SYNERGY

BECKMAN INSTITUTE FOR ADVANCED SCIENCE AND TECHNOLOGY

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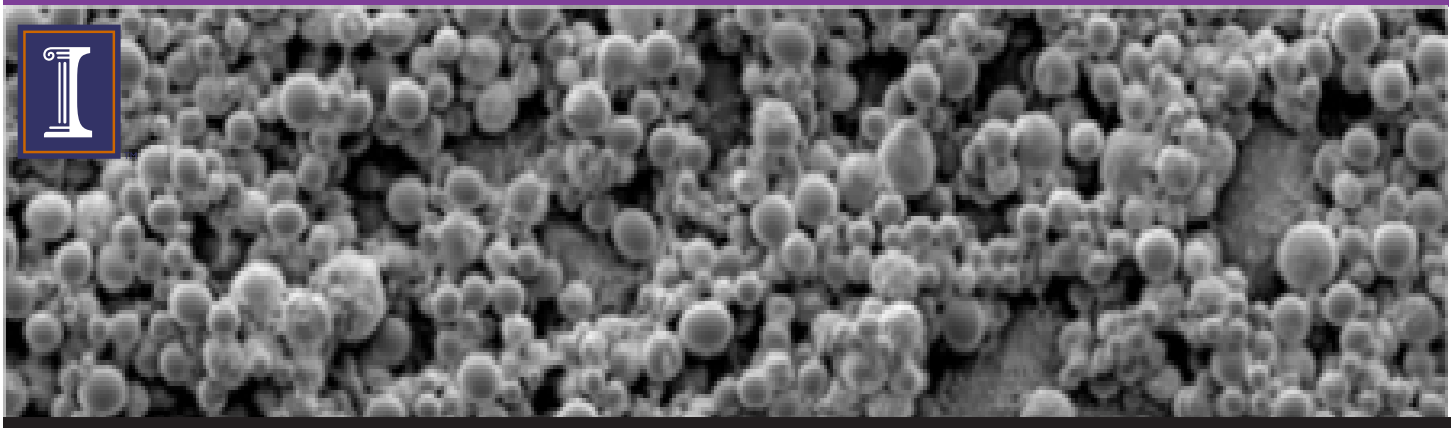

Faster, safer, more reliable, and more powerful

EV BATTERY SYSTEMS

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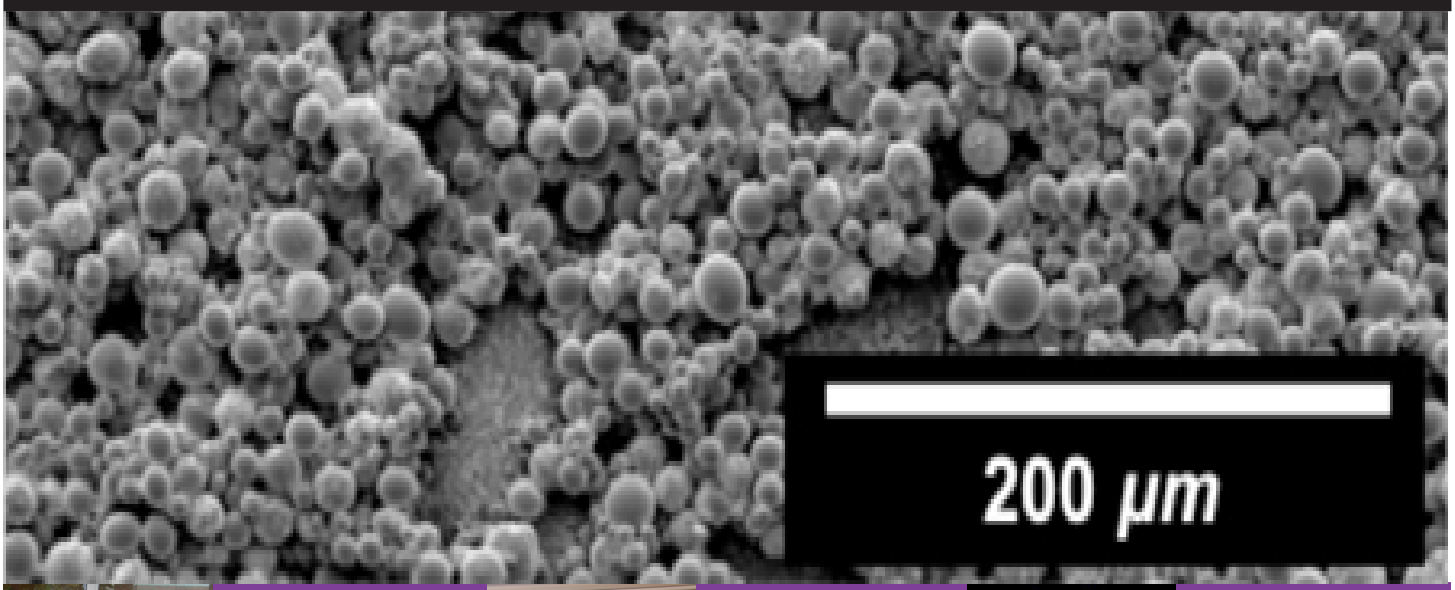

Minh Do's journey from Vietnam eventually led to doing research involving signal and image processing at the Beckman Institute and the University of Illinois.

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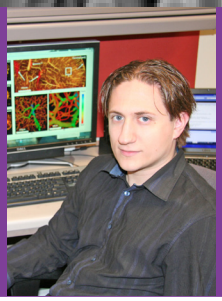

David Mayerich has made the most of his time as a Beckman Fellow as he prepares for life after his fellowship is done.

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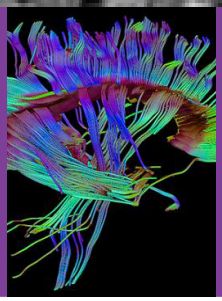

The newly-created Center for Nutrition, Learning, and Memory will offer researchers a unique opportunity to have an impact in nutritional health.

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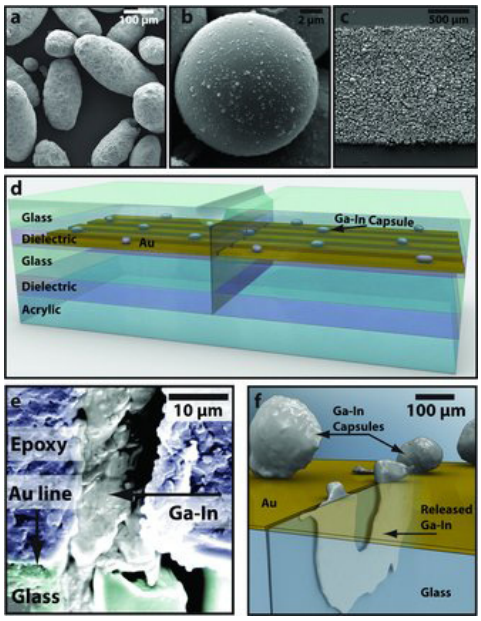
Faster, safer, more reliable, and more powerful

EV BATTERY SYSTEMS



Shown are self-healing circuit components, multilayer test specimen, and evidence of triggered release. Image courtesy Scott White.

The television ads are appearing more frequently and the cars they tout more recognizable. Within a few months public charging stations will start to spring up around central Illinois as electrical vehicles (EVs) enter the American consumer consciousness as a viable choice for motorists. And those EVs don't exist without batteries, just like laptops, cell phones, and almost every other one of the electronic devices that seem essential to life in the 21st Century.

With the factors of climate change, the energy crisis, and consumer demand as incentives, the government – principally the Department of Energy (DOE) — is pushing for big technology advances in batteries, or the more generic term, electrical energy storage (EES) systems. Beckman Institute researchers are at the forefront of these research efforts when it comes to creating battery systems that are longer lasting, more reliable, more powerful, faster, and safer. That is especially true when it comes to advancing battery technology for electrical vehicles.

Electrical vehicles have been around for awhile, but mostly they have been the transportation choice of those concerned with the environment and the hobbyist. Now there is a push by both manufacturers and government (in the form of tax credits and research grants) to bring them to a mass marketplace.

A new ad campaign for an all-electric car, the Mitsubishi i EV, is touting Bloomington-Normal, Illinois, as a model EV community. The car is already being sold by dealerships in California, and is slated to hit the roads locally this spring. The Chevrolet Volt is an electrical vehicle with a gas generator in reserve for longer distance driving; there are more than 6,000 already in use on American roadways.

Several faculty in Beckman's Molecular and Electronic Nanostructures research theme have made recent discoveries that have the potential for greatly advancing battery systems, including creating self-healing technology for EES (Scott White, Nancy Sottos and Jeff Moore), and developing ultrahigh energy and power density batteries (Paul Braun, Harley Johnson, and Sottos).

White, Sottos, and Moore are members of Beckman's Autonomous Materials Systems group who have developed self-healing materials systems based on microcapsule and vascular technology that autonomically responds to damage with healing agents. Now they are applying some of those same techniques toward self-healing for batteries. Their work is part of a new DOE-funded Center for Electrical Energy Storage (CEES) that seeks to create future battery technology for EVs that is both longer-lasting and safer.

But electrical vehicles are already coming off assembly lines,

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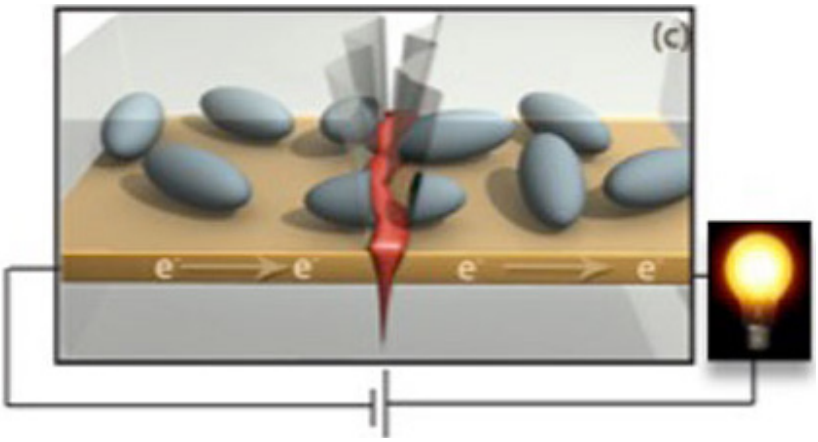
with companies like General Motors and Mitsubishi wagering a lot on their success. Fires in lithium-ion batteries — the most common battery technology in use today — have plagued electronic devices, and have occurred in delayed fashion following crash tests of the Volt.

"There is a huge amount of pressure to solve problems right away because these are being rolled out," White said. "As we've just seen with the Volt fire, the more these cars are out there, the more you're going to see these reports. If electric cars come out and have safety problems and have major loss of life and property, the public is just not going to go that route.

"And we *have to* in order to solve the energy problem. We *can't* fail. We've got to pay really serious attention to safety issues and make sure that is never going to be a problem."



Microcapsules full of liquid metal sit atop a gold circuit. When the circuit is broken, the microcapsules rupture, filling in the crack and restoring the circuit. Graphic image courtesy Scott White.

Self-healing Methods for Making Batteries Safer

Last year two Volts caught fire following crash tests — in one case, days and in another, weeks after the test — by the National Highway Traffic Safety Administration; later, the lithium-ion battery that powers the car was determined to be the culprit. According to the Associated Press story on one incident, an "NHTSA investigation concluded the crash test damaged the battery, which later led to the fire. Lithium-ion batteries, which are used in a vast array of consumer electronics, have a history of sometimes catching fire when damaged."

"That story made the rounds in our group right away," White said.

White said researchers like those from the AMS group and others at the CEES are trying to make battery technology that is longer lasting and more powerful, but also safer. The technology offered by the Beckman researchers employs an autonomic system that prevents potential fires or explosions through self-healing methods.

"We've made a lot of progress in autonomic shutdown mechanisms using microcapsules," White said. "We've been able to reduce the critical concentration to put into the battery to achieve shutdown by about an order of magnitude through surface functionalization of these capsules and various other methods for improving their dispersion."

White said they are looking at three approaches for delivering self-healing agents to damage sites in batteries. One involves liquid metal capsules that he said would more likely have applications in electronics. Another approach is to deliver a conductive monomer that would undergo polymerization within the battery after it's delivered to the damage site. A third, and most promising method White said, is to fill capsules with a conductive filler phase that is in suspension, so that when the capsule breaks, it delivers that conductive phase and re-establishes conductivity.

"We've been pursuing that pretty heavily over the last few months and it looks like it has good applicability in terms of battery anode materials," he said.

In addition to microcapsules, the group is also looking at a microvascular network system which is part of a battery that is integrated into the vehicle. White said that approach could be thought of as a flow battery in which the active materials, including the self-healing agents, are in a fluid phase and part of a vascular battery integrated with the vehicle's structure.

"We're starting on trying to meld together all of our expertise in new developments in terms of vascular materials with energy storage," White said. "It has lots of advantages in terms of application but what we are particularly interested in is trying to integrate energy storage together with structural functionality seamlessly; rather than having a car with a battery bank, it would be the car."

White said battery electrodes — the anodes and (to a lesser degree) the cathodes — are microporous materials systems that could be seen as a vascular material.

"The liquid electrolytes that are in batteries are pervasive throughout all of these pores," he said. "So we have thought about delivering compounds that would improve battery longevity through a vascular network that is embedded in these materials systems and that may play out as a good application.

"But when you're starting from the ground up and you want to develop a vascular materials system, it's natural for us to think 'well we've already got all of this technology that is structural material that is vascularized. Let's put them both together and make something that is seamless.'"

The CEES is focused on advancing battery technology generally, but White said the DOE is "pushing (EV batteries) as their focus. But there is lots of talk about grid storage and that sort of thing. The same issues are going to apply there."

Fast-charging Batteries

There is also the issue of range, and what is called "range anxiety" faced by consumers who might be considering purchasing an electrical vehicle, but are worried how many miles an EV can take them before needing to be recharged. That is one of the problems being addressed by Braun and his collaborators in a Beckman seed proposal and related efforts focusing on ultrahigh energy and power density batteries.

Braun reported last year in *Nature Nanotechnology* on the development of a three-dimensional nanostructure for use in battery cathodes that was fast-charging without reducing the energy density or storage capacity. Braun said the system they developed has capacitor-like power because it can release energy quickly but, unlike capacitors and similar to a battery, could store a large amount of energy.

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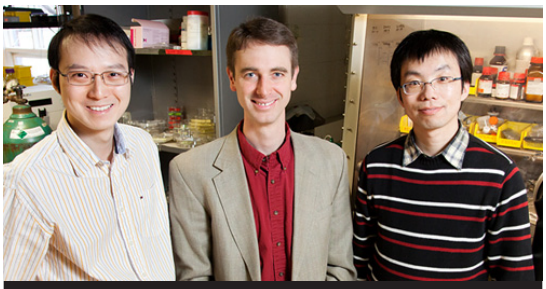
The method employs a thin film for the active material (for fast charging and discharging) but turns the film into a 3-D structure that can store energy, resulting in 10 to 100 times faster charge and discharge than normal bulk battery electrodes.

"Most of the time for a fast-charge battery, they make it where you have fast charge or high-powered discharge, but you sacrifice the storage capacity," Braun said. "Sometimes people will talk about how long it holds the capacity, which would be if you charge it today three months from now would it still be fully charged. We didn't work on that side of the problem. What we worked on was to have a battery that could deliver charge quickly or accept charge quickly and maintain the high energy density."

A recent advance in this line of work involves development of a three-dimensional structure for battery anodes.

"In a real battery you need both sides to be fast, you need a fast anode and a fast cathode," Braun said. "In the first paper we really concentrated on the cathode. Now we have developed a number of systems that give fast charge on the anode and are putting the two of them together to make a real battery."

The seed proposal work with Johnson, Sottos, and Beckman affiliate Shen Dillon involves comprehensive efforts to understand the science and engineering of high energy and power density batteries. They are looking to exceed government targets for introducing advanced battery technologies to consumers and the military.



Paul Braun, center, and graduate student Xindi Yu, left, and postdoctoral researcher Huigang Zhang of his research group developed a three-dimensional nanostructure for battery cathodes that allows for dramatically faster charging and discharging without sacrificing energy storage capacity. Photo courtesy Brian Stauffer, University of Illinois.

Commercialization

Taking these developments from labs to the marketplace and other applications is further away in some respects but much closer in others. The technology developed by Braun and his collaborators — called StructurePore — has already been licensed to a company at the University of Illinois Research Park called Xerion Advanced Battery Corporation for commercial applications. Manufacturing that technology for use in EVs is a few years down the road, but is being envisioned as one of its important potential outcomes.

Braun said the initial applications for the technology will be in niche consumer and military applications.

"Once they are making those batteries and have the manufacturing capability, that's when you start looking at things like automotive, where you would have to be able to make a million batteries," Braun said. "There is certainly development but the design we're using and the processes we're using are things that are compatible with bulk and volume manufacturing. From the beginning we've tried to focus on designs which can be manufactured."

Braun said Xerion is taking the lead on commercialization.

"They've hired a number of people so that is a real and active effort," he said. "They are starting with our cathode designs but now that we are getting some of these new advanced anode designs too, I think we'll be able to make batteries that are fast charge, fast discharge, and high power."

When the paper was published heralding the new technology in *Nature Nanotechnology*, Braun said that he was optimistic about its use in EVs. He sees it as one way to make electrical vehicles practical for consumers used to filling up with gasoline and driving for hundreds of miles. Charging stations offer much faster EV battery system recharging than home outlets, which can take 24 hours to fully recharge, but still don't come close to the few minutes drivers spend refilling with gasoline.

Braun said the problem lies not with the recharging station, but with current battery technology, which in vehicles like the Mitsubishi i and Nissan Leaf, is the sole method for propulsion.

"There are a lot of issues with delivering that much power; there are a lot of engineering issues that are going to be a challenge for the electrical filling station," he said. "But, for the most part, there are known solutions. Right now, for the battery, there is really just not a known solution. So, the structure for our design is one attempt at that. That's our goal.

"With conventional batteries, people are talking about 15 minutes to 30 minutes, so you could go shopping while your car recharges. But it's still not practical for driving to, say Chicago. You don't want to stop halfway, wait 30 minutes while it recharges, and finish your trip. If you want to get people to adopt this as their primary vehicle, they're going to have to be able to charge it the same way they fill up their car with gas."

Which means researchers like Braun will have to solve the problem of range anxiety.

"If you could build an electrical vehicle that could be charged as quickly as you can now refill a car with gas, that would greatly diminish what is called people's range anxiety," Braun said. "Today's electric vehicles can go a hundred miles and then you have to wait a half-an-hour, an hour, two hours to charge. That's difficult to get the consumer to accept. I think electric vehicles will really make an impact when you charge them just as fast as you can fill your car. I think our battery is the first step to doing that."

The Next Generation of Batteries

Commercialization of self-healing technology is being developed by a company called Autonomic Materials Inc., which was started by members of the AMS group. White said application of the conductivity restoration aspect of their self-healing work is years away from commercial use, but the autonomic shutdown method — which could prevent the types of fires seen with Volts — is much closer to becoming a reality.

"What we developed and showed here is infinitely scalable and doable pretty quickly," White said. "People can pick it up and run with it."

If the efforts pay off with these technologies being adopted in future electrical vehicles, whose numbers could swell to millions in the next couple of decades (California has proposed rules to increase the number of EVs on its road to 500,000 by 2025), then the University of Illinois and Beckman will likely be as integral to those advances as they have been in information technologies.

"We started it here and it's exciting that it came out of Illinois," Braun said. "The battery effort here is growing a lot, not just my group but others. Broad-based, this is great opportunity for Beckman and the University."

FACULTY PROFILE: Minh Do

Minh Do was part of the first generation of Vietnamese students who went abroad to study as the Southeast Asian country began to liberalize its economy and society in the early 1990s. Do, who was born a year before war with the United States ended in 1975, says his youthful interest in mathematics coincided with his country's growing commitment to education.

"I was fascinated by math and it is also very suited for a poor, developing country like Vietnam because you don't need to have a lot of investment; it's really just paper and pencil," Do said. "I was in this gifted class and was trained to solve math problems. So I went through a lot of competitions, and ultimately trained on the national team."

Eventually, Do and his team competed at the International Mathematical Olympiad in Sweden, where he won a Silver Medal.

"I saw that the living standards there were far more than what we had in Vietnam," Do said. "It opened up my perspective. And I saw the importance of engineering, not just solving problems, but how to make things too.

"I was 18-years-old at that point and I was just getting ready to go to college. It helped to shape my perspective. I said 'well, I want to be able to go into engineering, to make products, and really have an impact on people's lives and mathematics is not sufficient to do that.' We started to be able to read foreign magazines and I got really drawn to engineering."

Do won a scholarship from the Australian government that allowed him to earn an undergraduate degree in Computer Engineering from the University of Canberra. He then went to Switzerland to earn a Ph.D. in Communications Systems.

Do joined the faculty at Illinois in 2002. He is a member of Beckman's Image Formation and Processing group and an Associate Professor in the Department of Electrical and Computer Engineering, with joint appointments at the Coordinated Science Laboratory and the Department of Bioengineering, in addition to Beckman.

As a younger faculty member and researcher, Do has already won many honors, including a National Science Foundation CAREER Award, a Young Author Best Paper Award from the IEEE Signal Processing Society, and has been voted by his students to the Teachers Ranked as Excellent List.

When it comes to his research mission, Do remains true to the motivation that first steered him toward engineering as a young man back in Vietnam.

"I had read that the engineering disciplines involved innovation and how that changed people's lives," Do said. "So I thought 'maybe I want to build something like computer systems or software.'"

And that is exactly what Do is doing these days as part of his research involving the broad topics of signal and image processing. His group's research mission, as he writes, is to develop new "true" multidimensional tools — rather than the current, one-dimensional processing methods — that can capture geometrical structures that are usually the dominant feature in images and multidimensional data. Do believes future imaging systems have to be designed using an integrative approach that includes both image formation and high level image processing, as well as a variety of disciplines.

"It's really a multiple frontier that we have to tackle to create this new technology and slowly bring it to everyday life," he said.

In order to do that, Do develops multidimensional signal processing tools for imaging applications, using the physics of sensor data, computer algorithms, and the psychology of perception. He seeks to integrate those tools in advancing imaging from the level of physics to how data is collected and processed, and how images are received by the end-user.

"My research is about making the digital image better," Do said. "The digital image could be from a digital camera, or it could be something we see through an HD-TV, or that a doctor sees for diagnostics. My work is about all the computational tools: the understanding of mathematics, coupled with physics and computer science to make these images, for whatever purpose."

Do has several research areas involving signal processing, but has a special interest in collaborations with Beckman colleagues in advancing imaging modalities such as magnetic resonance, optical, and spectroscopic, especially as those methods apply to biomedicine.

"I'm collaborating with Stephen Boppart, Zhi-Pei Liang, Gabriel Popescu, Rohit Bhargava, Bill O'Brien, Michael Oelze, and Doug Jones, all from different modalities," Do said.

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"My contribution is to learn the underlying computational problems and add my expertise to manipulate signals and images. So my research is about understanding how to model the real world in the discrete domain (where computers work), and how to make the discrete construction faithfully capture what is out there in the real world. It would add speed and accuracy."

Do said working with collaborators like those he mentioned at Beckman offers him a unique opportunity.

"That really energizes me to work with these people and because we can really tackle unique and challenging fundamental problems," Do said. "And we have fantastic students, really the best of the world. The luxury and the benefit of being here at the Beckman and the University of Illinois is that these are the best students from all over the world coming here. They are able to learn from interdisciplinary research areas and make a strong impact in the field."

SYNERGY is a publication of the Communications Office of the Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign. Each issue spotlights the people and science that make the Institute one of the premier facilities for interdisciplinary research in the world.

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Cover photo: Scanning electron microscope image of polyethylene microcapsules spin coated onto Li-ion battery anode. These microcapsules are thermally triggered during thermal runaway conditions and infuse the anode shutting down ion transport and preventing lithium fires. Photo credit: Marta Baginska.

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FELLOWS CORNER

DAVID MAYERICH

David Mayerich's time as a Beckman Institute Postdoctoral Fellow comes to an end this summer, so he's been busy sending out resumes for positions in academia and elsewhere. Early in the process, his first choice is to continue the type of research he did at Beckman and begin the life of a professor at a research university.

"I like the idea of doing research and teaching," Mayerich said "I've had the opportunity to work in several different fields, and can identify several directions for future research. The university environment is great for multidisciplinary work."

The ability to go in different directions has served Mayerich well during his time as a Beckman Fellow, and it's set him up to make a unique contribution to biomedical research, either in academia or outside of it. He arrived here for a three-year appointment in 2009 seeking to expand his work toward advancing methods for the reconstruction and visualization of biomedical data.

As with everyone who applies to be a Beckman Fellow, Mayerich had to list his research goals for the three years of the appointment. He wrote that he planned to "focus on creating sub-cellular anatomical models of tissue as well as better ways to process and visualize datasets" by using a new microscopy technique that would "provide an unprecedented understanding of anatomy at the sub-cellular level."

By applying computational methods not typically used by biomedical researchers, Mayerich was able to give his collaborators at Beckman a way to process large datasets and visualize tissue in a new way. His work with Beckman researcher Rohit Bhargava and former Carle — Beckman Fellow Michael Walsh has taken advantage of high-performance computing using graphics processing units (GPUs) that are powerful and inexpensive. The method allows GPU-based visualization methods for large datasets of tissue samples, enabling researchers to interactively pull out much-needed chemical information.

"The data, in addition to being large, is very difficult to process, so one of the things I've been working on is creating interactive methods for processing them very quickly," Mayerich said. "This requires leveraging computational power from graphics processors, which are sometimes difficult to work with. But using that, what we can do is process the data in parallel, so you can get interactive feedback. Researchers can then adjust parameters in real-time. The end product is a 2-D image that allows them to interactively find chemical and structural information in the tissue."

The work with Bhargava involved an imaging method Mayerich was unfamiliar with when he first arrived at Beckman, fresh off a Ph.D. in Computer Science from Texas A&M University.

"When I applied, I said I wanted to do data processing with large datasets and visualization of EM (electron microscopy) data," Mayerich said. "I've done that but I didn't know much about vibrational spectroscopy and cancer research. That's the stuff that Rohit and Michael do and it's a major part of what I'm working on now."

Mayerich also continued his doctoral thesis work in which he developed a prototype microscopy technique called knife-edge scanning microscopy (KESM) that is capable of quickly imaging large three-dimensional tissue samples. He recently published a paper reporting on using KESM as a fast new method for mapping blood vessels.

Between that work and his contributions to imaging large biomedical datasets, Mayerich appears to be in a unique place as he enters the job market.

"A lot of fields aren't fully leveraging the computational tools that are available," he said. "Being around here it has been easy to find things I can do for colleagues, especially in high-performance computing and visualization. It's difficult for biologists to realize that they need parallel computation and then it's an even bigger step for them to have to implement algorithms. It's still pretty complicated for researchers outside of computer science to use the most recent computational tools, but it is getting easier."

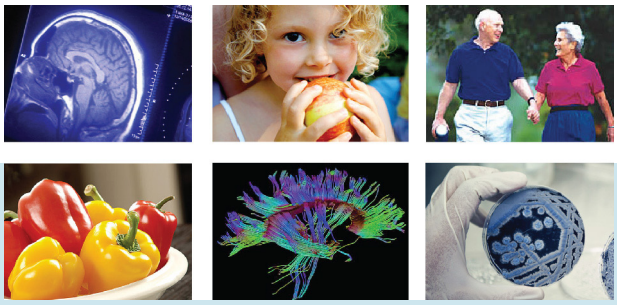
"The research focused experience here is excellent, the fact that you're put into a situation where you have freedom to do whatever you want, to pursue different research goals."

Mayerich says his time as a Beckman Fellow — a program in which no teaching or other duties are required — helped prepare him for a future position leading a research team.

"The research focused experience here is excellent, the fact that you're put into a situation where you have freedom to do whatever you want, to pursue different research goals," Mayerich said. "You even have enough funding to start projects, and that is very good. I was able to get equipment and work on things that are in fact unique to this university, in addition to collaborating with Beckman faculty."

As a soon-to-be Beckman Fellow alumni, Mayerich is in a good position to advise those who just joined or are thinking about applying to the program.

"One thing that you want to do, coming in here, is to try and hit the ground running," he said. "Have a project in mind for yourself. I think I got the most out of it because I had projects that I wanted to work on and then I could also collaborate with other people. So if you have two or three good projects going in parallel then you have stuff you're working on regularly."



Beckman Integral Part of New Center for Nutrition, Learning, and Memory

The Beckman Institute, through its people and facilities, was one of the key players in the creation of the new Center for Nutrition, Learning, and Memory, the first-ever interdisciplinary nutrition and cognition research center. The center and the funding supporting its efforts means researchers can now play a greater role in an area that is increasingly seen as key to cognitive health: nutrition.

An agreement between global nutritional company Abbott and the University of Illinois led to the announcement in December of the Center for Nutrition, Learning, and Memory (CNLM), and of an annual "Grand Challenge" competition funded by Abbott to support research in this area. Beckman researcher Neal Cohen was chosen as the Illinois Director for the new center.

Cohen said the center and the Grand Challenge will provide a new source of funding, but also a chance for campus researchers to make a difference in the area of human health.

"It's an opportunity to do applied or translational work that can do some real good," Cohen said. "It emphasizes areas that already exist as strengths (neuroscience and nutrition) on campus and gives them a new venue in which to operate."

That venue isn't limited to neuroscience or nutrition researchers, or those who are affiliated with Beckman.

"For the rest of our colleagues the attraction would be to have truly team-based work, create partnerships among people with lots of different expertise, and have a strong industrial partner where the work we're doing can translate into something tangible that could help people," Cohen said. "That's the opportunity we are being given."

The creation of the Center for Nutrition, Learning and Memory involved four campus units and their directors: the Beckman Institute, the Institute for Genomic Biology (IGB), the Division of Nutritional Sciences and the Neuroscience Program. Cohen, who is also Director of the Neuroscience Program, is the Illinois Director of the Center for Nutrition, Learning and Memory, while Keith Garleb, Director of Global Discovery Research at Abbott Nutrition, is the Abbott Director.

Abbott has had research ties to Illinois for more than 20 years and has a site at the Research Park on south campus, but the new center has its origins in visits by company officials to Beckman and IGB facilities, and talks with the directors of those two premier interdisciplinary campus research centers.

Beckman Institute Director Art Kramer and former IGB Director Harris Lewin had initial talks with Abbott about creating a research center on campus for nutrition, learning, and memory. Later, current IGB Director Gene Robinson joined in the efforts, along with Division of Nutritional Science faculty members Rod Johnson and Sharon Donovan. Johnson and Donovan have worked over the years with Abbott Nutrition, a division of Abbott, on individual projects.

Kramer said the company is providing not just funding opportunities for researchers at Beckman and on campus, but also a chance to expand the role of science in its business.

"Abbott Nutrition wants to be known as the company that takes science seriously," he said. "They are not required to; it's not like new drugs where you have to go through FDA trials. You don't have to do that in nutrition.

"I think, and rightly so, they want to be known as the company that takes science seriously in everything they develop. We'll do some of the basic research and some of the translational research that will help them do that. So it is a partnership."

Kramer agreed with Cohen that the new center will benefit both Beckman and its faculty members who take part in the research.

"It provides opportunities, and expands our research portfolio and horizons," Kramer said. "Researchers who get involved in the center don't have to be people who have expertise in nutrition. Instead they need to be interested in bringing their expertise to bear, whether in computational science, physiology, psychology, or a multitude of other domains, on important questions relevant to the relationship between nutrition and cognition."

The Center for Nutrition, Learning and Memory isn't a project that will take years to get under way. Offices for the center have been located on the first floor of Beckman, and workshops have been held to inform researchers about submitting research proposals. Scientists from the University will make up one-half of the 10-member executive committee that evaluates the proposals, while Abbott scientists will form the other half.

"We'll start off with white papers, and the way we write the request for proposals will be to strongly encourage interdisciplinary collaboration between Beckman and IGB and other places on campus, especially Nutrition and Neuroscience," Kramer said.

The timetable calls for those invited to submit full proposals to have them in by March 6, with the award announcement

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set for on or by April 16, and funding no later than May 16. Grants will be from one to three years, with awards ranging from $200K to $1M.

Cohen said they want research topics that involve nutrition, learning, and memory, but also are based on a team approach.

"It's important that people see this as a way to do cutting-edge, interdisciplinary, team-based work," Cohen said. "This is not an individual RO1, an individual investigator kind of program. We take very seriously the idea that it's a Grand Challenge.

"The way we see our interest and Abbott's interest in addressing the Grand Challenge is by, right from the start, having interdisciplinary teams. We see Beckman and IGB as being central because they are the places where people from all over campus can come together and work collaboratively."

Kramer said Cohen was the right choice to lead the new center for Illinois.

"He's a world-class scientist and has the capability, both Gene and I agreed, to lead something like this," Kramer said. "He's good at thinking broadly and you have to think expansively for this project because it goes beyond what any of us have done before. We needed a point person and he's our man."

Cohen said the center is a chance to build a unique partnership between the two premier interdisciplinary research facilities on campus, and with Abbott, a company that has extensive, worldwide research interests.

"We can combine the best features of both IGB and Beckman and produce an interdisciplinary, team approach to science that is bigger than either of the two institutes to enhance learning and memory," Cohen said. "With Abbott, we're talking about people who know how to take the things we find and turn them into products that actually help people.

"We don't know how to do that. We know how to test compounds and possibly develop new ones, and we know how to begin to understand their mechanisms in animal and human models. But Abbott can take our research and turn it into a product to create direct benefits to society from the research that we're doing."

CENTER FOR
NUTRITION, LEARNING, AND MEMORY

HONORS & AWARDS

Schulten Elected as Fellow of the Biophysical Society

Klaus Schulten, leader of the Theoretical and Computational Biophysics group, has been named as a Fellow of the Biophysical Society. Schulten was chosen for his groundbreaking effort to develop computational molecular biology as an important tool to solve problems in biophysics.

Schulten

Insana Chosen as IEEE Fellow

Insana

Michael Insana has been chosen as a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). Insana is in Beckman's Bioimaging Science and Technology group and was chosen for "contributions to ultrasound imaging methods, particularly elastography." Beckman affiliate Brian Cunningham was also chosen as an IEEE Fellow.

Kenis One of Six Named as a University Scholar

Kenis

Paul Kenis of the Beckman Institute's 3D Micro- and Nanosystems group is one of six University of Illinois faculty members chosen as a University Scholar. The University Scholar program honors outstanding faculty and provides them with a modest amount of funds annually for three years. For the last four years, the program has targeted faculty in the middle of their careers and who are associate professors or who have held the rank of full professor for no more than four years at the time of their selection.

Dobrucki Selected for Arnold O. Beckman Research Award

Wawrzyniec Dobrucki of the Biomedical Imaging Center was recently awarded an Arnold O. Beckman Research Award. His project "MicroPET-CT imaging of peripheral angiogenesis stimulated by controlled release microspheres in diabetic mice" will be supported by this award. In 1980, Dr. and Mrs. Arnold Beckman initiated the Beckman Research Endowment with a major gift to the Campus Research Board and a challenge to the University of Illinois to develop matching private support. The Board selects projects of special distinction or unusual promise for designation as Arnold O. Beckman Awards.

Dobrucki

Liang Receives Schmitt award

Liang

Zhi-Pei Liang, co-chair of the Integrative Imaging research theme, has been selected to receive the Otto Schmitt Award from the International Federation for Medical and Biological Engineering (IFMBE). The award recognizes a biomedical engineer for exceptional contributions to the advancement of the field of medical and biological engineering.

Federmeier, Simons Awarded APS Fellows Status

Beckman Institute researchers Kara Federmeier and Dan Simons were awarded Fellow status with the Association for Psychological Science (APS) in the field of Cognitive Psychology. They were recognized for making sustained, outstanding contributions to the science of psychology in the areas of research, teaching, and/or application.

RECENT BECKMAN INSTITUTE RESEARCH
IN THE NEWS

Two Beckman Projects Make Science News of the Year List

January 6 — Two projects from Beckman Institute researchers made the list of "Science News of the Year" in technology for 2011. The work of John Rogers involving epidermal electronics and self-healing battery technology being developed by Jeff Moore, Nancy Sottos, and Scott White were chosen.

Science News

Nature Chooses Rogers as One of 10 Who Mattered in 2011

December 23 — Beckman Institute researcher John Rogers was chosen as one of "Nature's 10" by the journal for its annual list of 10 scientists who mattered in 2011. The profile describes Rogers this way: "From flexible circuitry to miniature solar cells, this engineer has a knack for turning physics into technology."

Nature

Technique Makes it Easier to Etch Semiconductors

December 22 — Xiuling Li of the Nanoelectronics and Nanomaterials group developed a method to chemically etch patterned arrays in the semiconductor gallium arsenide, which is used in many high-end optoelectronic devices like LEDs. Using their chemical, or "wet" etching technique, is an advancement over manufacturing these devices with a dry method.

U of I News Bureau

Self-healing Electronics Could be Longer-Lasting, Reduce Waste

December 20 — Beckman researchers Nancy Sottos, Scott White, and Jeff Moore have developed a self-healing system for electronics using microcapsules filled with liquid metal. The researchers, who are part of the Autonomous Materials Systems group at Beckman, were able to restore 99 percent of original conductivity in more than 90 percent of the samples.

U of I News Bureau

Electro-thermal Nanoprobe Developed for Use in Electronics

December 20 – William King of the 3D Micro- and Nanosystems group led research that developed a heated atomic force microscope tip for new applications in measuring and controlling electronics. King said the electro-thermal nanoprobe can independently control voltage and temperature and measure the temperature-dependent voltage at nanometer-scale point contacts.

College of Engineering

University, Nutrition Company Abbott Announce agreement

December 19 – The University of Illinois and global nutritional company Abbott announced an agreement to create the Center for Nutrition, Learning, and Memory. As part of the agreement, the company will provide funding over five years in a "Grand Challenge" competition to spur research efforts for the center.

Abbott, University of Illinois

Team Designs Bandage for Guiding Blood Vessel Growth

December 15 – Beckman Institute researcher Rashid Bashir and his collaborators have developed a "microvascular stamp" that lays out a blueprint for new blood vessels and spurs their growth in a predetermined pattern.

U of I News Bureau

Spiral Proteins Efficient Gene Delivery Agents

December 15 — Beckman Institute researcher Jianjun Cheng and his collaborators have shown that short spiral-shaped proteins can efficiently deliver DNA segments to cells. Cheng says these new materials could be used for clinical gene therapy.

U of I News Bureau

Self-efficacy Key to Successful Exercise Regimen

December 15 – The work of Edward McAuley of the Human Perception and Performance group is featured in a story on the importance of self-efficacy to maintaining a successful exercise regimen.

Yahoo News

Tracking Eye Movements Can Lead to More Accurate Asessments

December 6 – A study that included Beckman researcher Neal Cohen and graduate student Carol Baym found that tracking eye movements can give a more accurate assessment of an actual experience than decision-making based on memory. The finding could have implications for such things as eyewitness testimony.

Association for Psychological Science

Paper by Beckman Researchers Among Most Read in Nano Letters

December 1 – A paper by Beckman Institute researchers was the sixth most read in a recent survey of articles in Nano Letters. The paper is Effects of Polycrystalline Cu Substrate on Graphene Growth by Chemical Vapor Deposition, and its authors are Beckman faculty Joe Lyding and Eric Pop, and graduate students Josh Wood, Scott Schmucker, and Austin Lyons.

Nano Letters

Imperfections Actually Improve Graphene Sensors

November 30 – Researchers at Illinois, including Beckman Institute faculty member Eric Pop, have found that more imperfections in the graphene used for chemical sensing actually improved the sensitivity of the sensor. Pop, a member of Beckman's Nanoelectronics and Nanomaterials group, and his collaborators reported their study in Advanced Materials.

College of Engineering

Network Predicts the Movements of Users

November 29 – Klara Nahrstedt of the Image Formation and Processing group is part of a team that developed a network that predicts users' movements, sort of a "pre-social network." The technology was developed to predict the movements of work crews but the creators believe it can do much more.

New Scientist

Of tribalism and touchdowns Features Hillman Research

November 28 – The research of Charles Hillman into the reaction of fans watching their favorite teams play is cited in an article called "Of Tribalism and Touchdowns." Hillman is a member of the Beckman Institute's Human Perception and Performance group.

Scientist 2.0

more on page 11

RECENT BECKMAN INSTITUTE RESEARCH
IN THE NEWS

Ultrathin, Flexible Brain Implant Developed

November 18 – Beckman Institute faculty member John Rogers worked with researchers at Penn and NYU to develop an ultrathin, extremely flexible brain implant with a sensor array that provides 50 times better resolution than current technology. The work was reported in Nature Neuroscience.

Technology Review

Increasing Neurogenesis Decreases Drug-seeking Behaviors

November 17 – Research from Beckman Institute faculty member Justin Rhodes and his group presented at the annual meeting of the Society of Neuroscience shows that increasing the brain's ability to generate new neurons decreases drug-seeking behaviors in animal models. Graduate student Martina Mustroph, a member of the Rhodes Lab, is featured in the story.

Nature Newsblog

Cohen Comments on Perry Lapse

November 14 – Beckman Institute researcher Neal Cohen is quoted in a New York Times story about the mental lapse, or "brain freeze" of presidential candidate Rick Perry in a debate. Cohen is a member of Beckman's Cognitive Neuroscience group.

New York Times

Ways to Reduce Risk of Memory Loss Includes Kramer's Work

November 9 – The work of Beckman Institute Director Art Kramer is featured in a story about ways to reduce the risk of memory loss. The story highlights Kramer's research showing the beneficial effects of exercise on the brain.

CNN.com

Nanowires Could Enable High-performance Solar Cells

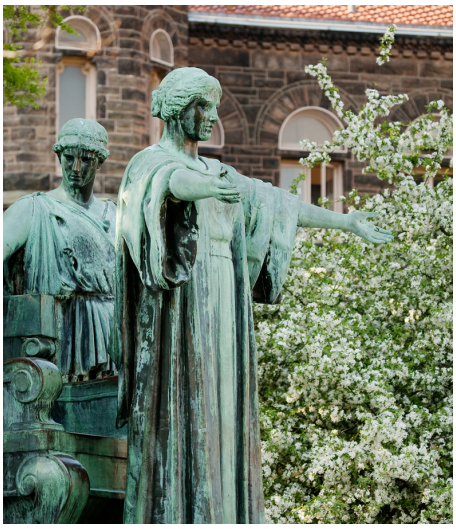
November 8 – Xiuling Li of the Nanoelectronics and Nanomaterials group led a research effort that was able to integrate compound semiconductor nanowires on silicon wafers, a technique that could enable solar cells and other electronics.

U of I News Bureau

Using a Tiny "Soldering Iron" for Nanolithography

November 8 – William King of the 3D Micro- and Nanosystems group is collaborating with researchers at the Lawrence Berkeley National Laboratory on a project that used scanning probe microscopy-based "soldering iron" technology developed by King. The collaboration provided insight into how temperature can be used to control a nanoscale fabrication technique called dip-pen nanolithography.

Berkeley Laboratory



Graphene Grows Better on Certain Copper Crystals

October 27 – Beckman Institute faculty members Joe Lyding and Eric Pop and graduate student Josh Wood discovered that the quality of graphene, a one-atom thick sheet of carbon that offers great potential for use in electronics, depends on the crystal structure of the copper substrate it is grown on. The discovery by the researchers, who are all members of Beckman's Nanoelectronics and Nanomaterials group, is an important one for advancing industrial production of graphene for use in future electronics.

U of I News Bureau

Rogers Research into Bendable Electronics Featured

October 21 – The work and applications of Beckman Institute researcher John Rogers involving bendable and stretchable electronics are highlighted in a recent profile.

Bloomberg Businessweek

Kramer's Research Most Cited over the Last 10 Years

October 6 – A review showed that the research of Beckman Institute Director Art Kramer had the highest percent of increase in total citations in the field of neuroscience and behaviors over a 10-year period.

Science Watch

Fabiani On the Aging Brain

October 3 – Beckman Institute researcher Monica Fabiani was the subject of a question and answer session for the publication Diario de Mallorca that focused on cognitive aging. The link is to an English translation of the article.

Diario de Mallorca

Energy-efficient Approach to Converting CO2 to CO Developed

September 30 – Paul Kenis is part of a collaboration that developed a more energy-efficient approach to converting carbon dioxide (CO2) into carbon monoxide (CO).

Science

Photonic Crystals From Beetle Shells Could Spur New Method for Optical Applications

September 27 – Beckman's Paul Braun of Beckman's 3D Micro- and Nanosystems group writes about photonic crystals (PCs) derived from beetle shells that "may represent the next step towards controlling optical emission in three dimensions for applications including lasers and LEDs" in the journal of the American Physical Society.

Physics

Hillman's work Cited as Way to Boost Memory

September 7 – The work of Beckman Institute researcher Charles Hillman is cited in a story about ways to boost memory. Hillman's research is focused on the effects of exercise on cognition, especially among children.

SF Gate

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