AIP Journal of Applied Physics

2013, Volume 114, Issue 4, p. 043516

Cathodoluminescence characterization of suspended GaN nanomembranes

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https://doi.org/10.1063/1.4816562

Abstract

Continuous suspended ~15 nm thick gallium nitride (GaN) nano-membranes have been investigated using cathodoluminescence microanalysis. The GaN nanomembranes are fabricated by focused ion beam (FIB) pre-treatment of GaN epilayer surfaces followed by photoelectrochemical (PEC) etching. CL microanalysis enables high sensitivity, nanoscale spatial resolution detection of impurities, and defects, and is associated with key features of the suspended GaN nano-membranes. CL spectra and images of the suspended nano-membranes reveal the broad emission band at ~2.2 eV which is associated with deep acceptor states and the near edge emission at ~3.4 eV which is associated with free exciton transitions at 295 K. The near edge emission can be resolved into two components, one associated with emission from the nanomembrane and the other associated with CL from underlying GaN transmitted through the nanomembrane. CL spectroscopy gives insight into the physical properties and optical quality of the suspended GaN nano-membranes. Blue shift of the CL near band edge emission indicates that the suspended GaN nanomembranes exhibit the combined effects of quantum confinement and strain.