UNIVERSITY OF PITTSBURGH

OFFICE OF TECHNOLOGY MANAGEMENT ANNUAL REPORT 2010

INNOVATIVE INTERCONNECTIONS

OUR NETWORKING APPROACH TO KNOWLEDGE TRANSFER

CONTENTS

When our staff members met a pharmaceutical industry representative a few years ago at a bio-partnering conference, they didn't know that the new relationship would lead to further introductions at a subsidiary company; or that the emerging relationship then would progress to potential partnering opportunities that eventually would include introductions to University of Pittsburgh Innovators and their research endeavors; or that those ongoing discussions ultimately would result in a sponsored research commitment to Pitt of more than a million dollars, which we anticipate will bear fruit down the road in the form of new innovations with commercial potential. But that's our long-term expectation for every new relationship we establish.

Indeed, I'm here to tell you that technology commercialization at the University of Pittsburgh today isn't just a series of singular business deals or exercises in the rigors of patent law and licensing, although both contribute largely to commercialization success. Rather, we're working hard to take single points of contact and facilitate interconnections that lead to a diversity of knowledge transfer over time.

For us, it's about building a dynamic, constantly changing, and growing network of relationships—working partnerships that interact and interconnect, fueling new research and ideas, new innovations, new opportunities, and new companies. That's at the heart of what Pitt's Office of Technology Management and Office of Enterprise Development, Health Sciences, continue to foster.

This past year, as the economy regrouped and we took pause to evaluate our own efforts, we gained a new appreciation for the value of strong long-term relationships. One of our major goals this past year has been to take what we learn from many sources, not the least of which is industry, and facilitate interactions on behalf of our Pitt Innovators, further strengthening the partnerships that allow us to transfer University knowledge to the world.

Why should people and companies partner with us? We spend much of our time serving as Pitt liaisons, letting the world know about the world-class expertise of Pitt Innovators, along with their diverse research capabilities and innovations. We make clear that we gladly will facilitate new connections that will benefit all parties—and society—and find innovative solutions to their needs and requests. We help foster a friendly, collaborative environment that makes the University a worthwhile and contributing partner in knowledge transfer.

As you'll see in this annual report, strong relationships among faculty, departments, investors, research sponsors, the local economic development community and industry have led to many unique innovations and opportunities this past year. For example, they have helped to boost our licensing activity. They have supported our efforts to launch six new companies this past year and to work successfully with other universities to commercialize a number of innovations. And they even have allowed

us to work more effectively with our patent attorneys, commercialization advisory committee, and other assistive resource partners.

At the same time, we continue to reexamine and refine our commercialization processes, marketing materials, service orientation, and activities between our Pitt Innovators and outside partners to support our commercialization relationships. In particular, we have been shoring up our data management system, beefing up our "triaging" processes, and planning more interactive events, all allowing us to more effectively analyze the market opportunities for Pitt innovations.

Supporting many of those enhancement efforts over the past year has been the Pennsylvania Department of Community and Economic Development via its local economic development initiatives and Keystone Innovation Grant program. Extramural grant funding over the past several years has provided crucial support for our innovators and our overall commercialization endeavors as we continue to make improvements and strengthen our relationships. We are grateful for the continued support.

So what can you expect from us in the year ahead? We will continue to strive to provide the most effective service possible to Pitt Innovators and our many partners in technology commercialization. Specifically, we will be working with outside partners to develop a start-up mentoring program for those who want to spin out new companies. We also will be working on an internal mentoring program that pairs experienced Pitt Innovators with new innovators. Moreover, we will be developing a more formal gap funding program to help launch more start-up companies.

Meanwhile, we also plan to propel our successful entrepreneurial education programs to a new level that includes comprehensive online training opportunities, and we will continue to find effective ways to market our Pitt Innovators, their expertise, and their innovations actively to the rest of the world.

Once again, we thank all of you—our Pitt Innovators, student interns, work-study students, economic development organizations, industry partners, investors, entrepreneurs, licensees, Technology Transfer Committee, and all of our other supporters—for your willingness to drive technology commercialization forward here. Your efforts help to ensure the long-term success of our endeavors. We are extremely grateful.

Respectfully,

Marc S. Malandro
Associate Vice Chancellor for Technology Management
and Commercialization
University of Pittsburgh

"It's about building a dynamic and growing network of relationships—working partnerships that interact and interconnect, fueling new research and ideas, new innovations, new opportunities, and new companies."

2010 YEAR IN REVIEW

Fiscal year 2010 was, in short, a commendable year for Pitt Innovators.

Even as the economy regrouped this past year, Pitt Innovators forged ahead with their technology commercialization activities at the University of Pittsburgh, marking significant progress over the previous year in licensing, start-ups, and industry interactions.

Driving this gust of innovation development and commercialization was the Office of Technology Management (OTM) and the affiliated Office of Enterprise Development, Health Sciences (OED), whose collective mission is to facilitate the development of products from University intellectual property for the benefit of the University; its faculty, staff, and students; and the community. Much of the ensuing commercialization activity we directed can be traced not only to the imagination and ingenuity of our innovators, but also to our serious emphasis on building long-term relationships that inevitably lead to prosperous partnerships. The results are more sponsored research and more licensing deals that allow Pitt innovations to make their way into the marketplace and help others.

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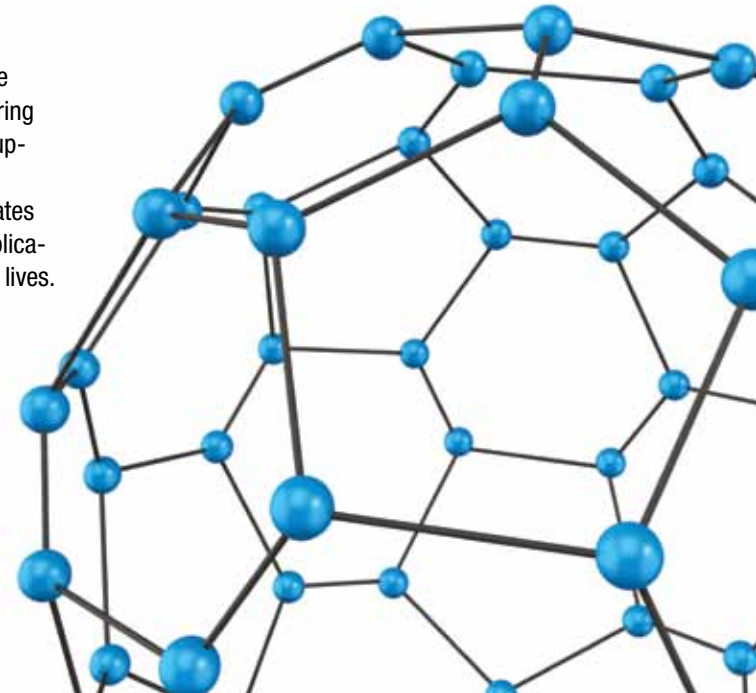
You will have an opportunity to read about some of those partnering endeavors in the pages ahead as we showcase eight of our leading Pitt Innovators. We believe that they are representative of the overall caliber of innovator with whom we work and of nearly every interaction we facilitate, whether a licensing agreement, start-up company launch, or sponsored research partnership.

You also will be able to review our overall performance, which continues to demonstrate the University's high level of commitment to ensuring that Pitt's world-class research endeavor—supported by total research expenditures in fiscal year 2010 of more than $735 million—translates effectively and efficiently into commercial applications aimed at improving society and people's lives. Here's how we performed:



"If my science dies in a drawer somewhere instead of helping people, it serves no purpose."

Samir Saba

SAMIR SABA

SAMIR SABA

By his own admission, Samir Saba is impatient when it comes to commercializing his cardiac research discoveries. "I am a practical person," says Saba, associate professor of medicine at the University of Pittsburgh and director of the Cardiac Electrophysiology Laboratory at the UPMC Cardiovascular Institute. "If my science dies in a drawer somewhere instead of helping people, it serves no purpose. There's pleasure in discovery but greater pleasure in helping people. If the tools I develop can be commercialized and marketed, then they will touch the lives of far more people than I personally can reach."

Saba and his research team have been working on significantly improving the functionality and safety of cardiac devices—an innovation development endeavor that promises to touch the lives of countless heart patients who depend on pacemakers and defibrillators.

A cardiac device serves two primary functions: as a pacemaker, "pacing" the heart to help it beat at a healthy rate, and, as a defibrillator, detecting potentially life-threatening arrhythmias and shocking the heart muscle back into a normal rhythm when an arrhythmia occurs. The problem with currently available cardiac devices, Saba says, is that they don't always function optimally—in part because the software that drives them and governs their decision-making can't precisely pinpoint the origin of an arrhythmia.

For example, when a defibrillator detects an abnormal heartbeat, it may be unable to determine if the abnormality originated in the heart's lower chambers, which would warrant the delivery of a shock, or in the upper chambers. As a result, a patient may receive unnecessary shocks. "These shocks are not just painful and stressful for patients," Saba suggests, "they also force patients to seek medical care that could be avoided, deplete the device's battery, and create other issues. The bottom line is that a defibrillator should only deliver a shock when an arrhythmia threatens a patient's life. We need to make these devices smarter and better at discriminating between life-threatening and non-life-threatening arrhythmias."

Calling on his own undergraduate background in electrical engineering and a longtime interest in electrophysiology, Saba developed algorithms that help devices to detect and respond to arrhythmias differently. Using simultaneous pacing in the upper and lower cardiac chambers, the algorithm responds to an arrhythmia by "disturbing" it—for example, by signaling to a patient's cardiac device to speed up the heartbeat and then examining the response of the heart to this disturbance.

"If the abnormality ceases after pacing, then we know that we did the right thing and prevented a potential problem," Saba says. "If the abnormality doesn't stop, the device will determine where the arrhythmia originates, and, if it's in the heart's lower chambers, it will deliver a shock." The algorithm, Saba says, can function as a stand-alone discriminator or may be added to other morphological discriminators to help them work more effectively.

The Office of Technology Management is working with Saba's research team to find corporate sponsors—in this case, a device manufacturer—to move its research into more extensive trials that can lead to the algorithm's incorporation into cardiac devices.

Saba and fellow researchers at the Cardiac Electrophysiology Laboratory are working on a variety of projects related to the use of cardiac devices, and they're looking for ways to leverage the devices' ability to measure and plot the heart's electrical activity.

"What if we can use electrical activity to identify problems long before they become life threatening?" Saba asks. "One area we're researching looks at using signals within the heart to develop something similar to an electrocardiogram. This would allow a cardiac device to send out signals that doctors could gather, plot, and use to spot ischemia, blockages, and other potential problems much earlier."

Another research project examines how the placement of a pacemaker's electrical leads in the heart can improve the device's effectiveness at alleviating heart failure symptoms and rejuvenating overall cardiac function.

"The University has an extremely open research environment," Saba says. "And the support we receive from the chief of cardiology and UPMC as a whole makes it much easier to perform cutting-edge research and also take it to the next level."

Invention Disclosures

The high volume of invention disclosures submitted to OTM for commercial consideration in fiscal year 2010 continued to bolster OTM's efforts to foster technology commercialization at Pitt. Invention disclosures, which represent the first official step in the commercialization process at Pitt, totaled 225 for the year.

While down slightly from the previous year, that number still demonstrates a very active interest in the process by more than 350 Pitt Innovators and continues to challenge the OTM and OED staffs to manage effectively such a tremendous number of promising innovations.

In light of that challenge, the OTM staff vigorously strove in fiscal year 2010 to improve and refine OTM's commercialization due diligence efforts, often referred to as triaging. OTM, with funding support from the University and the Commonwealth of Pennsylvania, hired a number of student interns and technology-focused market research firms this past year to conduct more comprehensive market research and competitive analyses on Pitt innovations to determine their level of commercial potential. The triaging efforts also allowed the OTM staff and Technology Transfer Committee, which reviews invention disclosures monthly, to make more informed decisions about whether to commit University resources to filing patent applications.

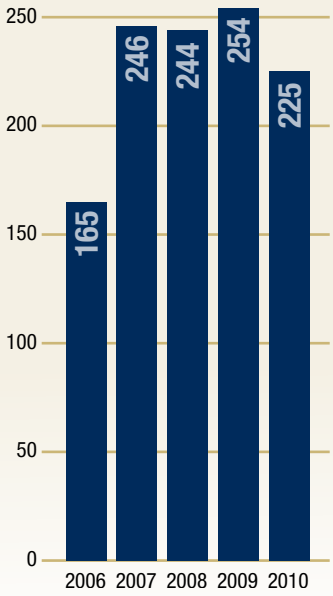
Pitt Innovators have submitted 1,138 invention disclosures to OTM over the past five years—more than 700 in the past three years alone.

Licenses/Options

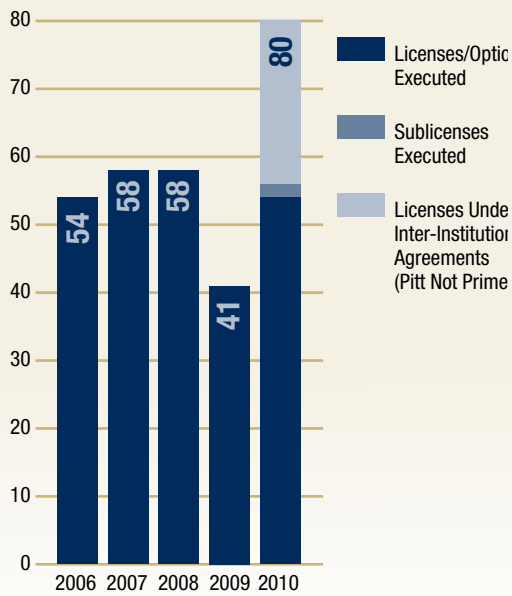
OTM experienced an increase in deal-making activity this past year as OTM's licensing managers continued to surge ahead in marketing Pitt innovations to potential industry partners. As expected, licenses and options were back up this past year after a predictably slower negotiating pace in fiscal year 2009. Licenses/options (as OTM has measured them in previous years) climbed to 54 in fiscal year 2010—an almost 32 percent increase over the previous year.

You'll also notice that the total number this year includes new license/option subcategories that bring the overall figure to 80 licenses/options for the year (see chart below). The new counting perspective reflects a change in metrics by the Association of University Technology Managers.

Invention Disclosures



Licence/Options Executed



"In the end, this is about finding ways to help the patients that I see in my clinical practice."

Flordeliza Villanueva

FLORDELIZA VILLANUEVA

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For Flordeliza Villanueva, a cardiologist and an expert in cardiovascular imaging at the University of Pittsburgh, the voyage of discovery has only one meaningful end point: a patient.

"I am a physician and a researcher," says Villanueva, associate professor of medicine in the School of Medicine, director of non-invasive cardiovascular imaging at the UPMC Cardiovascular Institute, and director of the University of Pittsburgh and UPMC Center for Ultrasound Molecular Imaging and Therapeutics. "My role is to identify needs and develop new techniques to address them. In the end, this is about finding ways to help the patients that I see in my clinical practice."

As such, Villanueva and her colleagues at the center are using tiny microbubbles to pioneer new ultrasound techniques for detecting and treating cardiovascular and other diseases—a field with huge potential based on the tiniest of delivery vehicles. Her research focuses on using the microbubbles as unique ultrasound contrast agents—tiny bubbles comprising a gas surrounded by a shell of biocompatible material such as a lipid or biodegradable polymer. The vibrations of these microbubbles in an ultrasound field are the fundamental basis for their unique value as both imaging and therapeutic agents.

Picture a very small water balloon. The microbubbles' outer shells can be modified to hold molecules that bind to specific cell markers of interest—markers, for example, that appear on cells constituting the lining of a blood vessel damaged by coronary artery disease. The microbubbles attach only to the cells expressing that unique marker. Then, when exposed to ultrasound imaging, they also produce a strong video signal, oscillating and literally glowing to reveal the damage and its precise location.Potential applications for Villanueva's work cover a broad range and include more rapid, definitive diagnosing of chest pain in emergency room situations; detecting arterial plaque and its severity; pinpointing microscopic blood vessels generated by new tumor growth; and delivering, detecting, and tracking stem cells used in therapies. In the case of heart transplants, the technology could be used to monitor cell rejection during the critical period following surgery, eliminating the need for repeated biopsies.

Because they attach to very specific targets, microbubbles also can be delivered to a problem area and then ruptured using ultrasound to deliver therapy with much greater spatial precision. Some examples include delivering gene therapy or drugs to a tumor or dissolving blood clots that might otherwise lead to a stroke.

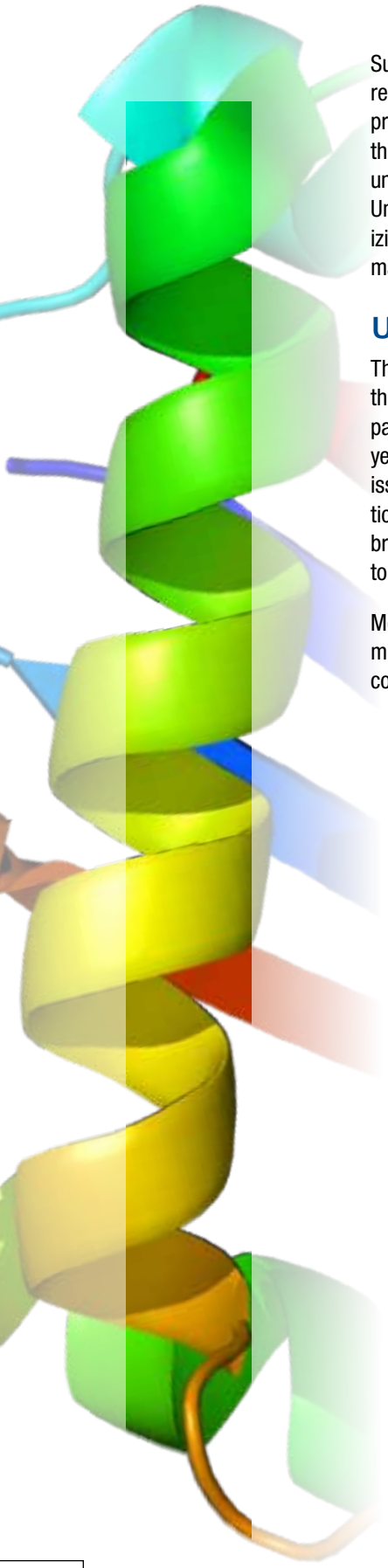
"Atherosclerosis is the number-one killer," Villanueva says. "What if we have a noninvasive way to identify the early signs in a patient when they're in their 20s instead of waiting until symptoms appear? Our microbubbles can uniquely act as imaging probes and therapeutic devices at the same time," she continues. "We call this 'theranostics': enabling you to deliver drugs or genes with spatial precision, dissolve clots by chiseling away at them, or make cells more receptive to therapies, all while simultaneously using ultrasound imaging to visualize what you are doing."

Equally important, ultrasound-based imaging and treatment promise fewer negative side effects than current options such as x-ray or systemic chemotherapy, respectively. "It's easy to forget that radiation is a carcinogen," she says. "But there's increasing recognition in the medical community and from agencies like the U.S. Food and Drug Administration that accumulated exposure from repeated radiographic imaging has potential consequences. The timing for non-radiation-based imaging alternatives like our technology is very propitious."

As Villanueva and her team continue to develop specialized microbubbles, the center works closely with the Office of Technology Management (OTM) to establish intellectual property rights and identify potential partners for more extensive future trials that may lead to eventual commercialization.

"I don't see our group as the one who takes our technology to clinical trials," Villanueva says. "Our role is to develop it then migrate it from the lab to industry. That's why a resource like OTM is so valuable." For her and every translational researcher, it's about the journey of problem solving.

"I keep looking at the microbubbles and asking 'what else can they do?' " she says. "That's the challenge each day. How do we take these unique characteristics and acoustic behaviors and apply them to a problem? Dealing with the unknown is challenging, but the rewards are so great—especially if we can take it from the bench to the bedside."



Subcategories this past year include the 54 regular licenses/options executed, as tracked in previous years; sublicenses executed, of which there were two this past year; and licenses that fall under interinstitutional agreements in which the University is not the lead institution commercializing the technology. This past year, 24 licenses made up that subcategory.

U.S. Patents Issued

The University's patenting activity remained brisk this past year, even as the OTM approached new patent filing activities more judiciously. In the fiscal year 2010, the U.S. Patent and Trademark Office issued 33 patents to the University for Pitt innovations, up one patent from the previous year. That brings the five-year total to 144 patents issued to the University.

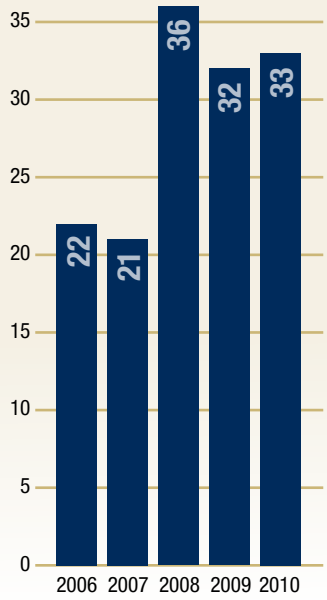
Meanwhile, OTM, in refining its efforts to determine commercial potential for Pitt innovations and conserve its financial resources, managed to make more informed decisions on its patent filing activity as a result. In fiscal year 2010, the University filed 69 new U.S. patent applications for Pitt innovations with commercial potential. Since fiscal year 2006, the University has filed a total of 457 new U.S. patent applications.

Total Revenue

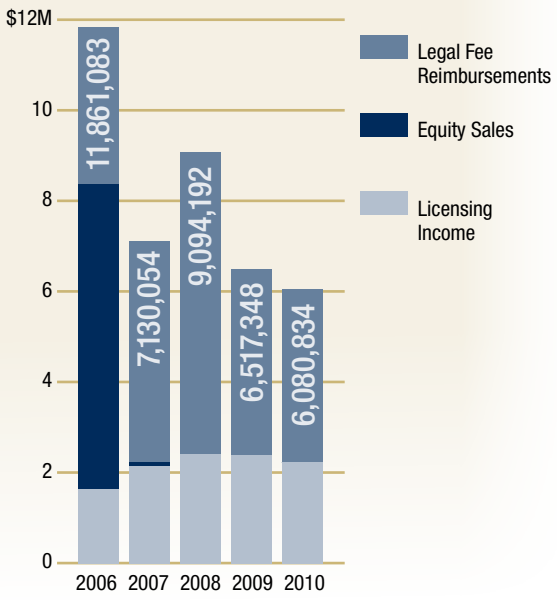
The University's technology commercialization activities generated a total of $6.08 million in fiscal year 2010, down slightly from the previous year. Of that total, licensing income came in at slightly more than $3.8 million, and the reimbursement of legal fees to the University totaled $2.2 million. No equity sales from start-up companies formed around Pitt technologies occurred in fiscal year 2010.

Added together, overall revenue from Pitt's commercialization efforts for the past five years totaled almost $34.3 million.

U.S. Patents Issued



Total Revenue




"As an immunologist, I focus on the fact that we are now defeating diseases that once killed people by getting the immune system to attack them."
Olivera Finn
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When it comes to taking care of one's own body, Olivera Finn knows all about self-advocating.

"Growing up as I did in a developing country, you have no expectations about doctors or drugs helping you if you're ill," says Finn of her childhood in the former Yugoslavia. "So people make it their business to know their bodies. We were taught to grow our own food, seek out good nutrition, and get in tune with the biology of our systems." In other words, give your body what it needs to fight off disease and you improve your chances of staying healthy. It's an ideal philosophy for a scientist who today serves as a Distinguished Professor and chair of the University of Pittsburgh School of Medicine's Department of Immunology as well as a professor in the Department of Surgery and program leader of the University of Pittsburgh Cancer Institute's Cancer Immunology Program.

"As an immunologist, I focus on the fact that we are now defeating diseases that once killed [people] by getting the immune system to attack them," Finn says. "That is why I am drawn to vaccine development."

Finn's research focuses on preventing certain types of cancers by marshaling the immune system to attack and fight off precancerous conditions, an approach that evolved from a groundbreaking discovery that she made two decades ago. She identified the first cancer antigen, known as MUC1. A protein made by normal cells, MUC1 is produced in excess by tumors, other growths, and inflammations and prompts a reaction from immune cells. If MUC1 is expressed by tumors, Finn and her colleagues reasoned, why not find a way to stimulate an immune response earlier—in a precancerous phase—when the body's reaction could have a greater positive effect?

That is exactly what happened in a recent study of an experimental vaccine developed by Finn's team. The vaccine showed the potential in an animal model to delay the onset of inflammatory bowel disease (IBD) and prevent its progression to colon cancer. In the case of IBD, MUC1 is produced by the inflamed colon and developing adenomas—polyps in the intestines and colon that may become cancerous. The vaccine stimulates the immune system's response against the MUC1 protein that is capable of attacking and destroying abnormal cells. Boosting the immune response can delay the onset of colitis and other conditions, control inflammation and reduce the risk of future cancers. This vaccine now is being tested in patients with a history of advanced adenomas in hopes that it will prevent their recurrence and progression to colon cancer.

"The MUC1 vaccine seems to change the local environment from one that promotes cancer development to one that inhibits it," Finn notes. "Certain immune cells that we usually see in the inflamed colon aren't present, and that could make the surroundings less friendly for potentially cancerous cells that also are directly targeted by the vaccine. By focusing on the common denominator, the body can recognize similarities and react when the symptoms occur. That way, conditions like colitis can be eliminated without pathology. We can treat it preventively."

The Office of Technology Management is working with Finn to identify and attract sponsors for broader trials that can lead to regulatory approval and commercial production of vaccines. In Finn's opinion, the immunological approach is our best hope in the war against cancer.

"Our goal should be cancer prevention, because I don't believe we will be able to cure it," she says matter-of-factly. "Because cancers develop over time, an immune response is the best opportunity for nipping them in the bud. Drugs can only prolong the time before recurrence."

She adds that we also need to become more immunologically savvy.

"We need a better understanding of what constitutes immunological health," she says. "The GNC store has an entire aisle of products claiming to improve your immune system, but who knows if they work? When I go to the doctor for a checkup and he ticks off a range of tests, he doesn't talk about my immune system. We don't measure how the immune system functions. We need to develop tests that tell us what it means to be immunologically healthy. That way, we will have a baseline that we use for comparison as we age."

Start-up Activity

Start-up business activity picked up substantially in fiscal year 2010, thanks in no small part to OED's dedicated start-up development activities, vigilant Pitt Innovators, OTM and OED's Commercialization Advisory Committee, and funding from both the University and Pennsylvania's Keystone Innovation Grant program. These ongoing efforts led to the establishment of a number of new start-up companies that are based on Pitt technologies. Among them are the following:

Cerêve: This local start-up company is based on a novel medical device for the treatment of insomnia. The company was founded by Eric Nofzinger, professor of psychiatry and director of the Sleep Neuroimaging Research Program in the University's School of Medicine. Nofzinger has been conducting sleep medicine research for the past 20 years and has been working persistently with OTM and OED for the past several years to commercialize his innovation. His device is designed to cool the front part of the brain and reduce metabolism during sleep. Nofzinger currently is serving as president and interim CEO of his company.

Decision Simulation: James McGee, associate professor of medicine and assistant dean for medical education technology at Pitt, developed a computer software system that provides virtual patient simulation in a medical education setting and includes a management system for education and assessment. The innovation has been licensed to this spin-off start-up company.

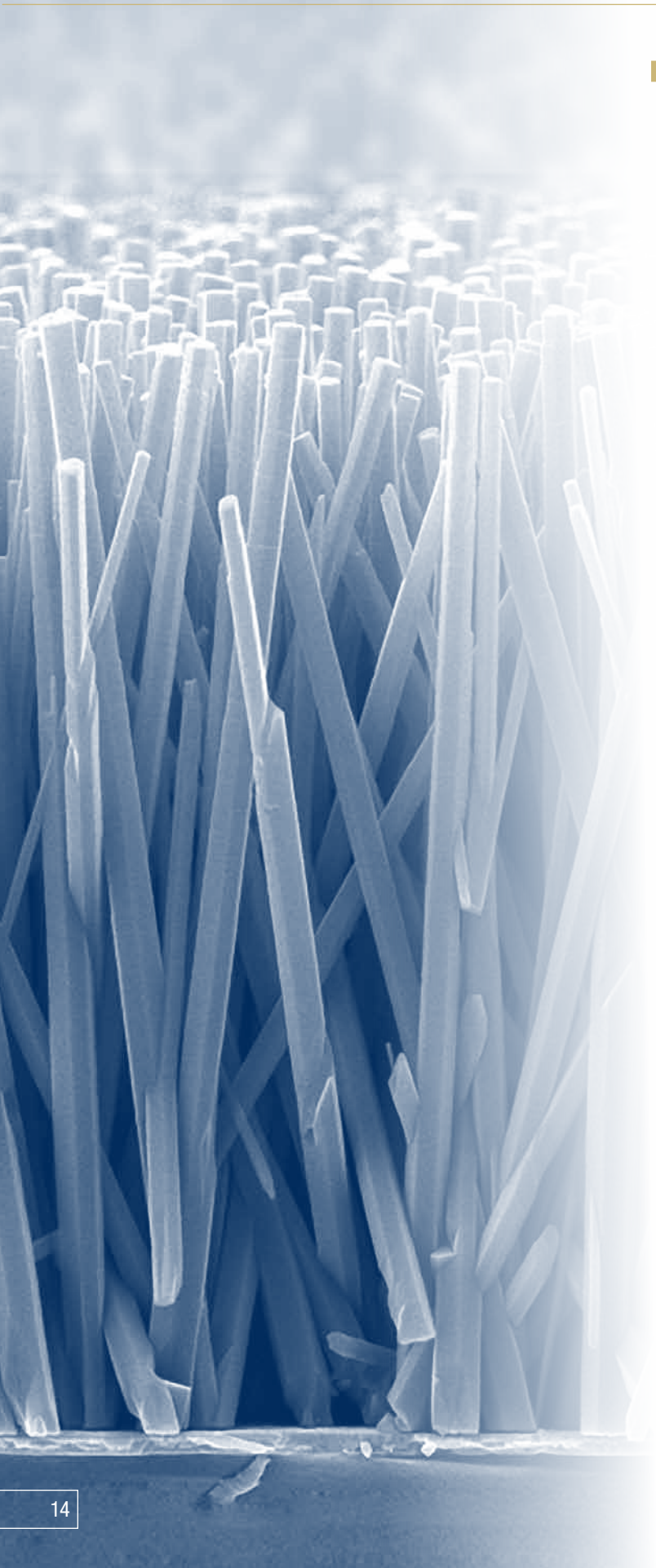
Insituvue: In fiscal year 2009, a California-based product development company called Venture Manufacturing Group licensed technology from Pitt called the Sonic Flashlight with the goal of developing it into a marketable product and then launching a new company around that technology. This past year, Insituvue was established to take that product to market. The handheld Sonic Flashlight, developed by George Stetten, professor of bioengineering at Pitt, replaces standard ultrasound monitor displays with a virtual image appearing exactly at the anatomy being scanned. The system is designed to improve the accuracy of target acquisition for, say, needle placement and reduces the risk of damaging the surrounding tissues.

Parallel Solutions: This local company was started around a radio frequency identification (RFID) technology-based system for real-time tracking and location. The system was developed by a research team at Pitt's RFID Center of Excellence, led by veteran Pitt Innovator Marlin Mickle, the Nickolas A. DeCecco Professor in the Department of Electrical and Computer Engineering and professor of electrical engineering, computer engineering, telecommunications, and industrial engineering. This system, designed largely for first responders, provides location, identification, and sensory information in buildings and structures. Among the markets targeted within the life safety industry are personnel in highly dangerous situations, child safety, hospital/hospice safety, and high-tracking situations such as prisons.

Plexision: A multiparametric immune system monitoring system designed to enable personalized medicine in the fields of transplantation and immunological disorders serves as the basis for this local start-up company. The diagnostic assay system was developed by Rakesh Sindhi, associate professor of transplantation surgery and director of pediatric transplant research at Children's Hospital of Pittsburgh of UPMC. The company plans to develop a line of diagnostic tests and biomarkers that assist in mediating disease pathways. The current system is designed to measure the risk of organ rejection and the effects of antirejection drugs on that risk.

Telecardia: This start-up is based on technology developed by seasoned Pitt Innovator Marco Zenati, professor of cardiac surgery. His latest innovation, called the CardioGuard, is a small medical device that provides an early warning to cardiac patients of the onset of even the slightest of heart attacks. The device, implanted on the surface of the heart via a minimally invasive procedure, is designed to evaluate the ventricular wall tension changes associated with myocardial infarctions. It is self-powered using piezoelectric technology that harvests energy from the natural movement and pressure changes of the beating heart.

ENGAGING PITT INNOVATORS AND INDUSTRY



The success of the University of Pittsburgh's growing technology commercialization endeavor depends almost entirely on the active participation of our well-informed Pitt Innovators and our continued efforts to foster partnerships between them and industry, potential funding sources, and regional supporting agencies.

It's an ongoing process, to be sure, but the success of this interactive commercialization model has been proved year after year. This past fiscal year was no exception.

Our model begins with outreach and education throughout the Pitt campus, then extends to helping Pitt Innovators to apply what they have learned in a variety of interactive settings facilitated by the Office of Technology Management (OTM) and Office of Enterprise Development, Health Sciences (OED). We have paired Pitt Innovators with business-focused mentors. We have escorted Pitt Innovators to industry conferences where we have helped them to showcase their innovations. We have facilitated meetings with large pharmaceutical companies and then helped to negotiate sponsored research partnerships or licensing deals. All the while, we have worked to help them to develop strong business cases for their innovations and market those innovations on their behalf.

As in previous years, we have striven to continually improve and refine those interactive programs and relationship-building efforts as well as to develop new programs and opportunities to increase our rates of success in licensing, start-up opportunity development, and even sponsored research partnerships. Consider the following:

Outreach/Education

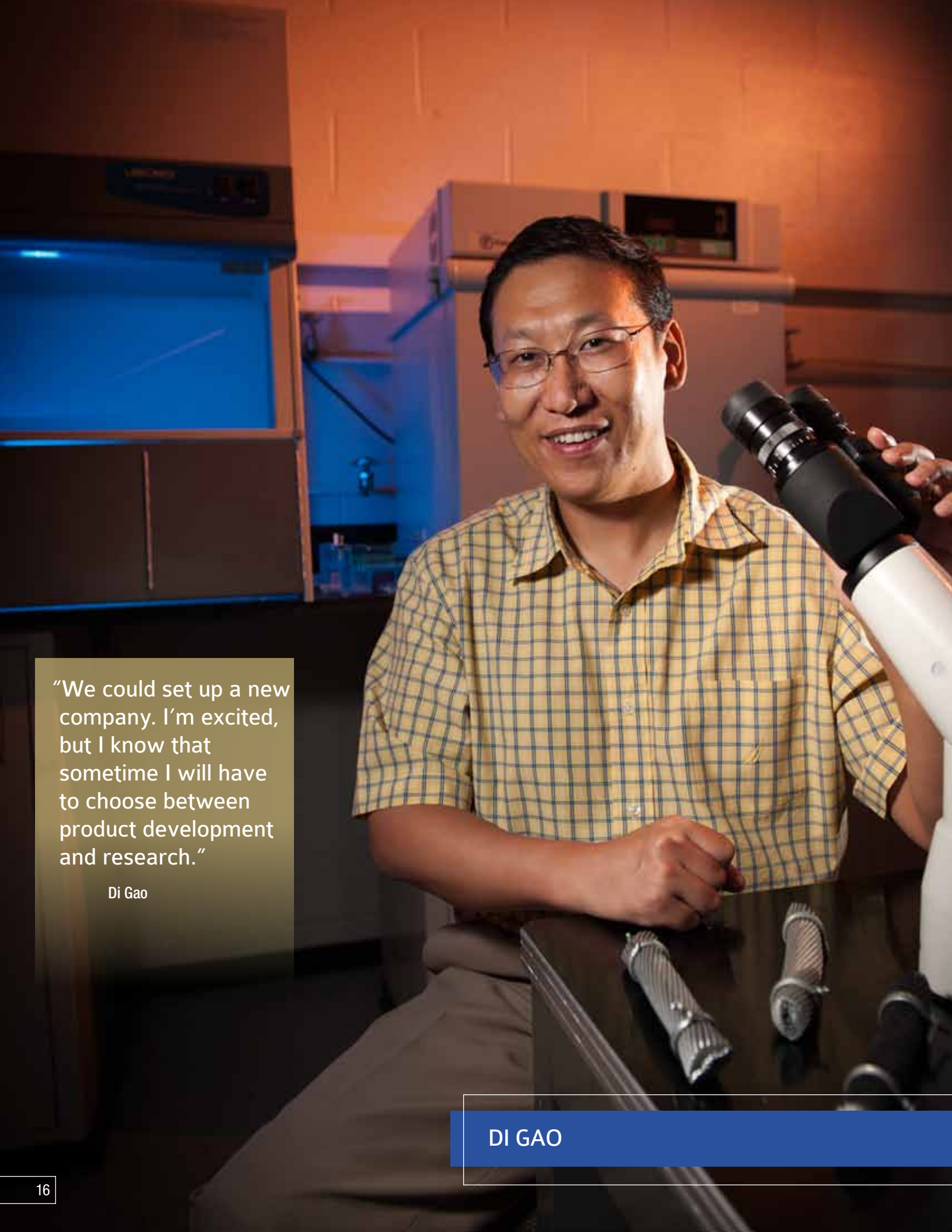
Introductory Presentations: We continued to take our introductory programs to academic departments and centers across the disciplines at Pitt in fiscal year 2010 in an effort to encourage more researchers to become Pitt Innovators. Among the faculty, staff, and student groups we presented to were the School of Dental Medicine, Critical Care Medicine, Center for Vaccine Research, Human Engineering Research Laboratories, Department of Acute/Tertiary Care in the School of Nursing, and Department of Anesthesiology, among others.

Educational Courses: OTM, in partnership with the Office of the Provost and the Center for Executive Education in the Joseph M. Katz Graduate School of Business, in the fall of 2009 once again hosted its seven-week educational course for faculty, staff, and students titled Academic Entrepreneurship: The Business of Innovation Commercialization, and once again the course attracted record attendance. More than 30 people registered for the hands-on commercialization course, which has been offered since fall 2002. Meanwhile, OED again offered its 10-week course From Benchtop to Bedside: What Every Scientist Needs to Know in the spring of 2010 and likewise attracted more than 30 participants. Both courses teach researchers how to transform their basic research into innovations with commercial potential and then help to facilitate the process for many of the participants.

The Pitt Innovator's Guide to Technology Commercialization: OTM, in early 2010, compiled a comprehensive guide for Pitt Innovators that walks them through the entire technology commercialization process at Pitt. The guide, which now is available from the OTM office in hard copy or as a PDF via its Web site, www.otm.pitt.edu, discusses everything from defining an invention and understanding the ramifications of public disclosure of information prior to patenting to how to file an invention disclosure and what to expect with regard to business opportunity development and licensing. It also covers University policies on conflict of interest, starting a company around Pitt technologies, and the patenting process, as well as what Pitt Innovators may get in return for their commercialization efforts.

Limbach Lecture Series: OED once again hosted this series of six free lectures for faculty and staff during fiscal year 2010 aimed at providing commercialization insights from entrepreneurs and industry partners. The fall and spring lectures addressed such issues as raising capital, developing new markets, the business of drug discovery and development, and what pharmaceutical companies want, among other topics.

Student Internship Program: Working with Pitt Business, OTM and OED continued to hire both graduate and undergraduate student interns who provided extensive market research, competitive analysis, and other related services on behalf of Pitt Innovators and their innovations. Over the course of the year, eight students were paired with licensing managers and business development representatives and contributed extensively to OTM and OED's efforts to build business cases for promising innovations. Some of the interns also participated in the Academic Entrepreneurship course as part of their commercialization training.



"We could set up a new company. I'm excited, but I know that sometime I will have to choose between product development and research."

Di Gao

DI GAO

DI GAO

On the surface, University of Pittsburgh engineering professor Di Gao's research effort doesn't look like much. Nanoscale particles usually don't, at least not to the naked eye. But look closely and you'll see a hairy-looking surface coating that actually prevents water from freezing—an innovation that now looks like a whole lot of commercial opportunity.

Gao, an assistant professor and William Kepler Whiteford Faculty Fellow in the Swanson School of Engineering's Department of Chemical and Petroleum Engineering, and his research team have been working for the past five years on nanoparticle-based coatings that not only will repel water but also will prevent supercooled water from icing when the water hits a solid surface coated with his material. Gao refers to his innovation as an "anti-icing" solution.

"It's a tough problem to solve," says the Chinese-born Gao, who earned his PhD in chemical engineering at the University of California, Berkeley, in 2004. "Super-cool water ices instantly when in contact with a solid. Then, you either have to heat the substrate or, when the ice forms, scrape it or somehow remove it."

The key to solving the problem, he says, is to somehow *not* provide water with the ability to nucleate.

"It needs a nucleus to start the icing process," Gao says of the cold water.

Inspired by the likes of the surfaces of lotus leaves, butterfly wings, and insect legs, Gao and his team have developed a coating made up of nanoparticles that are smaller than 50 nanometers in size. One nanometer is 1/1,000,000 of a millimeter in size. He has received grants from the National Science Foundation and the Mascaro Center for Sustainable Innovation, among others, to conduct his research.

Through a powerful microscope, the coating looks like a thick, fibrous lawn, with tiny air pockets between each particle. When water hits the "super-hydrophobic" coating, he explains, most of it simply rolls off the particle surface without ever touching the actual surface of the substrate—and without nucleating. Thus, no ice forms.

"The key point is that the size of the fundamental particles has to be small enough" to repel the water droplets, Gao says.

Among the most promising commercial applications, Gao suggests, are, for example, coatings for giant windmills. Ice, he says, often forms on the blades and can create rotational imbalances, which then can damage the giant turbines inside. He also envisions a large market for electrical power line coatings as well as those for airplanes and oil drilling platforms in cold locations, among other surfaces. "There are so many applications for this coating," Gao says. "We're open to all kinds of possibilities. But I think the most promising application is for power lines."

Gao says his work isn't finished yet. The challenge ahead, he suggests, is to refine the "robustness" of his coatings.

"Everything has a life span," he says of the coatings that his team is developing.

Gao says that his team so far has developed a proof of concept, but like any coating development effort, his team still has to solve problems, such as adhesion, the effects of ultraviolet light exposure, and other issues that will differ depending on the type of surface substrate that will be coated.

Meanwhile, he continues to maintain a rather diverse portfolio of coatings research. He also is working on the development of dye-sensitized solar cells using ordered titanium oxide nanotubes, and he's working with a physician at UPMC to develop DNA-based biosensors for influenza and other viruses.

And this past summer, he gained some national renown in the media during the Gulf of Mexico oil spill crisis for his development of what he calls a "super-oleophobic," or oil-repellent, and "super-hydrophilic," or water-attracting, filter that could separate oil from seawater. But he still has the greatest hopes for his anti-icing innovation and its many application possibilities. Gao's goal: "We could set up a new company," he says. "I'm excited, but I know that sometime I will have to choose between product development and research."

International Visitors: Given the University's active involvement in technology commercialization, international visitors to the Pittsburgh region often target OTM and OED for visits. This past year, OTM staffers met with delegations from Santiago, Chile; Herten, Germany; and Brazil in addition to delegations from the Baton Rouge (La.) Area Chamber and Montgomery County, Md.

Community Outreach: OTM and OED representatives aggressively marketed the University's Pitt Innovators, their innovations, and their research programs to regional business audiences while participating actively as sponsors and board and committee members in economic development and entrepreneurial education organizations and events in the region. Among them were Science2009, the MIT Enterprise Forum of Pittsburgh, The Indus Entrepreneurs (TiE), the Pittsburgh Venture Capital Association, the 3 Rivers Venture Fair, the Duquesne University Entrepreneurs' Growth Conference, Pennsylvania Bio, the Pittsburgh Life Sciences Greenhouse, Innovation Works, the Technology Collaborative, the Keystone Innovation Zone, and other initiatives aimed at supporting the region's technology-based economy.

Promoting Innovator Interaction

Industry Meetings: OTM and OED representatives conducted more than 100 meetings directly with industry representatives this past year to generate interest in Pitt Innovators, their innovations, and their research programs. Among the relationships being developed are those with Abbott Nutrition; Baxter; Centocor Ortho Biotech Inc.; Cypress Pharmaceuticals; Eli Lilly and Company; GlaxoSmithKline plc; Johnson & Johnson; Novartis AG; Novo Nordisk A/S; AstraZeneca; Pfizer Inc.; Merck and Co.; Sanofi Pasteur SA; and Sanofi-Aventis U.S. LLC; and a host of others. In all of these interactions, OTM and OED take a long-term approach, developing relationships rather than one-time deals. Thus, the relationships that have developed from those and previous meetings resulted in approximately $1.7 million collectively in sponsored research, several clinical trial opportunities, and efforts to license numerous technologies to pharmaceutical and other companies.

Conference Marketing/Meetings: Many of the industry interactions took place at international conferences attended by OTM and OED representatives. Taking a more aggressive, visible approach, OTM and OED set up trade show booths and attended partnering sessions at several large conferences, including the 2010 BIO International Convention in Chicago, Ill.; the 2010 Annual Meeting of the Association of University Technology Managers in New Orleans, La.; BIO-Europe Spring 2009; BIO Windhover & Pharmaceutical Strategic Outlook; and the BioPharm America conference.

Technology Showcases: In October 2009, OED and OTM hosted the annual First Look Technology Showcase as part of the University's annual Science conference. The showcase featured 26 Pitt innovations that were available for licensing. As part of the program, participating Pitt Innovators were paired with mentors from the region's economic development and entrepreneurial communities to help them to prepare their posters and pitches. The event attracted more than 200 attendees, including entrepreneurs, economic development representatives, venture capitalists, angel investors, and others who support technology commercialization at the University.

"[Jeff Vipperman and William Clark's] partnership has been great in developing a long-term and lasting relationship with NETL."

George Klinzing

JEFF VIPPERMAN AND WILLIAM CLARK

JEFF VIPPERMAN AND WILLIAM CLARK

When researchers from the National Energy Technology Laboratory (NETL) were working on the development of hydrogen fuel cells for cars, they turned to University of Pittsburgh research partners William "Buddy" Clark and Jeff Vipperman for help. And that was long before Pitt joined a multimillion-dollar energy research consortium of universities in partnership with NETL. This partnership began nearly 10 years ago when researchers at NETL, based just outside of Pittsburgh, needed to figure out how to direct the right amount of compressed hydrogen from a reservoir tank to multiple polymer electrolyte membrane fuel cells, each of which required different amounts of hydrogen at different times.

"They wanted valves on each [fuel cell], but there was no technology that would do that," says Clark, a professor of mechanical engineering and material science at Pitt for the past 18 years.

The pair, working with a team of researchers from an NETL laboratory in Morgantown, W.Va., and funding from the agency, spent more than five years analyzing data, comparing options, designing a set of complex microvalves, and even conducting simulations and studying the controls. Clark says that the Pitt team worked on the valves, meeting with NETL researchers at least once a month to discuss the progress.

"We actually built a device, and they tested it on a fuel cell in their lab," Clark says of the research partnership and the valves that became part of the much larger NETL project. "It was a very well-integrated project."

But that was just the beginning of what would become a much longer-term relationship with the national research agency. Once the original valve development project was completed, NETL came back to the pair with another proposition.

"Now, let's do something similar—but a whole lot harder," Clark says, laughing. And they did. Adds Vipperman, associate professor of mechanical engineering and materials science and director of graduate studies: "This early work, I'm told, served as a model for our next project [and for the university consortium]."

The goal of the project, according to Vipperman, was to develop a valve system for gas turbines that would decrease emissions, control combustion instabilities, and provide fuel flexibility that would allow the turbines to burn conventional fuels such as methane as well as gases derived from coal, hydrogen, petrochemicals, cow manure, and switchgrass, among other fuel sources. The turbines, used by electric power plants, are larger than airplane turbines. He says that NETL required valve technology that could handle high temperatures, high pressure, and "extremely high bandwidth—higher than any valve technology that exists today."

This time, Clark says, the Pitt team worked not only with NETL on the project but also with West Virginia University and Carnegie Mellon University. Pitt's role, as in the initial project, was to develop valves that could rapidly adjust the fuel flow rate based on information obtained from a combustion sensor that had been developed by NETL.

"Our valve complements their sensor," Vipperman says of the resulting technology developed by the Pitt team. The Office of Technology Management currently is working with Clark and Vipperman, along with NETL, to commercialize the innovation.

Both Clark and Vipperman say they have worked well together in solving engineering problems that lead to the kinds of innovations that resulted from the NETL projects.

"I think one of the things that has helped our relationship is that Jeff is a really detail-oriented guy," Clark says of Vipperman. "He's much more focused on the details of the designs and specifications. He's relentless. When he gets hold of a problem, he's like a bulldog. He doesn't let go until it's solved." Vipperman, meanwhile, describes Clark as an enigma. "He's really laid back but gets things done. He's amazingly creative and effective."

George Klinzing, vice provost for research at Pitt and the catalyst for the bigger university-NETL consortium, says the Clark-Vipperman research partnership is a good model for the kinds of working research partnerships that help to elevate the University's level of research excellence.

"They're a great research team," Klinzing says of Clark and Vipperman. "Their partnership has been great in developing a long-term and lasting relationship with NETL. It has provided a solid foundation for our much bigger research partnership commitment—and has led to some great innovations. That's what these partnerships are all about."

The University also hosted and sponsored a technology showcase at the 3 Rivers Venture Fair in September 2009, which was held at PNC Park. The regional fair, which presented entrepreneurial funding opportunities to investors, attracted more than 600 investors and entrepreneurs from at least 10 states. As part of the fair, Pitt partnered with Carnegie Mellon University to host a reception that ultimately showcased 25 technologies from at least five universities. In addition, the University sponsored a technology showcase reception at the Association of University Technology Managers Annual Meeting in New Orleans, La., this past March. The event typically attracts many industry representatives who are interested in technology commercialization.

Innovator "Speed Dating": Since 2006, OED has been hosting annual "speed dating" events that bring together Pitt Innovators and potential outside partners, including funders, economic development organizations, entrepreneurs and industry representatives. OED hosted its latest session in March 2010, allowing for prescreened systematic meetings between close to two dozen Pitt Innovators and outside partnering organizations.

Elevator Pitch Competition: In conjunction with the March 2010 speed dating event, OED also hosted an Elevator Pitch Competition, complete with a financial award for the winner. All told, 13 Pitt Innovators were given an opportunity to stand before an audience of investors and entrepreneurial leaders and give one-minute sales pitches highlighting the value propositions of their innovations. Prior to the event, the participating Innovators attended two elevator pitch training sessions from a seasoned local investor and fundraising professional for technology-based start-up companies.

Recognition

Celebration of Innovation: To recognize Pitt Innovators for their above-and-beyond commitment to technology commercialization at Pitt, OTM, OED and the Office of the Provost hosted their fifth annual Celebration of Innovation at the University Club. As part of the program, Pitt Innovators whose innovations were licensed to industry or start-up companies in fiscal year 2009 received Pitt Innovator Awards, and any Innovator who submitted an invention disclosure to OTM in fiscal year 2009 received an invitation to the event. Chancellor Mark A. Nordenberg served as the keynote speaker. Overall, the event drew more than 150 people.

All of these activities, we believe, serve as opportunities for us to support and serve our Pitt Innovators as they commit their time and energy to the rigorous process of technology commercialization at the University of Pittsburgh. We are fortunate to have so many world-class researchers who are recognized nationally and internationally for their research. Our goal is to work with those innovators to transform their research into commercially promising innovations and then develop opportunities to market them, their research, and their innovations to the rest of the world.

As we move into fiscal year 2011, we will continue to lift up and support our Pitt Innovators and find new ways to develop long-term relationships with industry and others who want to partner with them. As our tagline notes, Pitt Innovators are changing the world through imagination, ingenuity, and innovation. Our job, we believe, is to help them get there.

"The interesting thing is we're working in an extremely integrated way. He's the materials guy, and I'm the biology guy. It's a very nice collaboration.""

Charles Sfeir

CHARLES SFEIR AND PRASHANT KUMTA

PRASHANT KUMTA AND CHARLES SFEIR

Nothing creates a bond between a materials scientist and a dentist/molecular biologist like regenerative bone cement.

Indeed, Prashant Kumta, Edward R. Weidlein Chair and professor of mechanical engineering and materials science, chemical and petroleum engineering, and bioengineering, has teamed up with Charles Sfeir, associate professor and director of the School of Dental Medicine's Center for Craniofacial Regeneration, to develop a novel bioresorbable, injectable "smart" bone cement that not only fills defects in bone but also cultivates regeneration and renewal of the bone itself.

The Kumta-Sfeir research team, funded by the National Institutes of Health and the U.S. Department of Defense and supported by Pitt's McGowan Institute for Regenerative Medicine, has been working to develop this novel cement out of calcium phosphate and nanostructured calcium phosphate-based materials. The result is a substance capable of carrying proteins, cells, plasmid DNA, and drugs, all aimed at supporting regeneration of the endogenous bone. A key factor in the researchers' success has been their ability to control the pH, pressure, temperature, and environment of the cement to allow the proteins, cells, and integrated biological factors to be fully active.

Sfeir first met Kumta at an academic presentation where Kumta was discussing the concept of bone regeneration. Sfeir, whose center deals extensively with bone issues related to cleft palate, mouth cancer, and traumatic facial injury, approached Kumta after the talk, he says, and asked if Kumta had considered the potential of his calcium phosphate and calcium phosphate-based cement materials for providing gene delivery to promote bone growth. The two have been collaborating closely ever since.

"Bone is a huge field—a really large market," Sfeir says, his voice rising with excitement as he considers the possibilities. "There is great clinical need for advancement in this area."

The pair had looked at commercially available bone cements but quickly realized the limited potential of products currently in use. These products, designed simply to replace bone, face long-term issues of degradation and toxicity. In contrast, Sfeir and Kumta say they had a more dynamic vision to remediate bone loss. They wanted their cement to serve as a scaffold to support the damaged bone while seeding regenerative growth of new bone through carefully selected integrative biological factors. "Whatever we wanted to use, we needed to be able to translate it," says Sfeir, who describes commercially available bone cements as suboptimal. "They don't resorb or integrate very well. They cannot encourage bone to renew."

Working together, the two research teams began with calcium phosphate, from which Kumta's team fabricated nanoparticles. These particles, which Kumta has dubbed "NanoCaPs," or nanostructured calcium phosphates, are used in the Kumta-Sfeir model as delivery vehicles for binding growth factors and plasmid DNA. As this DNA is taken up by the surrounding bone cells, the expression of proteins known to foster regeneration of bone tissue ensues. Other key elements of the cement are controlled porosity and the fact that the materials are both bioresorbable and biocompatible.

So far, the research teams have developed both injectable cements and denser, more putty-like materials that can be molded and manipulated into the shape of the damaged bone structure. They're also working on a three-dimensional ink-jet printing technique that coaxes the cement into complex shapes mimicking the morphology of various organs and tissues.

"The printing technique can be used to mimic both the internal and external microstructure of the organs and tissues," Kumta says.

So how do they make their collaboration work? "The interesting thing is we're working in an extremely integrated way," says Sfeir, who adds that their research teams meet weekly to discuss their progress and challenges. "He's the materials guy, and I'm the biology guy. It's a very nice collaboration."

Both scientists say that they aspire to see a new company established around their innovation. In the meantime, they innovatively forge ahead—and build their own bond along the way.

"If this research and ensuing clinical trials are a success," says Kumta, "this will be a testament to the power of collaboration between a biomaterials scientist/engineer and a molecular biologist/clinician. Hopefully, this will lay the foundation for similar successful partnerships in the future."

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