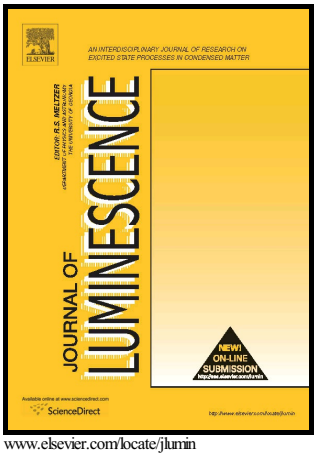
# Effects of underlying InGaN/GaN superlattice structures on the structural and optical properties of InGaN LEDs

Chia-Lung Tsai




www.elsevier.com/locate/jlumin

PII: S0022-2313(16)00019-3
DOI: http://dx.doi.org/10.1016/j.jlumin.2016.01.033
Reference: LUMIN13830

To appear in: *Journal of Luminescence*

Received date: 23 December 2014
Revised date: 2 January 2016
Accepted date: 27 January 2016

Cite this article as: Chia-Lung Tsai, Effects of underlying InGaN/GaN superlattice structures on the structural and optical properties of InGaN LEDs *Journal of Luminescence,* http://dx.doi.org/10.1016/j.jlumin.2016.01.033

# Effects of underlying InGaN/GaN superlattice structures on the structural and optical properties of InGaN LEDs

Chia-Lung Tsai*

Department of Electronic Engineering and Green Technology Research Center, Chang Gung University, Taoyuan, Taiwan, R. O. C.

## Abstract

This study proposes the use of InGaN/GaN superlattices grown beneath InGaN multiple quantum wells (MQWs) and designed with different well widths to act as an electron emitter layer (EEL). Cross-sectional transmission electron microscopy reveals strong indium segregation in the underlying superlattices with a 5-nm-thick $In_{0.1}Ga_{0.9}N$ well, thus corrupting the crystalline perfection of the resulting LEDs, and also increasing their leakage current. It was also found that the depth of the localized states increases with the well width of the underlying superlattices. In the proposed LEDs, variation in the biaxial strains of the superlattice EELs with different well widths results in an increase in indium incorporation of InGaN MQWs, thus obtaining a redshifted photoluminescence emission with respect to that of normal LED. Furthermore, the presence of relatively strong carrier localization and the alleviation of electron leakage from the InGaN MQWs results in improved light output performance from the proposed LEDs grown with a narrow $In_{0.1}Ga_{0.9}N$ well in the underlying superlattices. Although growth in a wide $In_{0.1}Ga_{0.9}N$ well (~3.5 nm) containing underlying superlattices suffers from poor crystalline quality due to partial strain relaxation, it resulted in improved roll-off behavior in terms of light intensity. This may be due to the improved hot electron cooling capacity