News

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Multi-quantum blocking raises deep-UV LED efficiency

A 2.7x efficiency enhancement from using multi-quantum barrier (MQB) electron blocking layers (EBLs) is claimed for deep-ultraviolet (DUV) nitride semiconductor light-emitting diodes (LEDs) developed by researchers based in Saitama, Japan [Hideki Hirayama et al, Appl. Phys. Express, vol3, p031002, 2010]. The wavelengths of the devices were in the range 262–250nm.

The maximum external quantum efficiencies and output powers achieved for a 250nm LED in continuous-wave (cw) operation at room temperature were 1.18% and 4.8mW, respectively. Even better performance was achieved at the longer wavelength of 262nm: 1.54% and 10.4mW, respectively.

These characteristics are claimed as "the highest values ever reported" by the researchers affiliated variously with Institute of Physical and Chemical Research (RIKEN), Saitama University and Japan Science and Technology Agency (JSTA) Core Research of Evolutional Science & Technology (CREST) basic research promotion program.

The possible applications for such sub-280nm devices include sterilization, water purification, medicine, and biochemistry.

Electron blocking layers are commonly used in LEDs to avoid overshoot of electrons into the p-type region of the diode. Electrons that reach the p-type region tend to recombine without producing radiation, reducing the possible light output of the device.

Traditional EBLs usually consist of a single layer of material with a large energy bandgap that raises a barrier to electrons moving toward the p-type region. However, because at very short wavelengths large energy bandgaps are already being used for the well structures where the light is produced, the relative effectiveness of the single-layer EBLs is reduced.

Multi-quantum barriers use interference effects from the wave-like behavior of electrons to enhance the barrier. The theoretical proposal for MQBs dates back to 1986 and was applied in the early 1990s to aluminum gallium indium phosphide (GaInP/AlInP) red laser diodes (LDs). For arsenide and