

The role of carbon nanotube-graphene hybrid structure for high performance LED

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In general, high-quality GaN layers are synthesized on low-temperature (LT) GaN buffer layer on a single crystal sapphire substrate. However, large differences in fundamental properties such as lattice constants and thermal expansion coefficients between GaN layer and sapphire substrate generate high density of threading dislocation (TD) that leads to deterioration of optical and structural properties.

Graphene has been attracting much attention due to its excellent physical properties. However, direct epitaxial growth of GaN film onto graphene layer on substrates is not easily accessible due to the lack of chemical reactivity on graphene which consisted of C-C bond of sp² hexagonally arranged carbon atoms with no dangling bonds.

In this work, an intermediate layer for the GaN growth on sapphire substrate was constructed by inserting carbon nanotubes and graphene hybrid structure (CGH). Optical and structural properties of GaN layer grown on CGH were compared with those of GaN layer directly grown on sapphire. CNTs act as nucleation sites and play a crucial role in the growth of single crystal high-quality GaN on graphene layer. Also, graphene film acts as a mask for epitaxial lateral overgrowth of GaN layer, which can effectively reduce TD density.