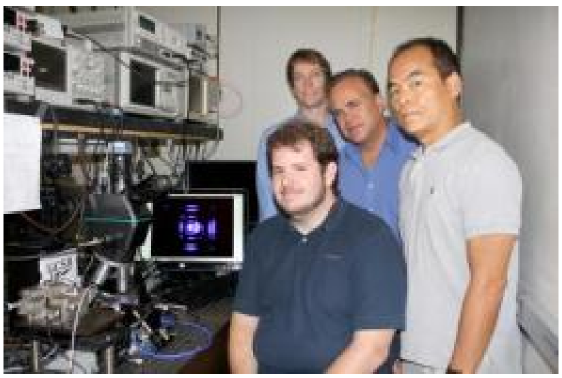
Physicists achieve world's first violet nonpolar vertical-cavity laser technology

July 23 2012



Shuji Nakamura and his research group at UCSB demonstrate the first violet nonpolar m-plane VCSEL based on gallium nitride. Pictured L to R: Casey Holder, Daniel Feezell (back), Steven DenBaars, Shuji Nakamura. Credit: UCSB College of Engineering

In a leap forward for laser technology, a team at University of California, Santa Barbara, has developed the first violet nonpolar vertical-cavity surface-emitting lasers (VCSELs) based on m-plane gallium nitride semiconductors.

This recent discovery by LED pioneer Shuji Nakamura and his research team at UCSB is an achievement in VCSEL technology that opens doors for higher optical efficiency lasers at greatly reduced manufacturing costs for a variety of applications.

"We have demonstrated working, electrically-injected nonpolar m-plane nitride VCSELs lasing at room temperature, and have shown that such devices are naturally polarization-locked along the crystallographic a-direction of the wurtzite crystal. This is in contrast to the majority of VCSELs, which are typically randomly polarized," said Dr. Daniel Feezell, project scientist with Nakamura's lab. Feezell directed the research effort with Nakamura and Steven DenBaars, Co-Directors of the Solid State Lighting and Energy Center at UCSB, and graduate student Casey Holder. Their findings have been submitted for publication.

"This is the first report of a nonpolar VCSEL, which we believe to be one of the biggest breakthroughs in the field of laser diode technology," explained Nakamura, a professor of Materials at UCSB. "The nonpolar VCSEL has a lot of advantages in comparison with conventional c-plane devices. One major advantage is that the light polarization is locked to one direction. This device could be used for a variety of applications, such as lighting, displays, sensors, and technology that requires energy efficiency and small form-factor."

VCSELs offer advantages over conventional edge-emitting laser technology for some applications. On-wafer testing of VCSEL arrays during the manufacturing process, for example, can save costs compared to edge-emitting lasers that require additional steps before they can be tested. VCSELs exhibit low threshold currents, circular and low divergence output beams, and are easily integrated into two-dimensional arrays.

The nonpolar VCSEL platform also provides high optical gain, which helps to increase optical efficiency of devices. "The nonpolar VCSEL could enable new products and applications, such as pico-projectors for smartphones, mobile cinema, or even automotive lighting," said DenBaars, professor of Materials.

"This breakthrough achievement by our Solid State Lighting and Energy Center leverages UCSB's globally recognized strength in materials science and engineering," commented Rod Alferness, Dean of the College of Engineering at UCSB. "The enhanced laser performance and prospects for significantly improved cost-effectiveness demonstrated is likely to have important impact on future generations of flat panel displays, mobile phones and lighting."

"Our UC Santa Barbara community is very proud of the continuing pioneering breakthroughs from the faculty and researchers at our Solid State Lighting and Energy Center," said Chancellor Henry T. Yang. "We congratulate our colleagues on this milestone achievement, which opens up exciting new opportunities for research and innovation."

Provided by University of California - Santa Barbara

Citation: Physicists achieve world's first violet nonpolar vertical-cavity laser technology (2012, July 23) retrieved 2 May 2024 from
https://phys.org/news/2012-07-physicists-world-violet-nonpolar-vertical-cavity.html