
Margaret Nicklas

# UT nanotech experts develop new windows on human health

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As the android named David says in Ridley Scott's recent sci-fi flick, "Prometheus": "Big things come from small beginnings."

By learning how to tweak the tiniest of particles, nanotechnology researchers at the University of Texas are poised to bring about big and positive changes in how we identify illness and monitor health.

Thanks to the work of Nanshu Lu and her colleagues, some of us may soon wear elastic, filmlike "tattoos" on our skin to monitor blood pressure and other vital signs.

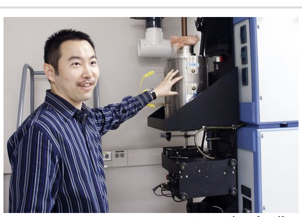
Zheng Wang's detective work, meanwhile, could one day let doctors insert ultrathin optical fibers into the body to transmit images from inside blood vessels or delicate brain tissue, providing a better alternative than harmful X-rays or intrusive scoping devices.

Oscar Ricardo Silva

*Assistant professor Nanshu Lu, a nanotechnology researcher in the Department of Aerospace Engineering and Engineering Mechanics at the University of Texas, has worked on developing elastic, filmlike 'tattoo' electronic devices that could be placed on human skin to monitor blood pressure and other vital signs.*

Their work is part of the rapidly developing field of nanotechnology, a microscopic world where matter often behaves differently than it would in our own, and which has led to new uses or functions for familiar materials. It's a world sometimes measured in units called nanometers — or billionths of a meter — that are the size of three atoms of gold, and that piled 100,000 deep would equal the thickness of a sheet of paper.

In recognition of their nanoscopic feats, Lu, 29, and Wang, 34, both Cockrell School of Engineering faculty members, were named this summer to the MIT Technology Review's list of "35 under 35," a yearly selection of the world's top young innovators.



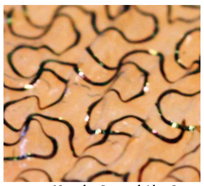
Oscar Ricardo Silva

Their presence at Cockrell reflects the school's bid to attract new blood to its programs. Many new hires are "very energetic, and top stars," said Ahmed Tewfik, chairman of Cockrell's Department of Electrical and Computer Engineering, where Wang is an assistant professor.

*e brain tissue. The researcher is an assistant Department of Electrical and ering at the University of Texas.*

engineering science center, designed to connect nanotechnology research with manufacturing, especially in the electronics, energy, health care and security sectors.

The National Science Foundation announced in September that it would award UT $18.5 million to create and lead the center, called the Nanomanufacturing Systems for Mobile Computing and Mobile Energy Technologies, or NASCENT. The field of nanotechnology is so new, and the ingredients so small, that finding ways to manufacture and mass-produce such products requires innovation beyond creation of the item itself in the laboratory.



*Nanshu Lu and Alex Jerez*

*es form a soft and pliable mesh in ped by assistant professor University of Texas of Austin. The used to create elastic, filmlike s.*

Lu's work on the "epidural tattoo" illustrates the type of connection between innovation and manufacturing UT will hope to make as the center takes off.

Before coming to UT, Lu was part of a multidisciplinary team at the University of Illinois, where she helped create the filmlike electronic devices that expand and contract with the suppleness of human skin. The result is a "smart" patch that stays put on the body not because of adhesives but because it is too light and soft to fall off on its own. MC10, a start-up company in Cambridge, Mass., is currently developing products using the stretchable silicon technology Lu helped pioneer.

One example is called the biostamp, "a prototype designed to showcase the benefits of this technology," according to Benjamin Schlatka, MC10 co-founder and vice president of business development. "We are in the process of developing biostamps now to measure and provide feedback on a variety of physiological functions," he wrote in an email.

The company partners with large industry players like Reebok and is focused in four primary industries: consumer electronics, connected health, medical devices and military applications, according to Schlatka. He said MC10 and Reebok are developing a product based in part on Lu's research that will launch this year, but declined to provide details.

Lu says her work also has potential for use inside the body, for example, as part of a "smart" catheter that could feed doctors information on the condition of blood vessels.

Lu, an assistant professor who joined the department of aerospace engineering and engineering mechanics in 2011, says achieving the stretchability of skin has been a long time coming. As part of the U.S. space program in the 1960s, scientists found that brittle silicon wafers, when made thin enough, became flexible and could then be rolled up and sent into earth orbit where they were used as solar cells to collect energy.

The field was ripe for innovation in 2009 when Lu received her PhD in material mechanics from Harvard University and joined the Rogers Research Group at the University of Illinois. The Rogers lab was looking to make electronics more useful for medical purposes — for example, by making devices more compatible with human tissue.

Lu's insights into the mechanics of materials were crucial in figuring out how to

Eventually, Lu realized that a meshwork of serpentine-shaped metal ribbons would provide a stretchable platform for nanosized silicon membranes and that the combination would flex without breaking.

Lu is now designing the next generation of the electronic tattoo, what she calls transdermal electronics. To do that, she is experimenting with adding prongs so small they will go unnoticed by the wearer but will help the device receive better signals from inside the body. She also wants to hollow out the prongs to allow doctors to administer medicine or take fluid samples.

Fellow Cockrell researcher Zheng Wang, meanwhile, has done his pioneering work in nanophotonics, researching how light interacts with other things, like solid materials.

For instance, Wang has made inroads in the constant search to find better, faster, more efficient ways to transmit data. Recently, he and colleagues at Sandia National Laboratories demonstrated a better way to convert optical signals to acoustic signals than was previously known. The advance could have dramatic implications for communications technology.

"What we did in this work was to show, 'OK, now, you can actually produce sound from light very, very efficiently,'" said Wang, explaining that ultrahigh-frequency acoustic waves can carry a signal used for communication.

Wang said his demonstration was significant in part because it means the conversion from optical to acoustic signals could take place on a single chip instead of a whole circuit board, requiring much less energy.

Down the road, this discovery could improve systems like cell phone signal routing and transmission, or any system that relies on signal switching, though Wang cautions that such practical results have yet to be demonstrated.

Wang has also done groundbreaking work creating fibers that can shift back and forth between different capabilities. Wang and a research group at MIT demonstrated for the first time that a fiber could send and receive optical and acoustic information, as well as sense and create pressure.

In August 2010, the journal Nature Materials described how these fibers could form the basis for an "active" catheter that could collect blood pressure and blood flow measurements in very small blood vessels such as those inside the brain. In addition, these fibers could produce images from inside air-filled organs such as the lungs, stomach or intestines that cannot be imaged from outside the body using ultrasound.

Such technology could be useful in creating devices that make the diagnosis of heart or lung abnormalities easier, Wang said.

The fibers could also have uses outside human health. For example, the technology might come in handy for testing hard-to-access areas in machinery or electronic devices, to find cracks or defects, said Joseph Haus, who directs the electro-optics program at University of Dayton's LADAR and Optical Communications Institute.

Program administrators hope the new research center, which specifically focuses on nanomanufacturing systems, will prove fertile ground for the work of researchers like Wang and Lu, and those who may come after them.

impact nano manufacturing but also educating the students so they'll be future leaders in that area," said Mary Toney, a program director with the National Science Foundation, which is funding the center over five years.

The center, which will partner with the University of New Mexico and the University of California at Berkeley, as well as the private sector, is one of only three of its kind in the nation.

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**CORRECTION**: This story has been updated to say that Zheng Wang is an assistant professor in UT's Department of Electrical and Computer Engineering.

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NEWS


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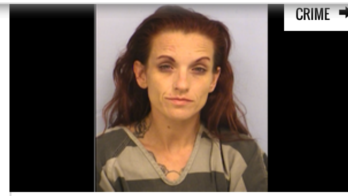
CRIME



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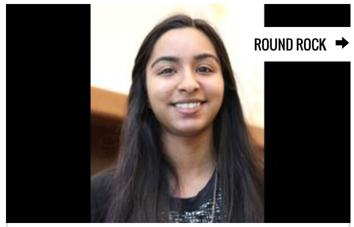

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