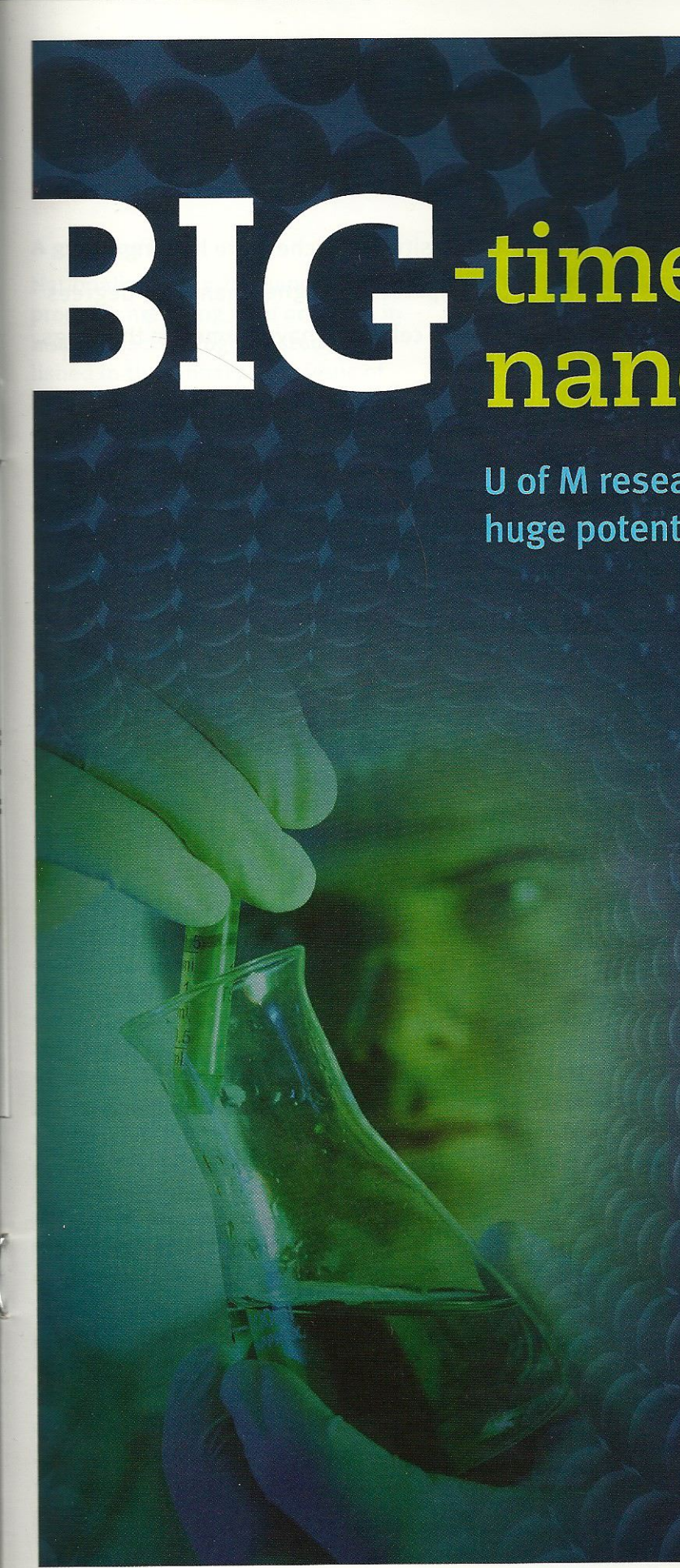
BY MIRANDA TAYLOR

BIG-time interest in nanomedicine

U of M researchers are tapping tiny particles' huge potential in a new realm



At the University of Minnesota's new AeroCore Center, researchers are thinking big by exploring the potential of particles one-billionth of a meter in size. The center has brought together researchers from the College of Pharmacy, Masonic Cancer Center, College of Science and Engineering, and Medical School to develop a new way to eradicate lung cancer cells: inhalation of nanoparticles.

The initiative is one of many University-wide and nationwide projects advancing nanotechnology—the science of manipulating materials on an atomic or molecular scale. Broadly speaking, it's showing up in medicine, energy, information systems, including sensors, and even in everyday products such as paints, sunscreens, and self-cleaning glass.

"The movement to put nano into medicine is a growing one," says Stephen Campbell, Ph.D., electrical and computer engineering professor and director of the University's Nanofabrication Center, which helps the University and companies across the country develop nanotechnology-based products.

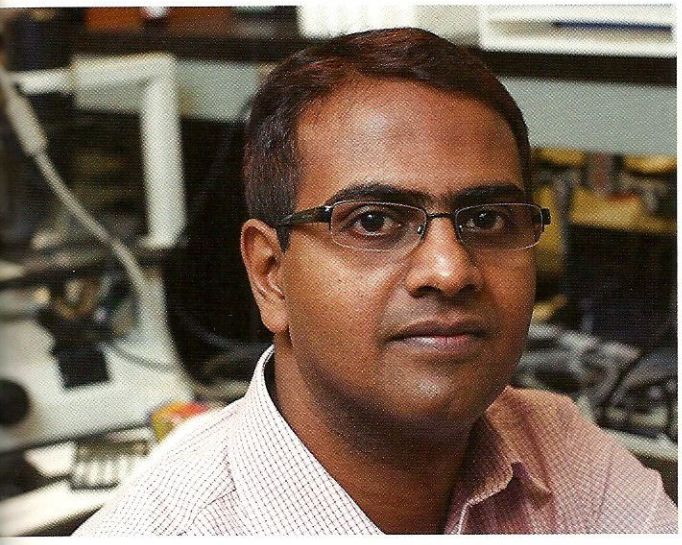


PHOTO: RICHARD ANDERSON

IMAGE: COURTESY OF ZIMMER GUNSUL FRASCA ARCHITECTS, LLP

TOP Masonic Cancer Center member Jayanth Panyam, Ph.D., leads research that uses nanoparticles and hyperthermia to kill cancer cells in the lungs.

BOTTOM An $80 million Physics and Nanotechnology Building is under construction on the University's East Bank campus.

In preliminary trials, University researchers are heating iron oxide nanoparticles to temperatures higher than 98.6 degrees Fahrenheit to kill cancerous cells that have formed in the lungs.

Increasingly, he says, nanoscale drugs and devices are being used to detect and treat medical conditions. And, as the lung cancer study suggests, these tiny particles have huge potential.

Nanomedicine and cancer

According to the Centers for Disease Control and Prevention, lung cancer is the leading cause of cancer-related death among both men and women, accounting for 28 percent of all U.S. cancer deaths expected this year.

At the AeroCore Inhalation Testing Research Facility, University researchers are combining nanoparticles with hyperthermia, the process of raising heat levels to a point that threatens cell survival, to kill cancerous cells that have formed in the lungs. By heating iron oxide nanoparticles to temperatures higher than 98.6 degrees Fahrenheit, they have been able to kill cancer cells in preliminary mouse-model trials.

To get the nanoparticles into the lungs, the researchers developed an aerosol inhalant that, with just a few deep breaths from the patient, carries iron oxide nanoparticles to diseased sites in the lungs.

Then, in a motion resembling a magician's trick, the wave of a magnet outside the body, over the area where a tumor has formed, causes the iron oxide particles to become agitated—and hot enough to kill many of the cancerous cells around them.

From there, cells in the body called macrophages remove the dead cancer cells and iron oxide particles. Over time, any remaining particles are converted into iron salts that the body can absorb or clear.

The next step in the research is to improve the technique to the point where it can completely clear a site of cancer, says the project's leader, Jayanth Panyam, Ph.D., codirector of the Department of Defense–funded AeroCore Center.

"We have not yet successfully eliminated 100 percent of the cancerous cells in an area," says Panyam, who is also an associate professor in the College of Pharmacy and a member of the Masonic Cancer Center, University of Minnesota. "Without all of the cancer cells gone, the cancer will continue to come back. But what we have now does serve to help eliminate a significant portion of the cancer."

And that's big progress.

A growing field

Nationally, nearly 250 nanomedicine products are being used or tested in humans, according to a study published in the January 2013 issue of *Nanomedicine: Nanotechnology, Biology, and Medicine*.

But the field is still in an early stage, says the study's lead author, Michael Etheridge, a Ph.D. candidate in mechanical engineering in the University's Institute for Engineering. So far, the identified applications "are only scratching the surface of the potential available," he told the *Huffington Post* in February.

"Nanomedicine products have exciting potential in so many different applications, ranging from cancer treatment or diagnosis, imaging, infectious diseases, immunologic diseases, or possibly facilitating transplantation," says the study's senior author, Jeffrey McCullough, M.D., a professor of laboratory medicine and pathology in the University's Medical School and a former director of the Institute for Engineering in Medicine. "There is no question that nanomedicine products will be important in medical advances over the next decade."

Collaboration is key

Collaboration within and beyond the University's walls has proven essential for nanotechnology research and development. Experts from such wide-ranging fields as biomedical engineering, pharmaceuticals, head and neck surgery, and veterinary medicine are connecting over nanotechnology's potential.

That means a person who wants to understand how to fix a problem has to find someone who has the technology to help.

"The developers behind nanotechnology don't always understand how their discovery can be applied elsewhere," says the Nanofabrication Center's Campbell. "That's not to mention the challenges of finding someone who may be interested but works for another institution or speaks another language."

To help connect the right people, the University supports a variety of interdisciplinary workshops, conferences, and centers. A joint program of the Institute on the Environment and Medical Devices Center, for example, provides start-up funding, resources, and a network for nanotechnology projects that cross collegiate boundaries.

Increasingly, researchers are coming together with the understanding that it's the small stuff that matters. MB

Miranda Taylor is a communications associate with the University's Academic Health Center.

To learn more about nanotechnology at the University of Minnesota, visit www.nano.umn.edu.

EXPLORING WHAT NANO CAN DO

University of Minnesota researchers from multiple disciplines are discoverin what nanomedicine can do. Here are a few examples:

SHAI ASHKENAZI, Ph.D., assistant professor of biomedical engineering

Developing less invasive imaging probes including a thin, flexible ultrasound device to provide a clearer picture inside the body

ALLISON HUBEL, Ph.D., associate professor of mechanical engineering and Masonic Cancer Center member

Creating synthetic corneal tissue that mimics natural tissue

WILLIAM KENNEDY, M.D., professor of neurology

Quantifying cognitive function via nanotech-enabled sensors

JAYANTH PANYAM, Ph.D., associate professor of pharmaceutics and Masonic Cancer Center member

Investigating effectiveness of nanoparticles in destroying lung cancer cells

AMY SKUBITZ, Ph.D., professor of laboratory medicine and pathology and Masonic Cancer Center member

Seeking to detect ovarian cancer earlie and identify recurrences

T. ANDREW TATON, Ph.D., associate professor of chemistry and Masonic Cancer Center member

Creating a cancer vaccine using protein coated nanoparticles