Multifunctional smart sensors and high-power devices on a computer chip

October 4 2010

Researchers from North Carolina State University have patented technology that is expected to revolutionize the global energy and communications infrastructure – and create U.S. jobs in the process.

The researchers have developed the means to, for the first time, integrate gallium nitride (GaN) sensors and devices directly into silicon-based computer chips. "This enables the development of high-power – high-voltage and high-current – devices that are critical for the development of energy distribution devices, such as smart grid technology and high-frequency military communications," says Dr. Jay Narayan, the John C. Fan Distinguished Chair Professor of Materials Science and Engineering at co-holder of the patent.

"GaN can handle more power than conventional transistors. And it can do so faster, because it can be made into single crystals that are integrated into a silicon chip – so electrons can move more quickly," Narayan says.

"This integration of GaN on the silicon platform without any buffer layers has enabled the creation of multifunctional smart sensors, high-electron mobility transistors, high-power devices, and high-voltage switches for smart grids which impact our energy and environmental future," Narayan explains.

Integrating GaN into silicon chips also makes a broader range of radio frequencies available, which will enable the development of advanced

communication technologies. "These devices stand to meet the challenges of high-power, high-frequency and high bandwidth needs for advanced consumer applications and military satellite communications," Narayan says.

"The United States still leads the world in innovation," Narayan says. "But with the advent of the internet and instant communication, just doing innovative research isn't enough any more. We have to take steps to ensure that our advantage in innovation can be translated into products that create jobs here at home."

"Direct integration of devices based on different types of semiconductors onto silicon chips is of considerable interest because it can enable different functionalities, such as lasers or higher performance transistors," says Dr. Pradeep Fulay of the National Science Foundation (NSF), which funded the GaN research at NC State. "Professor Narayan has used a special process that allows integration of semiconducting materials like GaN on the silicon so as to create hybrid type computer chips. This research will likely lead to transistors with far superior power and performance sought for many commercial and military communication applications."

The research that led to the GaN breakthrough was done by Narayan and former NC State Ph.D. student Thomas Rawdanowicz and published in *Applied Physics Letters* and U.S. Patent Granted (20050124161).

NSF is currently funding additional research in this area by Narayan. A U.S.-based corporation is already in the process of licensing the technology.

Provided by North Carolina State University