



utah

ENGINEERING



ROAD WARRIOR

TAYLOR SPARKS DRAWS THE
LINE AT SAFER DRIVING

BRIGHTENING OUR STREETS FOR SAFER DRIVING



Taylor Sparks' research effort to brighten America's streets for safer driving is on the road to success.

The University of Utah materials science and engineering associate professor is developing a new road marking paint that is much more visible when wet, improving safety for motorists who have a hard time following the lines when it rains.

Paint used for roadway markings is typically made of a synthetic resin that dries quickly and resists wear and tear. The paint is then covered with a layer of glass beads which reflect light back to the driver to improve visibility. However, when the paint is submerged in water due to rain or snow, the light is no longer reflected back because light refracts differently from water to glass than from air to glass.

"Every single person who has lived in Utah knows the problem and wants a solution," Sparks said.

In snowbound states like Utah, transportation officials can't install raised reflector markings on the roads like those used in warmer states because snowplows would tear them up. So Sparks, along with former graduate student, Jason Nance, a chemist for the Utah Department of

Transportation, are using an entirely new approach to formulate a paint that glows in the dark. Their paint includes a ceramic phosphor that absorbs ultraviolet light and then releases visible light more slowly, similar to a child's glow-in-the-dark stars. Phosphorescent roadway paint has been tried before, but the ceramic particles degrade when exposed to water.

"It's a tricky problem to solve," Sparks said. "You need a robust encapsulation that prevents water leaking, but it can't be so robust that it absorbs light on the way in or out. It has to have the right optical properties."

Sparks employed his celebrity brother, star of the Discovery Channel's popular truck-modification TV series, "Diesel Brothers," to test out the paint's wear-and-tear quality. Sparks' brother and his crew have been driving their monster trucks over a painted parking lot, and it's so far held up as well as traditional road paint, Sparks said. Meanwhile, he has received a provisional patent on the formula and is partnering with companies to develop it.

"We do have many places in Utah asking us to test it, such as places that value dark skies, like national parks, where they can replace street lighting," he said. "And it's got applications beyond roads such as crosswalks, bike paths - this opens up a lot of avenues where cities can use it."

Guiding drivers along the nation's highways is just one example of how new materials can dramatically improve society. In other research, Sparks is reducing the time required for discovering new materials by leveraging machine learning and data science.

The idea is to feed materials data into a computer program which identifies patterns among those materials. The algorithm then uses these patterns to identify candidate compounds that meet whatever criteria the researcher establishes for the new material. This could potentially eliminate years of trial and error in finding the right material.



For example, Sparks and his team of students were tasked with finding a superhard material to replace the use of polycrystalline diamond used in oil, gas, and mining drill bits. While this synthetic diamond is hard enough, it's expensive to produce because it requires extreme pressures and temperature during manufacturing. Sparks needed to find a more affordable alternative.

Using a database of compounds that calculates rigidity and incompressibility, Sparks and his researchers developed a machine-learning algorithm that learned the patterns of each compound and predicted the hardness of new materials.

In just six months, without relying on supercomputers, Sparks and his colleagues discovered two new promising superhard materials for drill bit applications. Using the traditional trial-and-error approach to find a qualifying material could have taken years. "It was a huge discovery, and it underscores the power of this technique," he said.

"The story of materials discovery is so much dumb luck," he added. "Vulcanized rubber was a total fluke. Teflon was an accidental discovery as was stainless steel, and so many others. That is still how many new materials are discovered."

After receiving a doctorate in applied physics from Harvard University, Sparks arrived at the U as an assistant professor in 2013 where he served as the Director of the Materials Characterization Laboratory until 2019. He is now serving as the Associate Chair of the U's Department of Materials Science and Engineering. His love of the field is also apparent in his popular podcast, "Materialism," which examines the past, present, and future of materials science.

"I got my bachelor's degree at the University of Utah, so it's fun to come full circle and be back here, this time teaching students and telling them about my passion for materials science," he said.



TRANSFORMATIVE GIFT LAUNCHES CAMPAIGN

The College of Engineering is proud to announce a \$15 million lead gift from philanthropists and benefactors John and Marcia Price to build a new home for computer science. Pending approval of the University of Utah Board of Trustees, the building will be named in their honor.

"We are pleased to lend our support to this effort that is so crucial to Utah's expanding economy," said John Price. "The University of Utah has an international reputation for innovation in computer science, and Marcia and I want to help ensure that opportunity for this generation and all future generations of Utah students."

John Price is an American diplomat and former US Ambassador to Mauritius, Comoros and the Seychelles. He moved to Utah as a teenager and earned a bachelor's degree in geological engineering at the University of Utah in 1956. Price started his career as the founder of a construction company, which developed into JP Realty Inc. and was listed on the New York Stock Exchange in 1994.

Price is known as one of Utah's most prominent businessmen, with success throughout the intermountain region. He has also served on numerous local, state, and national boards, including the University of Utah's Board of Trustees from 1992 to 1999.

Marcia Price is a leader in the arts community, with a lifelong passion for the Utah Museum of Fine Arts where she serves as board chair. She has devoted herself to advancing the arts in Utah, serving as chair of the Utah Arts Council and later helping to establish Salt Lake County's Zoo, Arts and Parks program. Price received an Honorary Doctorate of Fine Arts from the University of Utah in 2006. The UMFA building, as well as the new Theatre Arts building and amphitheater are named in honor of the Price's contributions to the arts. Marcia Price also sits on the National Committee for the Performing Arts at the Kennedy Center in Washington, D.C., and serves as board member emeritus on the boards of the Utah Symphony and Utah Opera.

The college has launched a \$30 million private campaign for a new home for computer science that will serve as a bridge to computing initiatives across campus. The 209,000 sq. ft. building will house the School of Computing and expanded offerings in data analytics, cybersecurity, fintech and potentially others.

ALGAE AFTER EFFECTS



Algae blooms, those slimy green layers of microorganisms that appear on the surfaces of some lakes and the bottom of rivers, are more than just unsightly. They can also be toxic.

And "it's a growing problem, not only in the U.S. but across the globe," said University of Utah civil and environmental engineering professor Ramesh Goel, who has been researching this mysterious natural phenomenon.

Goel has been studying algae blooms at Utah Lake, the state's second largest body of water, and in the Virgin River of Zion's National Park where a dog died in 2020 after drinking the toxins from the algae. He has also been researching the problem at the Great Salt Lake, Yuba Lake in southern Utah, Lake Erie and several streams in California. Meanwhile, he has been partnering with researchers at the U.S. Environmental Protection Agency and with researchers in California, Ohio, New Zealand, and Switzerland, where the problem is also on the rise.

Algae blooms contain cyanobacteria, also known as "blue-green algae," microscopic organisms that use carbon dioxide gas or inorganic carbon and light to multiply. But their growth also depends on availability of the nutrients, nitrogen and phosphorous. The excess of these nutrients that drive algae blooms usually comes from man-made sources such as fertilizers from farming and nearby homes and from urban runoff such as storm drainage. Because the algae are buoyant, they can move up and down a water column and spread.

Toxic algae blooms were also to blame for the deaths of 15 calves and three adult cows that died from liver failure in 2004 after drinking water from Matt Warner Reservoir in eastern Utah. "For humans, it can cause stomach aches, irritations and rashes on the skin," Goel said. The toxins can even attack a person's nervous system.

The professor and his team have been using DNA and RNA sequencing and bioinformatics (analyzing biological data) to better understand how much blue-green algae depends on nitrogen and phosphorous to grow. They have learned that these microorganisms can adapt to lower concentrations of those nutrients than originally thought.

"The findings suggest that cyanobacteria tend to use special molecular mechanisms or genomic mechanisms to counteract nutrient limitations," he said. "Knowing that can lead to better management tools where people can think about controlling it with more than just limiting nitrogen or phosphorous. We have to think beyond that paradigm."

Another factor that is making algae blooms worse is climate change, he said. Longer summers and shorter springs due to climate change allow the algae blooms to start earlier in the year, last longer and therefore become more toxic by the end of the summer. And an increase of the algae blooms also blocks the sunlight, causing the oxygen content in the water to drop, affecting the ecological balance.

"It's a very complex problem, and we have to think beyond just controlling the nutrients. We have to think holistically," he said.

Goel, who received his doctorate degree in environmental engineering from the University of South Carolina, was only about 12 years old and living in the small town of Hissar in northern India, when he became interested in pursuing water engineering.

"I used to see these water-resource engineers in my village, and that's when I became interested in becoming like them," he said. "In the 70s and 80s, water issues were big problems everywhere, and back then I thought it was important to become an engineer to try and solve these societal problems."

MASTREN RECEIVES DOE EARLY CAREER AWARD

Nuclear engineering assistant professor Tara Mastren was awarded a U.S. Department of Energy Early Career Research Award, given this year to 83 scientists to support their current research projects. She will receive a total of \$750,000 over five years.

Her research will focus on the development of better radionuclide generator systems that provide short-lived alpha emitting radionuclides for the use in cancer therapies. Targeted alpha therapy (TAT) has grown in recent years as a method for treating cancer. In TAT, the alpha emitting radionuclide is attached to a molecule that acts as a mail carrier delivering the dose directly to the diseased cancer cells while bypassing healthy cells. The power of alpha decay for cancer therapy lies in the short range of the emitted alpha particle allowing for maximum damage to targeted cancer cells with minimum damage to the surrounding healthy tissue.

"This work seeks to develop methods to increase the supply of these valuable radionuclides allowing for more patients to have access to targeted alpha therapy for cancer treatment," she said.

The DOE Early Career Research Program, which is now in its 12th year, is designed to "bolster the nation's scientific workforce by providing support to exceptional researchers during the crucial early career years, when many scientists do their most formative work."



EIGHT NSF CAREER AWARDS

The College of Engineering is proud to announce that eight COE faculty members have received this year's National Science Foundation's Faculty Early Career Development Program (CAREER) Award, the organization's most prestigious grant in support of early-career faculty. This year's record number of recipients underscores the college's commitment to seeking out the world's most dedicated researchers and educators in all engineering fields.



Xianfeng Yang
Civil and
Environmental Engineering

"Physics Regularized Machine Learning Theory: Modeling Stochastic Traffic Flow Patterns for Smart Mobility Systems"

Heayoung Yoon
Electrical and
Computer Engineering

"Optoelectronic Local Probes Measuring Microstructural Degradation and Recovery Under Accelerated Environmental Stressors"

Cunxi Yu
Electrical and
Computer Engineering

"OneSense: One-Rule-for-All Combinatorial Boolean Synthesis via Reinforcement Learning"

Claire Acevedo
Mechanical
Engineering

"Discovering the Mechanisms Governing Fracture in Fragile Bones"

Tommaso Lenzi
Mechanical
Engineering

"Bio-inspired Multi-joint Design and Control for Efficient and Lightweight Wearable Robots"

Aditya Bhaskara
School of
Computing

"AF: Models and Algorithms for Beyond Worst-case Analysis of Learning"

Rogelio Cardona-Rivera
School of
Computing

"Plan-based Simulation of Human Story Understanding"

Shandian Zhe
School of
Computing

"Embedding High-Order Interaction Events: Models, Algorithms, and Applications"

IN BRIEF

BUTTERFIELD WINS NATIONAL TEACHING AWARDS



Congratulations to University of Utah chemical engineering associate professor (lecturer) Tony Butterfield who was honored with both the Award for Service in Chemical Engineering Education from the American Institute of Chemical Engineers (AIChE) and the Robert G. Quinn Award from the American Society for Engineering Education (ASEE).

These are just the newest awards for the distinguished educator, who has already amassed a long list of honors for his teaching, including the 2017 Award for Innovation in Chemical Engineering Education from AIChE and the GLBT Educator of the Year Award from the National Organization of Gay and Lesbian Scientists and Technical Professionals. The University of Utah has recognized him with the Beacon of Excellence Award, the Distinguished Teaching Award, the Career Services Faculty Recognition Award, and the Online Excellence Award.

The ASEE Robert G. Quinn Award recognizes outstanding contributions in experimentation and laboratory instruction. It is named for the professor of electrical and computer engineering who established Drexel University's highly successful engineering curriculum.

The AIChE Award for Service in Chemical Engineering Education recognizes an educator "who has shown dedication and broad service to chemical engineering teaching and learning, especially in chemical engineering professional societies."

IVAN B. CUTLER PROFESSORSHIP

The College of Engineering is proud to announce the appointment of Professor Feng Liu as the Ivan B. Cutler Professor of Materials Science and Engineering.

Liu received his Ph.D. in chemical physics from Virginia Commonwealth University in 1990. Since joining the University of Utah in the year 2000, he has developed into one of the world's leading experts in the fields of surface science and thin films, with a current focus on low-dimensional nano, quantum, and topological-materials.

He received the Senior Humboldt Award in 2008, was elected a fellow of American Physical Society in 2011, and served as Chair of the Department of Materials Science and Engineering from 2011 to 2019.

The Ivan B. Cutler Professorship honors the life and legacy of one of the college's most revered faculty members. From 1968 to 1979 he was part of the Materials Science and Engineering Department faculty at the University of Utah where he was awarded the Distinguished Research Award in 1975. Professor Cutler passed away on September 26, 1979, at the age of 55.

The Ivan B. Cutler Professorship in Materials Science and Engineering was made possible through the generous support of Kent and Kathleen Bowen, along with members of the Cutler family and Professor Cutler's former students.



ALUMNI SPOTLIGHT CARY JENKINS

Like all good engineers, Cary Jenkins is guided by one credo: Solve the problem.

But this University of Utah mechanical engineering graduate doesn't just solve it with the right technology. He also launches a company to make sure that technology ends up in the hands of people who need it. And that entrepreneurial prowess has made Jenkins a very lucrative businessman in the tech sector.

In just 20 years, Jenkins has launched, built and sold three successful technology companies. He is now building two more.

"I just go to people and ask them to complain, and I just listen," Jenkins said about the secret to knowing what the kernel of a good business is. "They don't know the solutions. But what I got from the University of Utah is I know how to solve the problem."

Ironically, while Jenkins is a mechanical engineering graduate, his career in business was based on software development. "I grew up in a house with a father who developed software for financial services," he said. "But somewhere in my journey, I got into mechanical engineering."

That detour proved to be an astute move, he said. "My horizons were expanded by studying something that I would not do day to day for the rest of my life. And there's something good about that," he added.

Jenkins' first job out of college was as a mechanical engineer for a Utah medical devices company, but he ended up building the company's computer network and installing the necessary software. Later, he took a job for a large systems integrator in New York. As the head of the company's software division, he had a front-row seat as companies such as Microsoft and Novell began to grow.

"I was meeting with Bill Gates and Steve Ballmer when they were competing with WordPerfect and Lotus," Jenkins remembered. "It was really fascinating to be in the middle of all of that and see the winners and losers in the software wars."

In the late 1990s, Jenkins "tested the waters" with his first company, a digital-photo-sharing site similar in function to Facebook. The largest company he started was Visible Equity, a data analytics firm that provided cloud-based services to banks and credit unions. That later merged with nCino, which went public in 2020. He also co-founded Financial Guard, a registered online investment advisory firm, which later was acquired by Legg Mason. And he launched TopNoggin, a web-based actuarial firm, after a friend complained how much the industry needed modernizing. That company was acquired by The Hartford.

But Jenkins, who calls himself "a dreamer by nature," wasn't finished. After being told how difficult it was for companies like Coca Cola to know where to place products to maximize sales, he built a team to solve the problem. With the help of his son, who earned a Ph.D. in artificial intelligence, Jenkins co-founded Delicious AI to build mobile technology that identifies



products and then recommends placement for optimal sales using machine-learning algorithms. One of the largest Coca Cola bottlers is currently using the technology in 1,500 stores across nine states.

Meanwhile, he also launched Enzy, a company that has developed a social platform for employers to provide what Jenkins calls "a dopamine delivery system for companies."

And there are no signs of Jenkins stopping. He credits his time with the U's College of Engineering as an important phase that taught him the value of being surrounded by the smartest people.

"Part of the reason to be at the University of Utah is because of the people you are sitting next to," he said, referring to classmates. "I was sitting around really smart people every day, and I became really comfortable with that. You'll only get that in the engineering college."

To learn more about the Engineering Alumni Association, or to become a member, go to the Alumni tab on the College of Engineering homepage: www.coe.utah.edu.

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U'S FIRST GRAND CHALLENGE SCHOLARS GRADUATE



"What are my opportunities to learn something new?"

Matthew R.T. Williams, a proud Hoosier, entrepreneur and passionate problem solver from South Bend, Indiana, came to the University of Utah with that question in mind.

He knew college was more than earning a degree – it was an opportunity to gain useful skills and experiences. This mindset led him to become the U's first graduate from the Grand Challenge Scholars Program (GCSP), a prestigious three-year program endorsed by the National Academy of Engineering.

To graduate from the GCSP, students must create a portfolio encompassing five competencies: research, entrepreneurship experiences, interdisciplinary courses, multicultural immersion, and service involvement.

Williams centered his portfolio around the theme "Making Solar Energy Economical." There were many experiences he gained from completing

the GCSP, he says. Some of his favorites include his study abroad in London where he fulfilled his multicultural immersion and his active involvement as a finance director and coordinator for the U's Charity Dance Marathon, which successfully fulfilled his interdisciplinary component.

When asked what advice he would give to others pursuing the GCSP, he remarked: "Get involved in everything! It lets you try new things and helps you learn about yourself. Sometimes involvement can get tough to balance, so remind yourself why you're doing it."

Williams, who also received the Engineering Entrepreneurship Certificate graduated in Spring 2021 from the University of Utah with an Honors Bachelor of Science in Chemical Engineering. He recently received a prestigious ARCS fellowship to support his graduate studies. Williams is excited about pursuing a doctorate as he seeks to expand his knowledge and add value to the energy and consulting industry. He is looking forward to the next stage of his career at the U.

To learn more about the program or read about Williams' experiences, visit our website <https://www.coe.utah.edu> under the "Grand Challenge Scholars" tab.