NEWS

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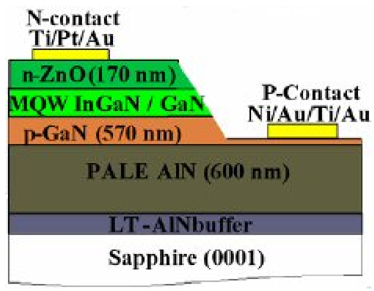
ZnO/GaN hybrid shows green LED promise

Low-temperature growth of n-ZnO above the active layer is the latest approach to improve the performance of green LEDs and fill the "green gap".

Hybrid LED epistructures featuring GaN and ZnO layers could produce higher performance green emitters than existing devices, according to a joint French-US research collaboration.

Northwestern University and French startup Nanovation showed the concept's feasibility by making an LED with peak continuous-wave electroluminescent emission in the order of 2 mlm at 510 nm.

In the 25 August issue of *Applied Physics Letters* the researchers outlined their approach, which avoids precipitation of indium from the LED's InGaN multi-quantum-well (MQW) layer.



ZnO/GaN Hybrid LED

The team used this strategy to tackle the lower efficiency of green emitters compared with their red and blue counterparts - known as the "green gap".

"The higher indium content required in the active layers for green emission causes problems," Can Bayram – a member of the Northwestern team led by Manijeh Razeghi – told *compoundsemiconductor.net*.

"The elevated substrate temperature necessary for the conventional p-type GaN top layer causes indium to leak out and reduces the performance and lifetime of the LEDs."

The resulting epistructure redesign also flips the conventional arrangement of the p-doped and n-doped layers surrounding the MQW.

The team's device features an AlN-on-sapphire substrate capped by an MOCVD-deposited p-GaN layer – rather than the usual n-GaN - on which the MQW is grown. The n-doped layer is instead made above the MQW, using pulsed laser deposition (PLD) of ZnO, which can be done between 200°C and 800°C. In comparison, the team annealed the p-GaN layer at 1000°C to activate its magnesium dopant before growing the MQW.

Because ZnO also possesses a refractive index of 2.5, compared with 2.0 for GaN, these LEDs should benefit from improved light extraction efficiency.

Although the Northwestern team produced the final devices and measured their efficiency, Nanovation deposited the ZnO layers. According to Bayram, the structure's key performance inhibitor is now the quality of the p-GaN layer, which is helped by growing on the AlN template.

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Alongside work to further boost the quality of the p-GaN material in their devices, Bayram and his co-workers are now looking to produce thicker active layers.

“As the ZnO growth temperature is lower than that of the MQW, thicker InGaN layers will be more stable and should lead to higher LED output power in the green spectrum,” he said.

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