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Direct growth of GaN layer on carbon nanotube-graphene hybrid structure and its application for light emitting diodes.

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Abstract
We report the growth of high-quality GaN layer on single-walled carbon nanotubes (SWCNTs) and graphene hybrid structure (CGH) as intermediate layer between GaN and sapphire substrate by metal-organic chemical vapor deposition (MOCVD) and fabrication of light emitting diodes (LEDs) using them. The SWCNTs on graphene act as nucleation seeds, resulting in the formation of kink bonds along SWCNTs with the basal plane of the substrate. In the x-ray diffraction, Raman and photoluminescence spectra, high crystalline quality of GaN layer grown on CGH/sapphire was observed due to the reduced threading dislocation and efficient relaxation of residual compressive strain caused by lateral overgrowth process. When applied to the LED structure, the current-voltage characteristics and electroluminescence (EL) performance exhibit that blue LEDs fabricated on CGH/sapphire well-operate at high injection currents and uniformly emit over the whole emission area. We expect that CGH can be applied for the epitaxial growth of GaN on various substrates such as Si and MgO, which can be a great advantage in electrical and thermal properties of optical devices fabricated on them.

Keywords
GaN layer, light emitting diodes, metal-organic chemical vapor deposition, SWCNTs, MOCVD, LED structure, graphene hybrid structure, CGH, NTEGRA Spectra