory.

The organizations sought ISO certification as one way to improve their business management systems into a fully integrated, well-understood, data-driven system that enables delivery of products and services that meet customer requirements.

ISO was established in 1947 as a nongovernmental worldwide federation of national standards bodies from some 140 countries. It promotes the development of standardization and related activities to aid the international exchange of good and services. It also bolsters cooperation in intellectual, scientific, technological, and economic activity. ISO’s work

(Continued on page 4)
What’s what

You would have thought last Thursday after work was MESA Day at Garduño/Winrock, and you can forget that stereotypical image of the quiet, shy, geeky Sandia techie who wouldn’t know a canapé from a canopy. MESA was outstandingly represented along the back wall of the patio by a boisterous, laughing, chattering, milling, munching, sipping group that just kept growing and growing.

They were having such a great time that I wondered if we’d gone through a time warp and MESA was finished. A drive-by the following morning deep-sixed that notion. But if that many happy MESA people can have that much fun at just the start of the project, whew! . . . I’d like to have the margarita and salsa concession for the finish!

Life shouldn’t always be serious, and Laurence Phillips’ recent “out-of-office” e-mail response reminded me of that and gave me a real chuckle – and a lot of others, too, I bet. He wrote:

“11:00 out until next Wednesday (7-16-03) dealing with my daughter’s wedding. My primary all-around boss and pearl of great worth is Barbara Maclais at 844-2219. She can possibly help you until I get back, but don’t abuse the privilege. Later, LR”

* * *

Sandians are justifiably proud of the precision and elegance of a half-century of work on some of the most exacting systems in existence. That amazing record is marveled at inside and outside the lab.

Imagine, then, Jack Hudson’s (9322) double-take at some small red-on-white signs along the H Avenue sidewalk just north of Bldgs. 864 and 751: YEILD TO ON COMING TRAFFIC.

My amused, he e-mailed: “Wonder if the signs were painted at Sandia?”

I don’t know, but if they were, I hope the painters don’t matrix to a chemistry lab, or worse – the vacation records desk.

And on the subject of words, acronyms or initialisms are often bewildering, but sometimes you run across a really clever one. One such fell into my e-mailbox last week, compliments of John Dexter (9322).

Charles Shirley (9620) had submitted a proposed blurb for the Sandia Daily News (that’s my other hat) and copied Dex because it’s his subject. It got to the SDU e-mailbox, but not to Dex, so Charles sent it again. Same result.

Telephone calls ensued and it turned out Dex had received them, but they weren’t showing up due to something he had done. Realizing that, he responded: “Turns out all of your messages did show up in my mailbox. Let’s just say it was a cockpit error, a PIONIC (problem in chair, not in computer!”

So, if you make a mistake and discover it yourself, you can announce that the trouble has been sorted out and admit making the mistake without seeming to have done anything wrong. You can write back:

“No problem, dude; it was a picnic!”

— Howard Kercheval (844-7842, MS 0165, hckerch@sandia.gov)

Heart of Diversity

Award honors people who have positively addressed diversity

Ever see anyone in your workplace who has done something significant to positively address a diversity issue? You can now honor that person with a Heart of Diversity Award.

“The award is to give recognition for demonstrating knowledge and awareness around diversity issues, having the courage to take positive action on significant diversity issues, and making Sandia a better place to work,” says Rochelle Larri (1356), who heads up the Labs Diversity Leadership Program.

Giving the award is the Corporate Diversity Team (CDT).

Anyone can nominate people by contacting their division CDT representative. CDT members review the nomination, discuss it in the monthly meeting, and reach consensus on a decision to make the award.

The award is presented to the recipient at a future CDT meeting or by the person’s management at department or center meetings.

Some 50 people have been given the award since it was initiated in 2001. This is a simple, nonbureaucratic, and inexpensive way to reward appropriate behaviors of individuals who are, through their actions, creating an inclusive, high-performing workplace.

For more information contact Heidi Welberry at 844-7776 or Rochelle Larri at 844-2111.

Employee deaths

Kenneth Griego of Weapons Program Integration Dept.
2102 died July 26 from injuries suffered in a motorcycle accident.
He was 34 years old.

Ken was an electrical/electronics/emechanical engineer who had been at Sandia nearly six years.
He is survived by his wife Reanne, son Tomas, and daughter Mackenzie.

Larry G. Hoffa, of California Weapons Engineering Dept.
8243, died after an auto accident July 29.
He was 55 years old.

Larry was a technologist and had been at Sandia 35 years.
He is survived by his wife Donna, son Brian, and daughter Kelly.
I have worked at Sandia Labs over 25 years, and recently find myself looking for work elsewhere . . . any kind of work, anywhere else. It seems as though the entire organization is exploding. We have Assurance, Governance, Self-Governance, ISO 9001, and now the NW organization is going ISO 9000. There are mountains of DOE orders, dozens of committees, and stacks of required reports. There are internal audits, risk assessments, QA assessments, ES&H surveillances, Safeguards and Security Assessments, and probably others I don’t know about. There are some questions I have as a loyal employee who is very frustrated?

1) Who is in charge? What is their name?
2) Why are these efforts NOT connected and working together?
3) Why is ISO measuring its activities separate from the rest of the corporation? Aren’t they part of getting the service done? Doing the design?
4) Why can ANYONE ask us to do reports, surveys, assessments, but NO ONE has the authority to tell us to stop doing anything. We do 50 things 50 times, 50 ways.
5) We would not ask a chemist to do a physicist’s job, but we ask engineers and physicists to design infrastructure programs and businesses. They invent new things, but none of them make sense. Are there NO engineers in the lab with business management degrees, or training in re-engineering or business standards. Why do we put engineers in charge of business designs?
6) NW is creating a whole new system, unique to themselves. Has anyone noticed? Does this mean we have two separate corporations now, NW and Sandia? They do things different from each other. Is there anyone in management who understands that this is not ok? We should have some consistency in our corporate activities.
7) Last, but not least . . . if you are on the Admin side of the house, and you get a mentor on the technology side, you get to become an MTS (member of technical staff). This means you make $30,000 more for doing the same work. If you are an MTS and are having problems, you move to the Admin side of the house. You remain an MTS; still make $30,000 more than the others doing the same work you are. Unfortunately, you have to hire a $2,000-a-day consultant to help you out. (Because you are creating new things that a first year business student would understand). This policy, or lack thereof will get Sandia sued. Has anyone noticed?

A: Your sense of frustration is obvious, and I apologize for that. You are not alone in your concerns about how all of the various initiatives and goals fit together. Even those of us in the middle of many of these initiatives can lose sight of the forest while we’re hacking away at tree branches. And your questions have helped convince me that we are not doing a good job of communicating this within the Labs. So let me try a short explanation, and if you’d like more information I’ll be happy to provide it.

What may appear a bevy of initiatives created by Dilbert-like bureaucrats out of whimsy, boredom, or plain old cruelty do relate to one another under an overarching construct. — Pace VanDevender

**In California . . .**

**East Ave. closure adds new measure of security**

CLOSURE OF THE mile-long corridor between Sandia/California and Lawrence Livermore National Laboratory (LLNL) began Aug. 1, with access control instituted for this stretch of East Avenue in Livermore. Providing an additional measure of security — and set in motion following 9/11 after being considered for 20 years — the new checkpoints will allow access to anyone with a Sandia, LLNL, contractor, Department of Energy, or National Nuclear Security Administration badge, or residents on an authorized access list. To arrange for badges to be picked up by a visitor, contact the SNL/CA Badge Office at 294-3042. (Photo by Randy Wong)

**In California . . .**

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very simple chemicals such as silicate. Silicate, Jun says, is a very common ceramic material that is frequently experimented on in laboratories.

In general, Jun adds, the proteins play two important tricks. First, the proteins control where the mineral is deposited. Second, they control how the minerals are formed. In red abalone, a marine snail, water-soluble proteins control mineralization of calcium carbonate. Some of these proteins are responsible for the formation of column-like calcite (a natural form of calcium carbonate), while others are for the formation of plate-like aragonite (an unusual form of calcium carbonate). The cooperative action of these proteins produces a highly ordered nanocomposite composed of oriented calcite columns and close-packed aragonite nanoparticles. This combination gives the best mechanical properties to the hard tissue.

The process

The first step of the process is to understand and control the solution chemistry. Instead of using high temperatures, high concentrations of chemicals, and organic solvents, as widely investigated, the team studies low-temperature — well below the boiling temperature of water — and low-chemical-concentration experimental conditions in aqueous environments. Under these conditions the team has better control on how fast the materials grow from the solution and avoid precipitations commonly encountered.

The minerals are controlled where they are formed through chemical and physical means. Modifying of the surface chemistry is often used to stimulate the formation of the minerals on specific locations. Other times nanoparticles are used as the nucleation seeds from which the new minerals will be formed. Using this approach the team can control exactly how the minerals are formed, and potentially align and pattern the minerals for microdevices. The orientation, microstructure, and morphology of the crystals are controlled. Since the roles of mineral-directing proteins are not yet completely understood, and since they cannot be directly applied to synthetic materials, simple organic molecules are used to control crystal growth. Computer modeling is also used to help understand how the organic molecules bind to the crystals.

Overcoming challenges

“Making these kinds of complex nanostructures is a very significant challenge,” Jun says. “This is a very important new research area. Not a lot has been understood.”

However, Jun says, manufacturing of nanoscale materials in general remains a significant scientific and technological challenge. Most of the approaches currently investigated involve high-temperature processes and complex toxic chemistry.

One challenge now is to fundamentally understand how organic molecules affect crystal growth. Jun says this is not only a challenge for synthetic materials, but also a problem for biomimeralization that needs the attention of physicists, chemists, biologists, and material scientists.

Another challenge is developing general rules that will guide the production of a wide range of nanomaterials.

Optimistic outlook

Jun says the team is also in the process of developing tools to control the delivery, diffusion, and transport of the chemical species in the reaction chambers. “We will use Sandia’s state-of-the-art microfluidic platforms to provide precise control of the experimental parameters,” Jun says. “The microfluidic studies may also lead to methods for continuous manufacturing of tailored nanoscale materials, including nanoparticles, nanowires, and complex nanostructured films.”

The team recently published their studies in the Journal of American Chemical Society, Angewandte Chemie, and Nano Letters.

Jun says he hopes to bring visibility to this area and stimulate others to follow.

Electricity consumption spikes down during July 4th weekend

The New Mexico site’s holiday weekend “electricity spike-down” during the three-day weekend of July 4 resulted in some energy savings but fell short of the goal of using 40 percent less electricity than it uses on an average July workday, says Malynda Aragon (10862) of Sandia’s Energy Management Program. New Mexico employees were asked to minimize electricity waste during the three-day weekend. During a typical week in July, the site’s electricity demand peaks at 31 to 34 megawatts of continuous power. During the July 4 holiday weekend the site’s electricity demand dropped to 22 to 24 megawatts, or about 70 percent of normal. “A lot of energy is wasted during weekends when few people are around, so we thought we would challenge people to see how much energy we can save during one weekend,” says Malynda. The resulting 30 percent drop in demand is typical for a summer weekend, says Malynda. Watch the Lab News and Sandia Daily News for information about future spike-downs. For energy conservation information and assistance, call Malynda at 844-1288 or see Sandia’s Energy Management Program web site at http://www.im.sandia.gov/facilities/engn_proj/energyplan.htm.
results in international agreements that are published as international standards.

ISO 9001:2000 — the latest version of ISO 9000 — is used by companies seeking a management system that provides confidence in their products conform to established or specified requirements.

A robust Business Management System (BMS) that can be certified to ISO 9001:2000 means everyone in the organization understands how their work contributes to successfully addressing customer needs and requirements,

He adds, “However, being certified is not the end. It’s the beginning of a journey that never ends to improve business. Our philosophy is to offer organizations a method of improving their business by using the criteria of the ISO 9001:2000 standard. As the organization matures and improves, a by-product may be ISO 9001:2000 certification.”

Telecommunications

One Thursday in July two people in Media Relations and Communications Dept. 12640 were scheduled to swap offices. A little before 8 a.m., a telecommunications representative was on hand to change phones and take care of networking. What lies behind such prompt service?

As part of improving its business management system, the department defined seven areas of doing work.

“As a result of our efforts, we have greatly improved how we deliver our products,” says Mike Gomez (9334). “We can now respond faster to requests and problems.”

The concept of adopting ISO 9001:2000 was first mentioned in the department in the summer of 2000. Several department members took an ISO class in December 2000, and over the next two years all 130 employees in the department were bought into the concept.

The overall process from the time the customer communicates with you to the time you finish the work and communicate with them is pretty darn good.”

“It’s a lot of things: one is you have the best handle on measuring customer satisfaction I’ve seen yet, two is you have probably the most complex system to understand.”

Not bad, Mike says. But the department intends to continue to make improvements and be responsive to its customers. “We will keep seeking new and better ways to do our business.”

International Procurement

The International Procurement Team’s contracting effort with foreign suppliers around the world means they constantly work within a variety of different systems, regulations, and cultures. As a recognized worldwide quality management standard, ISO 9001:2000 provides the International Procurement Team (IPT) the ability to provide quality assurance to partners and suppliers around the world while meeting or exceeding customer requirements at home.

The department issued an internal pre-assessment audit performed by Bob Campbell representing the Performance Review Institute, followed in March 2002 by an official certification audit. It received certification to the 9001:2000 standard on May 13.

Mike says auditors noted on a scale of 1 to 10, the department rated a 9 in the area of staff commitment. Some of the comments from the auditors at the closing meeting included:

• “You guys have one of the best systems I’ve ever had to audit.”

• “I concluded your design process is pretty darn good.”

• “The overall process from the time the customer communicates with you to the time you finish the work and communicate with them is pretty darn good.”

• “You guys have become my benchmark in developing objectives and metric procedures and took on ownership of their business management system — something necessary in order to improve the business and sustain their system. After formalizing their processes, procedures, and objectives, the team performed a comprehensive internal audit followed by a comprehensive management review. The management review proved particularly beneficial to the team. It gave the team an opportunity to identify and address system deficiencies, customer evaluations, and feedback and then establish action plans and goals for the future. Roy was able to communicate to customers exactly what actions the team would be taking to address any concerns or deficiencies.

After the identification and correction of findings and deficiencies, the team engaged the services of an independent accredited third-party registrar for two days to review the organization’s operations and business management system.

“A robust Business Management System (BMS) that can be certified to ISO 9001:2000 means everyone in the organization understands how their work contributes to successfully addressing customer needs and requirements. It also acknowledges a system is in place that addresses identified problems or issues to assure sustainable improvements. ISO certification comes at a considerable effort.”

Roy notes that everyone in the department “became engaged” in developing objectives and procedures and took on ownership of their business management system — something necessary in order to improve the business and sustain their system.

During the exit conference, the registrar commented on the high quality of services the team was able to provide and referenced recent comments obtained from the department’s customers: “These people work above and beyond what I have experienced in most private-sector companies. Jet-lagged, working almost all night several nights in a row, and then still being able to negotiate with fresh adversaries on their home turf is exceptional. This doesn’t happen on the outside!”

At the end of the two-day visit the registrar notified the team that they would be recommended for certification.

Roy says he is already seeing measurable benefits and anticipates even more in the future as the department adopts corrective actions, preventative actions, and best practices in order to continuously improve ITP services. The benefits will come in the form of cost savings, efficiency, and better customer service.
Management promotions

New Mexico

Ann Campbell from Manager to Level II Manager, Microsystems Partnerships Dept. 5911.

Ann joined Sandia in 1985 as a technical staff member working in materials characterization. From 1989 to 1999, she worked in the microelectronics failure analysis department, focusing on advanced microelectronics analysis techniques. Ann has managed the Microsystems Partnerships Department within the Systems Assessment and Research Center since 1999. Her responsibilities include managing Sandia’s anti-tamper program, coordinating with Sandia’s science and technology organizations to bring their technologies to bear on national security challenges, and managing one of the Nonproliferation and Materials Control LDRD investment areas.

Ann has a BS in materials engineering from Rensselaer Polytechnic Institute and an MS and a PhD in materials science from Harvard University.


Since joining Sandia in 1983, Bill has worked in nuclear reactor safety, explosive field testing and component design, and as a member and manager of nuclear weapons emergency response programs. For the past two years, Bill has managed the Explosive Materials and Subsystems Dept. 2552, working with staff involved in analyzing and characterizing energetic materials, production of explosive components for weapon use, and surveillance of WR components. As Sandia’s new Emergency Response Program Manager, Bill will be working with a variety of organizations across Sandia to develop a unifying vision and technologies that can be applied to these important national response programs.

Bill has a BS in mechanical engineering from New Mexico State University.

Recent Retirees

To Janet Sheldon and Jack Smith (2991), married in Bernalillo, N.M., July 5.

To Terri and Hamilton (6517) Link, a daughter, Bronwen Faye, July 8.

Congratulations
How to submit classified ads
DAILY NEWS, Friday noon before week of publication,不停, $1,000.00, max $2,500.00. 310-321-2951.
$300.00, especially if used, $1,000.00, max $3,000.00. 310-321-2951.
$250.00, max $500.00. 310-321-2951.
$100.00, max $150.00. 310-321-2951.
$75.00, max $125.00. 310-321-2951.
$25.00, max $50.00. 310-321-2951.
$10.00, max $20.00. 310-321-2951.
$2.50, max $5.00. 310-321-2951.
$1.00, max $2.00. 310-321-2951.
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$2.50, max $5.00. 310-321-2951.
$1.00, max $2.00. 310-321-2951.
$0.50, max $1.00. 310-321-2951.
$3.00, max $6.00. 310-321-2951.
$1.50, max $3.00. 310-321-2951.
$0.75, max $1.50. 310-321-2951.
$0.50, max $1.00. 310-321-2951.
$350.00, max $700.00. 310-321-2951.
$200.00, max $400.00. 310-321-2951.
$150.00, max $300.00. 310-321-2951.
Sandia supplies books for 200 children at 33 sites in community’s annual Summer Reading Program

More than 200 children received free reading material appropriate for their age after completing the 2003 Summer Reading Program sponsored by the City of Albuquerque, Bernalillo County, Sandia, Lockheed Martin, KNME-TV, University of New Mexico Athletics, and Albuquerque Business Education Compact (ABEC).

Children ages 6-16 at 33 recreation sites took part. The sites and participants include city/county community centers, playground programs, and Boys and Girls Clubs.

Children who read six books received a book purchased by Sandia and Lockheed Martin and KNME-TV and two tickets to a UNM Lobo volleyball or soccer game. Books and tickets were distributed in July.

“The goal, she says, is to invent creative ways to keep children reading during summer months. Some ways to get older youth involved are to read to them or encourage them to read to younger children,” Williams as her favorite.

Darlene Leonard, volunteer program manager in Sandia’s Community Involvement Dept. 12650, handed out books to delighted children at the Whittier Community Center.

“We believe business should partner with education initiatives,” Darlene says.

Jesse Zamora, director of the Whittier Community Center, says the reading initiative complemented a literacy program already in place.

The goal, she says, is to invent creative ways to keep children reading during summer months. Some ways to get older youth involved are to read to them or encourage them to read to younger children.

Of Zamora’s students, Chelesa, 9, read six books, naming The Blanket Burglar by Sandra G. Garrett and Philip C.

Williams as her favorite.

Anthony, 11, read numerous books including Jack London’s White Fang and Call of the Wild.

Literacy is also valued at Anthony’s home.

“My dad is always reading,” he says.

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