Phase-transition cubic Gallium Nitride doubles ultraviolet emission efficiency

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Novel photonics materials are becoming pivotal for energy conversion, communications, and sensing, largely because there is a global desire to enhance energy efficiency, and reduce electricity consumption. As Dr. Can Bayram, assistant professor in the Department of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign, notes, "Who doesn't want to consume less electricity for the same quality of lighting?"

When the 2014 Nobel Prize in Physics was awarded to a trio of researchers for inventing a new (In)GaN-based energy-efficient, more environmentally friendly light source, this idea was brought to the forefront and gained more widespread recognition.

In related work, the Innovative COmpound semiconductoR Laboratory (ICOR) team led by Prof. Bayram has published a well-received paper titled "High internal quantum efficiency ultraviolet emission from phase-transition cubic GaN integrated on nanopatterned Si(100)". Richard Liu, a Ph.D. candidate advised by Prof. Bayram, and whose primary research areas are optoelectronics and nanophotonics, is the lead author for this paper.

The team's paper and its promise for a novel emitter have recently been featured in *Compound Semiconductor* and *Semiconductor Today*.

GaN materials (also known as III-Nitrides) are one of the most exotic photonic materials, and in the U of I team's work, they investigate a new

phase of Gallium Nitride materials: cubic. Using aspect ratio nanopatterning technology, they report a hexagonal-to-cubic phase transition process in GaN, enabled through aspect ratio patterning of silicon substrate. The emission efficiency of optimized cubic GaN, thanks to the polarization-free nature of cubic GaN, is measured to be approximately 29%, in sharp contrast to the general percentages of 12%, 8%, and 2%, respectively, of conventional hexagonal GaN on sapphire, hexagonal free-standing GaN, and hexagonal GaN on Si.

Bayram comments that "New photonic materials are critical in next-generation energy conversion devices. GaN-on-Si, enabled through phase-transition technology, provides an efficient, scalable, and environmental solution for integrated visible photonics."

More information: Richard Liu et al. High Internal Quantum Efficiency Ultraviolet Emission from Phase-Transition Cubic GaN Integrated on Nanopatterned Si(100), *ACS Photonics* (2018). DOI: 10.1021/acsphotonics.7b01231

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