Scilight

NEWS | MARCH 29 2019

New AlN film growth method enhances emission of deep ultraviolet LEDs FREE

Chris Patrick

Scilight 2019, 130001 (2019)
https://doi.org/10.1063/1.5097052

AIP Publishing

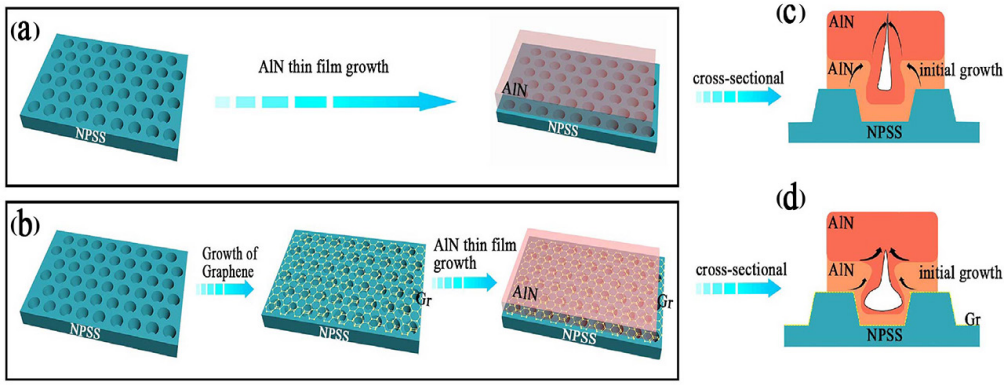
Scilight

26 March 2019

New AlN film growth method enhances emission of deep ultraviolet LEDs

Chris Patrick

The combination of a nano-patterned sapphire substrate and a graphene buffer allow researchers to grow higher quality AlN films for higher quality AlGaN-based deep ultraviolet light-emitting diodes.



Aluminum gallium nitride-based deep ultraviolet light-emitting diodes, or DUV-LEDs, have applications including sterilization, polymer curing, and biochemical detection. When manufacturing an AlGaN-based DUV-LED, the template for the epitaxial layer of AlGaN is usually made of aluminum nitride. These AlN films are usually grown on sapphire substrates because they are the most cost-effective option available. But AlN and sapphire substrates have a large lattice mismatch and thermal expansion mismatch, which causes stress and dislocations, ultimately reducing the internal quantum efficiency and degrading the performance of the resultant LEDs.

To address this problem, Wei et al. introduced a layer of graphene between the AlN films and the sapphire substrates. The new method allowed the researchers to grow high-quality AlN films that increased both the internal quantum efficiency and light extraction efficiency of resultant DUV-LED with an enhanced emission and a peak wavelength of 280 nm.

According to the authors, the layer of graphene acts a buffer between AlN and the sapphire substrate—while the epitaxial growth process for AlN on the sapphire substrate is heteroepitaxy, AlN and graphene exhibit quasi-van der Waals epitaxy, which reduces the mismatch effect and allows higher quality AlN films to grow. The graphene layer also shortens the growth time because it promotes aluminum atoms to migrate laterally, causing AlN to rapidly coalesce on the nano-patterned sapphire, reducing dislocation density and strain.

Next, the authors plan to optimize the growth of AlN on graphene and nano-patterned sapphire substrate to further reduce the dislocation density of AlN films and increase the external quantum efficiency of DUV-LEDs.

Source: "Graphene-assisted quasi-van der Waals epitaxy of AlN film for ultraviolet light emitting diodes on nano-patterned sapphire substrate," by Hongliang Chang, Zhaolong Chen, Weijiang Li, Jianchang Yan, Rui Hou, Shenyuan Yang, Zhiqiang Liu, Guodong Yuan, Junxi Wang, Jinmin Li, Peng Gao, and Tongbo Wei, *Applied Physics Letters* (2019). The article can be accessed at https://doi.org/10.1063/1.5081112.