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Nanostructured GaN light-emitting diodes on unusual substrates and blue light enhancement by surface plasmon resonance

There have been significant recent developments in the growth of single crystal gallium nitride (GaN) on unconventional templates for large-area blue or green light-emitting diodes (LEDs) which, together with layer transfer onto foreign substrates, can enable flexible and stretchable lighting applications. Here, the heteroepitaxial growth of GaN on amorphous and single-crystal substrates employing various interlayers and nucleation layers is discussed, as well as the use of weak interfaces for layer-transfer onto foreign substrates. Layer-transfer techniques with various interlayers are also discussed. These heteroepitaxial GaN growth and layer-transfer technologies are expected to lead to new lighting and display devices with high efficiency and full-color tunability, which are suitable for large-area, stretchable display and lighting applications. We shall also discuss blue light enhancement in CdS/ZnS quantum dots using surface plasmon resonance to achieve near-unity quantum yield. Finally, nanostructured GaN-based LEDs for white light generation will be reviewed.

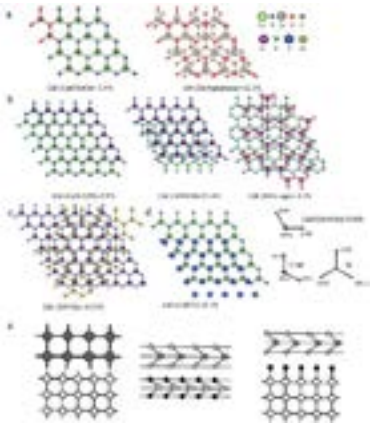

Figure1: Atomic arrangement of various hetero-epitaxial interfaces for different multilayer structures: a) GaN/ZnO (NL)/graphite (IL/SB): (left) GaN/ZnO and (right) ZnO/graphene. b) GaN/AlN (NL)/BN (IL)/sapphire (SB): (left) GaN/AlN, (center) AlN/BN, and (right) BN/sapphire. c) GaN/Ti (IL)/glass (SB): GaN/Ti. d) GaN/AlN (IL)/Si (SB): AlN/Si. e) Interfaces connected by (left) dangling bonds (3D on 3D), (center) van der Waals gap (2D on 2D), and (right) quasi van der Waals gap (2D on dangling-bond passivated 3D).

Biography

Jun Hee Choi received his PhD in Materials Science and Engineering from Seoul National University in 2012. He is currently a Research Master and Research Staff Member of the Device and System Research Center at Samsung Advanced Institute of Technology, Samsung Electronics. He has published more than 45 papers in SCI journals, more than 20 conference papers, and more than 50 US patents. His research includes GaN-based optoelectronics on unconventional substrates, and low dimensional electronics based on quantum dots, ZnO nanorods, and graphene.

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