Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Atom Probe Tomography Analysis of Gallium-Nitride-Based Light-Emitting Diodes TY J. PROSA, DAVID OLSON, A. DEVIN GIDDINGS, PETER H. CLIFTON, DAVID J. LARSON, CAMECA Instruments, Inc., Madison WI USA, WILLIAMS LEFEBVRE, Universite de Rouen, FRANCE — Thin-film light-emitting diodes (LEDs) composed of GaN/$In_xGa_{1-x}N$/GaN quantum well (QW) structures are integrated into modern optoelectronic devices because of the tunable InGaN band-gap enabling emission of the full visible spectrum. Atom probe tomography (APT) offers unique capabilities for 3D device characterization including compositional mapping of nano-volumes ($>10^6$ nm^3), high detection efficiency ($>$50%), and good sensitivity [1]. In this study, APT is used to understand the distribution of dopants as well as Al and In alloying agents in a GaN device. Measurements using transmission electron microscopy (TEM) and secondary ion mass spectrometry (SIMS) have also been made to improve the accuracy of the APT analysis by correlating the information content of these complimentary techniques. APT analysis reveals various QW and other optoelectronic structures including a Mg p-GaN layer, an Al-rich electron blocking layer, an In-rich multi-QW region, and an In-based super-lattice structure. The multi-QW composition shows good quantitative agreement with layer thickness and spacing extracted from a high resolution TEM image intensity analysis. [1] T. F. Kelly and D. J. Larson, Annual Reviews of Materials Research 42 (2012) 1.

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Date submitted: 15 Nov 2013 Electronic form version 1.4