

# Applying AI to microelectronics manufacturing

## Assistant professor receives grant from Applied Materials to combine machine learning with expert knowledge

By Kelly deVos, ASU News  
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Rivers flow across the planet's surface, carving deep valleys and intricate canyons. Likewise, makers of microelectronics direct plasma, an ionized gas, to travel over silicon wafers, etching intricate patterns, creating pathways for electrical energy and forging the complex circuits required by today's devices.

These microchips power everything from fighter jets to flat-panel televisions.

But experts at [Applied Materials](#), a global innovator in semiconductor manufacturing, believe this process can be improved. They have turned to [Kookjin Lee](#), an emerging leader in scientific machine learning research, to study the physics of plasma and glean insights that can improve microchip manufacturing.

Lee is an assistant professor of computer science and engineering in the [School of Computing and Augmented Intelligence](#), part of the [Ira A. Fulton Schools of Engineering](#) at Arizona State University. He has received a three-year grant from Applied Materials to create artificial intelligence solutions that improve the manufacturing systems of plasma chambers where microchip etching takes place.

### Down to a science

Lee studies a form of AI known as scientific machine learning.

He creates algorithms — or the instructions computers use to do their work — that combine a level of awareness of key facts about the natural sciences, especially physics, with expert knowledge.

Building on this approach, Lee seeks to train an AI model using what experts at Applied Materials know about their microchips and what physicists understand about plasma. The result will be software that can make accurate predictions about what can happen in the plasma chamber during

the manufacturing process.

“Applied Materials is out to make the best-quality semiconductor,” Lee says. “So, what we’d like to do is build machine learning systems that can help them evaluate their manufacturing processes — to quickly know whether design changes will lead to success or failure.”

The project’s aim is to speed up production, lower manufacturing costs and reduce microchip defects.

Satheesh Kuppurao, Applied Materials vice president for business development and growth in the Semiconductor Products Group, says that these research grants are part of a strategic vision to bring the most innovative products to market.

“We want to partner with academia on the toughest challenges,” Kuppurao says. “Academic researchers often have the depth of knowledge and talent to solve long-term problems.”

## **They say everyone has a twin out there ...**

Lee’s project is part of ongoing research in the Fulton Schools that uses AI to develop digital twins.

In this type of work, researchers create virtual versions of people, products or systems, and use AI to run helpful simulations.

In cybersecurity, [Tiffany Bao](#) leads a team developing digital twins of cyberphysical systems, such as drones and autonomous vehicles. The assistant professor in the Fulton Schools has received funding from the [U.S. Defense Advanced Research Projects Agency](#) to use AI to [secure critical systems from cyberattacks](#).

Meanwhile, Fulton Schools Professor [Sandeep Gupta](#) uses this technology to [improve women’s heart health](#) and help the medical sector provide better maternal care for pregnant women with diabetes. Given the understandable reluctance to experiment on pregnant women, the concept of creating digital profiles of expectant mothers is especially impactful.

Under this new grant, Lee and his team will make software that can model digital versions of semiconductors designed by the Applied Materials team and then use AI to test the virtual components.

Lee explains the process: “We’re developing machine learning models that mimic what various devices do. We can then see how the digital twins of the microchips perform. This should enable experts at Applied Materials to make better-informed decisions during the design process.”

## **Speeding up success**

This new funding is the next step in Lee’s already-promising career.

In 2024, he received a Faculty Early Career Development (CAREER) Award from the [U.S. National Science Foundation](#) to develop machine learning algorithms designed to discover new

scientific laws. The prestigious award funds the work of especially promising researchers in the beginning stages of their work.

Similarly, in 2022, Lee received an NSF grant to use deep machine learning to study how disinformation on social media might lead to anti-Asian racial bias and spikes in real-world hate crimes.

He also strives to create research opportunities for both graduate and undergraduate students in his lab at ASU.

[Ross Maciejewski](#), director of the School of Computing and Augmented Intelligence, says that Lee's project is an important step in the Fulton Schools' plan to do meaningful artificial intelligence work and innovate in microelectronics.

"The award is a validation of efforts to create a home for scientific machine learning here in the Fulton Schools," Maciejewski says. "This is a relatively new area of research, and Kookjin is not only doing leading-edge work, he is providing incredible opportunities for students to study in this emerging field."

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## Main image



Kookjin Lee is an assistant professor of computer science and engineering in the School of Computing and Augmented Intelligence, part of the Ira A. Fulton Schools of Engineering at Arizona State University. He has received a three-year grant from Applied Materials to develop artificial

intelligence solutions that improve microchip manufacturing. Photo by Erika Gronek/ASU