

'Superchip' Project Gets \$725,000 Grant



Engineering researchers at the University of Arkansas are working on a project to further develop a new material for advanced electronics devices. The project is funded by a \$725,000 grant from the US Air Force Office of Scientific Research (AFOSR).

The new material – a combination of silicon, germanium and tin grown on silicon substrates – will create a so-called silicon optoelectronics “superchip” by improving processing speed and reliability through combining photonic and silicon devices. The technology will increase the efficiency and decrease the cost of devices such as lasers, detectors and cameras, the researchers said.

Photonics is the science of all things related to light, including its generation, emission, transmission and sensing. Optoelectronics focuses on the development of electronic devices that source, detect and control light.

Changing the Landscape of Optoelectronics Research

“The demonstration of key applications of our research will generate critical momentum toward the advancement of this new material and will radically change the landscape of optoelectronics research,” according to Fisher Yu, an associate professor in the Electrical Engineering Department, University of Arkansas. “It will eventually lead to the emergence of a new field of silicon-based, integrated optoelectronics.”

Yu and Hameed Naseem, a professor of electrical engineering, are collaborating on the project with Mansour Mortazavi, a professor of physics at the University of Arkansas at Pine Bluff and the grant’s principal investigator.

In fact, the research team has already demonstrated the efficacy of silicon-germanium-tin as a powerful semiconductor, one that addresses the problem of so-called “band gap indirectness” (which, in semiconductor physics, has to do with the momentum of electrons in various energy bands). This problem leads to inefficiencies because photons cannot be emitted in an indirect gap, the researchers explained.

Project Uses ‘Ultra-High-Vacuum Chemical Vapour Deposition’ Method

For this project, the researchers will grow and characterise silicon-germanium-tin materials on silicon substrates through a process called ultra-high-vacuum chemical vapour deposition. This process is possible because of sophisticated equipment and machines in laboratories directed by Professors Yu and Naseem.

The project includes funding for three positions: a postdoctoral researcher at the University of Arkansas at Pine Bluff, as well as a doctoral and a master’s student at the University of Arkansas.

Prof. Yu heads the Applied Nano & Bio Photonics Group at the University of Arkansas. In his research, Prof. Yu develops optoelectronic devices such as lasers, photo detectors, and renewable energy devices using novel materials, such as bismide compounds and silicon-germanium-tin alloys, and advanced nanofabrication techniques. He is a member of the International Society for Optical Engineering and the Institute of Electrical and Electronics Engineers.

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