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Paths to Innovation

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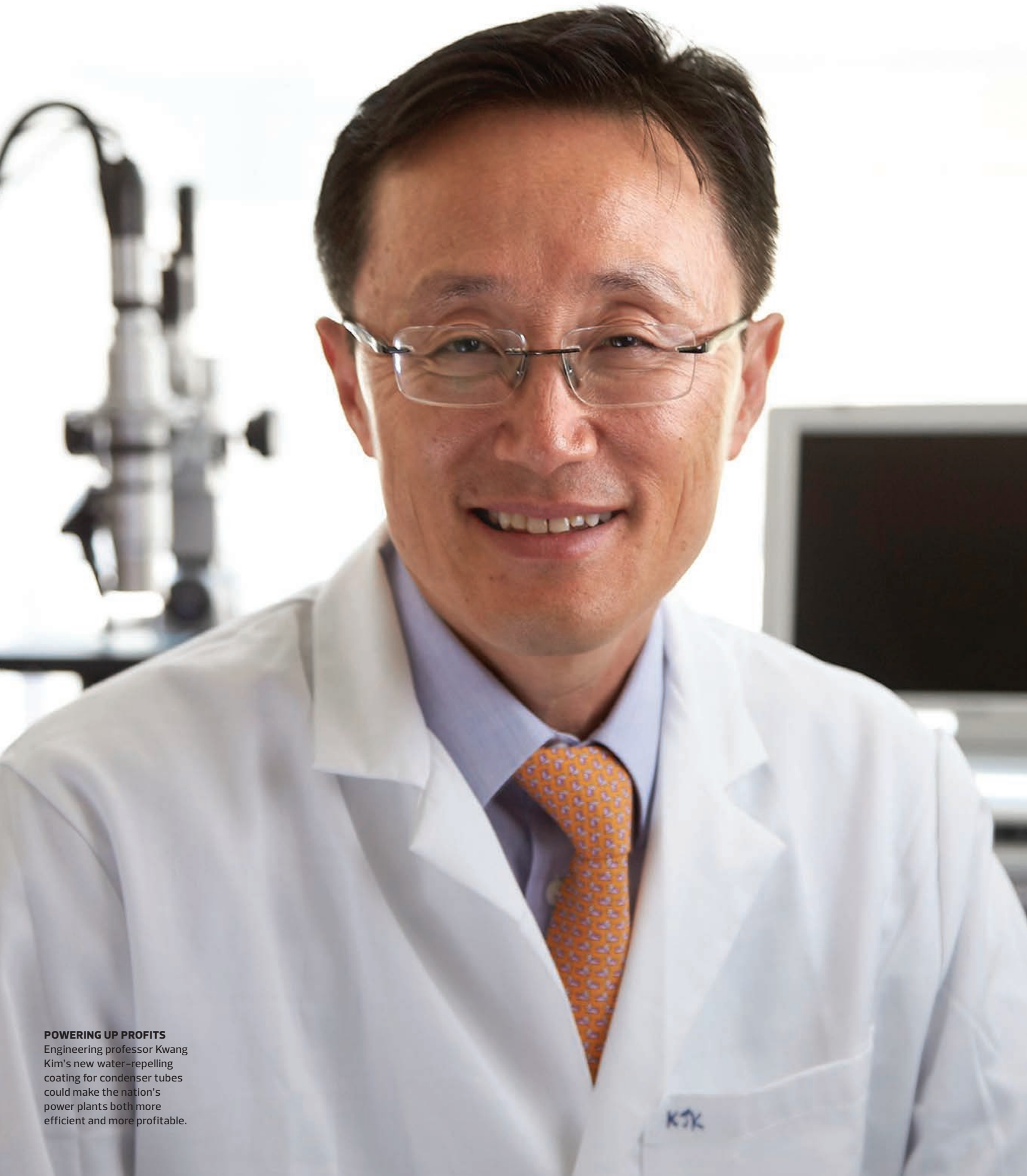
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Paths to Innovation

For more than 30 years, U.S. universities have had the right to commercialize discoveries made through faculty research funded by the federal government. For a time, few universities made much of the opportunity. But today, as funding support for higher education is increasingly imperiled, marketing great ideas has never been more popular — or more crucial. Three UNLV projects show how research benefits the university, the business community, and you.





POWERING UP PROFITS

Engineering professor Kwang Kim's new water-repelling coating for condenser tubes could make the nation's power plants both more efficient and more profitable.

KJK

KWANG KIM Energy Booster

After nearly 25 years of digging deep into surface modification — the branch of materials science that explores the outer parts of all things solid — UNLV's Kwang Kim has emerged as a thought leader in developing and deploying a technology that helps condensers at steam-power plants function more efficiently.

The technology, called “dropwise condensation,” could one day save power companies millions and lead to decreased electricity costs for consumers around the globe.

Condensation is a familiar part of daily life: Think of water vapor, for example, forming droplets on a cold bottle of soda. At power plants, a similar process occurs at heat-exchanging units called condensers. Here, exhaust steam from electricity-producing turbines condenses into water that is recirculated to a boiler. The boiler heats it and produces steam that's pumped back into the turbines.

But the process isn't perfect. When water molecules adhere to the surface of the condenser's collection tubes they create a thin film of moisture. This “film condensation” tends to make heat transfer less robust than it might be.

Working in collaboration with the Daejeon-based Korea Institute of Energy Research, Kim and his team found that by coating condenser tubes with a water repelling, or hydrophobic, substance they can manipulate the water to form droplets instead film.

“The film is the killer for heat transfer,” says Kim, who serves as the Southwest Gas Professor of Energy and Matter in the Howard R. Hughes College of Engineering. “In what we have done, if you look at the surface of the tube, the condensate drops off instead of creating a film. This creates a cost savings for the power plant. You can maintain the size of these drops and transfer more heat. Intrinsically, you will have better power plant efficiency. It all interconnects and makes things quite interesting.”

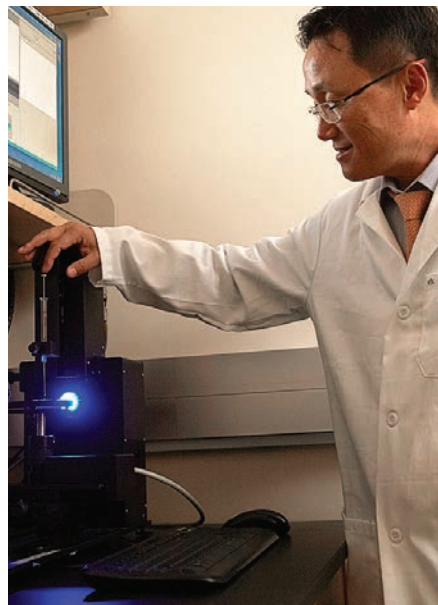
The dropwise condensation method can improve heat transfer by more than 200 percent in some steam-producing environments, says Kim, who is also a fellow with the American Society of Mechanical Engineers. Its

wider application, he adds, could even revolutionize the way steam plants are constructed.

In a typical power plant using steam, condensers take up a very large footprint of a building. With Kim's coating, their footprint could shrink to a much smaller size.

NBD technologies, a Boston-based venture company, took note of Kim's research nearly two years ago.

“They looked at the entire playground of research and noticed that this guy is always popping up. They said, ‘Why don't we visit him?’” Kim recalls. “They knew we had one invention that is quite unique. The industry was ignoring this particular application, and we just happened to put things together in



the right context.”

One patent application had been filed on the technology, and in January 2014 UNLV finalized the licensing deal. Also, NBD hired Bong June Zhang, a postdoctoral scholar and Kim's former doctoral student who had worked closely on the project. As NBD finalizes the product for commercial use, Zhang will be an important part of the testing process.

“This is a great example of a technology developed at a university finding a great commercial partner to create a product to benefit

the public,” says Zachary Miles, UNLV's executive director of technology transfer and economic development. “We are excited about this partnership and look forward to working with NBD in the future.”

The coating may have other important applications as well. It could be used one day to turn fog into water in countries and regions that lack water resources, could boost the performance of everyday condenser-dependent appliances like refrigerators, or speed the “de-icing” of frost-bound passenger planes.

The dropwise method is just one of many discoveries Kim has made during his career. His research interests also encompass a wide spectrum of energy systems and active materials and sensors, blending expertise and concepts from mechanical engineering, physics, biology and more. In his Active Materials and Smart Living (AMSL) Laboratory at UNLV, Kim provides an environment that promotes the acquisition of the skills and attitudes students need to become great innovators.

Among Kim's ongoing projects is an investigation aimed at developing a battery system that uses a unique composite material as part of an electrochemical cell for energy conversion. The device could offer several advantages over conventional batteries: lower maintenance, a longer cycle life, and unlimited scalability of energy capacity. It could be particularly attractive for electric vehicles, for example, since the batteries could be easily — and almost instantly — recharged.

Finally, Kim is currently at work on a next-generation “robotic catheter,” one using an ionic polymer-metal composite artificial muscle, for use in medical therapy and diagnosis. The National Science Foundation is supporting the project.

Kim has authored and co-authored more than 325 publications, including 148 refereed journal papers and three monographs. His research has been funded by NASA, the U.S. Office of Naval Research, the U.S. Department of Energy, the Army Research Office, the National Science Foundation, private companies, and other organizations.

— Megan Downs

INVENTING GAMING'S FUTURE

Under the guidance of former gaming executive Mark Yoseloff, student inventors are developing and patenting technologies that will ensure Las Vegas keeps its edge.



MARK YOSELOFF An Edge on Gaming

Mark Yoseloff is wagering on the creativity of UNLV students, and it's paying off for all involved.

Yoseloff is the former chairman and CEO of SHFL Entertainment, Inc., a top global gaming supplier. He recently partnered with the university to establish the Center for Gaming Innovation at UNLV, whose primary goal is to support student designers seeking to develop next-generation gaming technologies.

It's a move calculated to keep America's gaming mecca ahead of the competition, with a safe side bet that a mutually beneficial

relationship between UNLV faculty and gaming industry leaders will produce valuable payouts.

Priority one, Yoseloff says, is ensuring that Las Vegas doesn't lose its innovation edge.

"Although there has been a dramatic proliferation of gaming throughout the world, Nevada has, for many years, been the center of new product creation," says Yoseloff, who holds a doctorate in mathematics from Princeton. "This is extremely important to the Nevada economy. Although gambling may take place in many jurisdictions, creating and manufacturing gaming

products in Nevada represents important revenue and jobs for our state."

Yoseloff is helping ensure the industry maintains its edge, and he has even put up his own earnings to help make this happen.

"During Governor Sandoval's 2013 State of the State Address, he talked about the need for Nevada to remain the intellectual property capital of the world for gaming," says Yoseloff. "Having worked in this field for many years, and knowing that many of the new ideas in gaming have come from young creative minds, I began to formulate a plan to

harness that creativity. This ultimately became the Center for Gaming Innovation at UNLV. As far as I know, there is no other such program in the gaming field.”

The center, which is located in UNLV’s International Gaming Institute in the William F. Harrah College of Hotel Administration, was launched last year with a course in gaming commercialization. Yoseloff taught the course through the college’s gaming management concentration, though the class itself is open to students from all disciplines. Local game creators and industry and legal experts also participated as guest speakers.

Seventeen students, both undergraduate and graduate, signed on for the program’s first semester. Among them was doctoral student Dan Sahl.

Sahl, whose dissertation research explores video game-like elements in slot machines, says the class was the most distinctive one he’s ever taken.

“One of the things I took away was a better appreciation of the value of creative and innovative ideas,” he says. “Any good university course will make you think, but this was the only class I’ve ever taken where equal time and consideration were spent learning and navigating the process of protecting and commercializing my intellectual property.”

“We spent a lot of time discussing our ideas and trying out different game configurations in the gaming lab. The opportunity to receive both criticism and advice from Dr. Yoseloff and other industry experts was a key part of the development process.”

Sahl credits his advisor, the International Gaming Institute’s Executive Director Bo Bernhard, with recommending he enroll. For his part, Bernhard says steering students toward Yoseloff’s program was an easy call.

“I’ve now been in university classrooms for nearly 25 years, and I’ve never sensed a positive, collaborative energy like I felt when I had the privilege of observing Mark teach that class,” says Bernhard. “These students are creating and innovating in a manner that all of us, as teachers, can learn from. I know that I’ve taken lessons learned from that class into my



One of Yoseloff’s students, Hien Nguyen (center), licensed her casino game concept to Konami Gaming, represented here by Tom Jingoli (right), Konami’s Chief Compliance Officer and Senior Vice President.

own teaching, as I now actively seek ways to get students to work in teams on challenging, real-world problems like those associated with intellectual property in new games.”

“Being a mentor and teacher in this program has been extremely rewarding,” says Yoseloff. “I don’t believe that it is possible to teach someone to be creative. What I do believe is that it is possible to teach creative people to harness and direct their creativity. This has been my approach in the program, and I am very happy with the results.”

Those results speak for themselves. “My hope is that my students become important contributors in this regard; thus far, I am both surprised and very pleased. My first class produced 12 patentable ideas. In addition, one new company has already been started as the result of the sale of one of these patents.”

Yoseloff says the most important point for new inventors to know is that they must closely guard their intellectual property. “Discussing their ideas without the proper legal safeguards can damage their later ability to patent and protect what is theirs,” he says. “Early in our program there is a discussion of copyrights, trademarks, and patents, just for this purpose.”

The program is focused on real-world outcomes, in this case bringing game ideas from the classroom to a casino floor or online gam-

ing platform. Yoseloff, who spent a career designing technically advanced casino games for resorts and the web, is an ideal mentor. He is also well-connected and isn’t shy about using his contacts.

Yoseloff has enlisted a roster of gaming-industry superstars to guide program participants in areas such as the commercialization of ideas, the patent process, and effective business methods. “Las Vegas has a creative edge in that most of the world’s gaming experts are right here,” he says.

He notes that gaming companies are looking for employees who understand the intersection of their industry with math, psychology, business, and sociology. These are the employees who will bring new ideas to the market. Starting with students learning the patent process for casino games seems to be a logical first step.

The Center for Gaming Innovation is supported by the state’s Knowledge Fund, which promotes research in sectors Nevada has targeted for economic growth. The objective of the grant is to maintain Las Vegas’ role as the global “intellectual capital” of gaming.

Based on the success of the first course, UNLV is continuing the program. The revamped class will include dedicated sections on innovation in the areas of entertainment, security, and productivity.

Yoseloff knows that even the students who do not have their proprietary games purchased will benefit. In fact, as his former student Sahl explains, failure is often the first step towards success.

“You could go home, consider what the professor and fellow students liked and didn’t like about your idea, and then return the next week to present a better product,” Sahl says.

Exactly right, says Yoseloff, adding that those who are equipped to make these “better products” are sure bets to do well after they graduate.

“Technology is driving the gaming industry like never before, and the program is designed to give students the tools they need to perform and succeed in a competitive business.”

— Robyn Campbell-Ouchida



INNOVATING AGAINST ILLNESS

Unique platinum-containing chemotherapy compounds, created by Bryan Spangelo and his UNLV research team, offer hope for improvement in cancer treatment.

BRYAN SPANGELO 8,703,756

More than just a number, 8,703,756 represents years of hard work, patience, and collaboration.

It's the number of the UNLV patent that names chemistry professor Bryan Spangelo and his team as co-inventors on a discovery involving promising new chemotherapy compounds.

The research team has spent the past five years developing the compounds in the laboratory, and have observed that they have greater effect and less toxicity than some existing cisplatin therapies used in the treatment of cancer.

Spangelo is joined on the project by UNLV chemistry professor Pradip Bhowmik, assistant professor-in-residence Haesook Han, doctoral student Ontida Tanthmanatham, and recent doctoral graduate Van Vo.

Their discovery involves cisplatin derivatives that use platinum, a heavy metal already used to disrupt the replication of cancer cells' DNA, to anchor a novel tumor-combating compound.

Their new compounds, Spangelo says, are unique, thanks to the way in which the UNLV researchers were able to modify two rings of carbon and nitrogen atoms — a change that promises to boost platinum drugs' cancer-fighting abilities while reducing their negative side effects.

Cisplatin is the most common of the FDA-approved chemotherapy compounds containing platinum. While effective in fighting a number of difficult-to-treat cancers, cisplatin can cause serious problems for patients: It can harm the kidneys, can kill the neurons in the periphery of the body, and can cause hearing loss.

Development of the new, less toxic drug began after Vo synthesized a series of new platinum-containing compounds. Subsequent testing on human cancer cells in test tubes indicated that three of these new compounds were, in some cases, much more effective than cisplatin.

"I was floored at the extent of the differences between existing platinum-containing drugs and our compounds," says Spangelo.



"In science, we call it 'orders of magnitude,' and these new compounds are hundreds and perhaps thousands of times more effective in terms of concentration."

The research team also discovered that the most potent of these new platinum-containing compounds wasn't toxic in mice. This opens the possibility that these new compounds might be much easier on patients.

The key to enhancing effectiveness while reducing side effects, the researchers say, is using less platinum. Platinum works by causing apoptosis, or programmed cell death, by disrupting the DNA of cancer cells. But these are not precision weapons; when deployed, scores of healthy cells inevitably become collateral damage.

In a clinical setting, Spangelo says, the hope is that use of the new drugs will mean noncancerous cells will be exposed to less platinum. Fewer unintended cell casualties will mean fewer damaging side effects.

He is quick to acknowledge, however, that gaining federal approval and making such treatments available to patients is no simple matter. The researchers' first steps were to formally disclose the nature of the research and then apply for a patent on the discovery. This process in-

volves close coordination with UNLV's intellectual property experts, including Zachary Miles, the executive director of technology transfer and economic development.

Miles says his office supports research faculty and staff in assessing, protecting, managing, and potentially commercializing promising findings — the "intellectual property" of the researchers and UNLV.

"Through the assessment process we can identify the commercial path the intellectual property may take," Miles says. "After an assessment of the discovery, we then determine if it can be protected and marketed successfully. If it can be, the university will expend resources to file for patent protection. We clearly felt this was the case with the cisplatin derivatives developed by Dr. Spangelo and his team."

Miles says he is excited about the possibilities of their discovery, and he and his staff are currently seeking partners to commercialize drugs covered by the patent, as well as potential research partners to help refine the research.

Spangelo, who came to UNLV in 1994 from the Medical University of South Carolina, says he hadn't thought much about the patent process until recently.

"As a scientist, I was interested in publishing my work and sharing it with the scientific community. But we want to be a Tier One university, and this kind of work has to be promoted," he says.

Patent in hand, Spangelo and his team continue conducting research on their novel compounds. Their next step is to better understand the genetic mechanisms behind their drugs' apparent effectiveness. This was the subject of Vo's dissertation.

"It is a very exciting time here at UNLV, and I am thankful that the administration understands the importance of supporting this kind of work because it is essential for both a medical school environment and the Tier One initiative," says Spangelo. "This is exactly the kind of project that thrives in an environment that supports research."

— *Shane Bevell*