

ABSTRACT

MAXIMIZING ELECTRICAL DOPING WHILE REDUCING MATERIAL CRACKING IN III-V NITRIDE SEMICONDUCTOR DEVICES

N-type doping in III-V-nitride semiconductor compounds, *i.e.* GaN-based compounds such as GaN, AlGa_N, AlIn_N, InGa_N, or AlGaIn_N, can be optimized to improve N-contact electrical resistance, carrier injection, forward voltage, and recombination characteristics without inducing cracking of the device layers. The N-type layer is constructed of sub-layers such that an N-type sub-layer is provided for each desired characteristic or property. The thickness of each sub-layer is carefully selected to avoid material cracking: the higher the required doping, the smaller the corresponding thickness.

In illustration, the buffer layer of a light emitting device (LED) has three sub-layers. The first sub-layer is lightly doped to avoid cracking and is grown to the desired thickness for good material quality. The second sub-layer is heavily doped to provide good N-contact and electrical resistivity characteristics and is kept correspondingly as thin as necessary to avoid material cracking. The third sub-layer is doped to the desired level to provide optimum carrier injection and pair recombination in the active layer of the device.

(Figure 1)