TW-P039

Effect of Si-doping on the luminescence properties of InGaN/GaN green LED with graded short-period superlattice

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Generally InGaN/GaN green light emitting diode (LED) exhibits the low quantum efficiency (QE) due to the large lattice mismatch between InGaN and GaN. The QE of InGaN-based multiple quantum wells (MQWs) is drastically decreased when an emission wavelength shifts from blue to green wavelength, so called “green gap”. The “green gap” has been explained by quantum confined Stark effect (QCSE) caused by a large lattice mismatch. In order to improve the QE of green LED, undoped graded short-period InGaN/GaN superlattice (GSL) and Si-doped GSL (SiGSL) structures below the 5-period InGaN/GaN MQWs were grown on the patterned sapphire substrates. The luminescence properties of InGaN/GaN green LEDs have been investigated by using photoluminescence (PL) and time-resolved PL (TRPL) measurements. The PL intensity of SiGSL sample measured at 10 K shows stronger about 1.3 times compared to that of undoped GSL sample, and the PL peak wavelength at 10 K appears at 532 and 525 nm for SiGSL and undoped GSL, respectively. Furthermore, the PL decay of SiGSL measured at 10 K becomes faster than that of undoped GSL. The faster decay for SiGSL is attributed to the increased wavefunction overlap between electron and hole due to the screening of piezoelectric field by doped carriers. These PL and TRPL results indicate that the QE of InGaN/GaN green LED with GSL structure can be improved by Si-doping.

Keywords: InGaN/GaN, Green LEDs, Photoluminescence, Time-resolved photoluminescence

TW-P040

Conformal Zinc Oxide Thin Film Deposition on Graphene using molecular linker by Atomic Layer Deposition

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The graphene, a single atomic sheet of graphite, has attracted tremendous interest owing to its novel properties including high intrinsic mobility, optical transparency and flexibility. However, for more diverse application of graphene devices, it is essential to tune its transport behavior by shifting Dirac Point (DP) of graphene. So, in the following context, we suggest a method to tune structural and electronic properties of graphene using atomic layer deposition. By atomic layer deposition of zinc oxide (ZnO) on graphene using 4-mercaptophenol as linker, we can fabricate n-doped graphene. Through π -π stacking between chemically inert graphene and 4-mercaptophenol, conformal deposition of ZnO on graphene was enabled. The electron mobility of graphene TFT increased more than 3 times without considerably decreasing the hole mobility, compared to the pristine graphene. Also, it has high air stability. This ZnO doping method by atomic layer deposition can be applicable to large scale array of CVD graphene TFT.

Keywords: graphene, zinc oxide, TFT