EXCELLENCE RECOGNIZED

NJIT OVERSEERS HONOR TWO RESEARCHERS FOR BIOMEDICAL AND MATERIALS BREAKTHROUGHS

In 2008, the NJIT Board of Overseers initiated recognition of exceptional achievement by researchers who have been members of the university community for at least five years. Since then, they have honored individuals for work that has significantly advanced knowledge in their field of expertise as well as the reputation of the university.

For 2013, the Board of Overseers presented two Excellence in Research awards to pioneers in the fields of materials science and tissue engineering whose careers have overlapped consequentially in the university's Medical Device Concept Laboratory. Michael Jaffe, a research professor in the Department of Biomedical Engineering and the founder of the lab, was honored with the university's first-ever Lifetime Achievement Award for his many game-changing innovations in materials science over the course of successive careers in industry and academia.

Treena Livingston Arinzeh, also a professor in the Department of Biomedical Engineering and the director of the department's graduate program, won the sixth annual Excellence in Research Prize and Medal for her contributions to regenerative medicine. Both innovative and original thinkers, deft at applying concepts from diverse engineering fields to advance biomedicine, they have worked together on breakthrough biomaterials such as the scaffolds that form the backbone for new tissue.

PHOTO: JED MEDINA

Professor Treena Livingston Arinzeh is taking research with adult stem cells and biomaterials in new and very promising therapeutic directions.

FROM SATELLITES TO STEM CELLS

Originally intent on building satellites, Treena Livingston Arinzeh switched gears early on in her career to become what she calls an "engineer of the body," focusing on longstanding, intractable medical challenges such as bone, cartilage and nerve repair. Now, just over a decade after beginning her signature work on calcium phosphate scaffolds – composite structures that stimulate, guide and support the growth of new bone tissue from adult stem cells – she stands on the verge of a professional milestone.

"We've just completed tests of these scaffolds in large animals, obtaining good results, and so the next step is clinical trials in humans. We're now in the process of fine-tuning the technology and showing it to companies who would license it and carry it forward," she says, adding, "The area of greatest immediate need for bone regeneration is spinal fusion surgery, because we now have to find the bone from somewhere else in the body or use donor bone and those grafts often don't repair well."

Arinzeh was honored this fall with the Overseers Excellence in Research award for her tenacious pursuit of transformative medical applications and for the scientific breakthroughs she has made along the way, including the discovery that adult stem cells taken from one person could be implanted in another without being rejected.

"She has been at the forefront of breakthroughs, integrating innovative biomaterials and non-embryonic stem cells to promote the regeneration of bone, cartilage and nerve tissue," Don Sebastian, senior vice president for research and development, said at the October awards ceremony, while lauding her ability to turn scientific discovery into "engineering innovation."

PHOTO (OPPOSITE): JAMES MARKO

ENGINEERING TISSUE REGENERATION

Indeed, Arinzeh has creatively borrowed techniques from other engineering sectors to advance tissue regeneration. The polymer fibers that compose the framework of her scaffolds, for example, are formed by electrospinning, a technique developed by the textile industry. She is harnessing piezoelectricity, an electrical charge created by mechanical force that is used in sonar and sound technologies, among others, for use in cartilage scaffolds.

Arinzeh, who recently received funding from the National Science Foundation to identify markets for the latter technology, is focusing in the near-term on strategies to maintain tissue that is under assault from daily wear and tear.

"Cartilage experiences a lot of loading throughout the day, and the idea is to stimulate cells to replace the tissue as it wears down. As of now, there is no way to repair cartilage, and its degradation can lead to severe osteoarthritis, so the thinking here is prevention."

She works closely with clinicians, orthopedic surgeons and neurosurgeons, always asking the question, "What is the clinical problem we're trying to tackle?" To date, repairing spinal cord injuries poses the greatest research challenge, while the stakes are high.

"With bone and cartilage, we're relying on the body's own processes to regrow tissue, but the biological factors driving the formation of neural tissue in the spinal cord appear to be different," she notes. "At this stage, we're looking at multiple approaches, including a combination therapy that uses growth factor with electrically charged scaffolds. We're trying to prompt neural stem cells to form neurons that will extend across the defect zone and reform connections between the brain and the rest of the body."

As a researcher, she keeps an open mind and is willing to question current thinking. While much of her early research focused on using stem cells to regrow tissue, for example, she is also now mulling new materials.

"We will continue to improve this technology, exploring materials other than cell-based ones, as we try to stimulate patients' own cells to grow, rather than having to get cells from somewhere else. Essentially we will keep working to simplify the technology."

PIONEERING NEW BIOMATERIALS

Serendipity played a role in the late 1990s in steering the enterprising industrial researcher Michael Jaffe to his present post in NJIT's Biomedical Engineering Department. Just as the materials expert was leaving Hoechst Celanese Corp. after a long and prolific career there developing synthetic polymers, the federal government was mounting a push to produce new biomaterials for medicine, defense and other arenas. The effort would require a high degree of cooperation among the best minds from both academia and industry.

"The idea was to integrate the biological and physical sciences. One of the important insights at that time was that biological materials are a lot more sophisticated than synthetic ones, and I was in the middle of this emerging area of research with my work on synthetic polymers and biomimetic materials," Jaffe recounts.

Initially recruited by the New Jersey Center for Biomaterials based at Rutgers, he joined NJIT in 1999, founded the Medical Device Concept Laboratory, and recruited prominent industrial scientists to join him. They got to work immediately on projects ranging from collagen fibers for tissue-engineering devices to NASA-funded research on nanocomposites for use in space stations. Nearly empty when he arrived in 1999, the CHEN building is now humming with projects ranging from stem cell and neural tissue engineering to studies of catastrophic brain injury.

"INTERACTING WITH STUDENTS IS THE HIGHLIGHT. IT'S SO EXCITING TO SEE THEM DEVELOP, AND HELP THEM MAKE THE TRANSITION FROM STUDENTS TO COLLEAGUES."

Research Professor Michael Jaffe

PHOTO: JED MEDINA

Founder of the Medical Device Concept Laboratory at NJIT, Research Professor Michael Jaffe has had a long and productive career as a materials scientist.

BRIDGING INDUSTRY AND ACADEMIA

In receiving the first-ever Overseers Excellence in Research Lifetime Achievement Award, Jaffe was lauded not only for his distinguished careers in industry and academia, but for his success in bridging the two.

At the awards ceremony, Vice President Sebastian cited Jaffe's foundational work in the "golden age of synthetic polymers" leading to such critical advances as new technologies to reinforce tires, super high-strength fibers and nearly twenty patents, while also praising his undimmed creativity in recent years in the pursuit of renewable, environmentally safe materials for wide application.

"He has developed a whole new field based on the synthetic pathways for taking naturally occurring sugars into viable feedstocks for replacing petroleum-derived chemicals," Sebastian said of Jaffe's work on sugar-based epoxy resins, which could replace bisphenol-A (BPA), an industrial product used to line food cans that has raised public health concerns by functioning as a hormone mimetic.

Jaffe has collaborated with fellow award winner Arinzeh since she joined the Department of Biomedical Engineering in 2001, working together on key projects such as scaffolding technologies used to repair damaged tissue.

Jaffe, speaking at the ceremony, thanked NJIT for "providing me a home to do what I love to do."

But he was no stranger to academia before coming to NJIT. Hoechst Celanese had named him a research fellow, giving him free rein to pursue new ideas. This pursuit took him to university campuses from Boston to Tokyo to Moscow to advance research on materials ranging from spider silk to toughened ceramics.

"I find that you need credibility as a scientist to work with academics and as a technologist to get business people to listen," he notes.

He describes life on campus as an "an absolute joy" in ways that he could not have predicted fifteen years ago.

"There are more large research projects going on here than students know what to do with," he says, adding that what inspires him most, however, is working with young scientists. "Interacting with students is the highlight. It's so exciting to see them develop, and help them make the transition from students to colleagues." ■

Author: Tracey Regan is an NJIT Magazine *contributing writer.*

http://www.njit.edu/about/boards/overseers/awards/prize-medal/index.php

LEADING THE SEARCH FOR NEW KNOWLEDGE

Professors Treena Livingston Arinzeh and Michael Jaffe have joined the distinguished members of the NJIT community recognized by the Board of Overseers for their continuing efforts to seek new knowledge on the frontiers of science and technology.

2012
Reginald Farrow
Research Professor of Physics

2011
Haim Grebel
Professor of Electrical and Computer Engineering

2010
David B. Rothenberg
Professor of Humanities

2009
Kamalesh K. Sirkar
Distinguished Professor of Chemical Engineering and Foundation Professor in Membrane Separations

2008
Philip R. Goode
Distinguished Professor of Physics and Director of the Center for Solar-Terrestrial Research

PHOTO: JAMES MARKO

Research Professor Michael Jaffe and Professor Treena Livingston Arinzeh with NJIT President Joel S. Bloom at the October awards ceremony where the two members of the Biomedical Engineering Department were honored by the university's Overseers for their significant accomplishments as researchers.