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III-Nitrides on Ferroelectric Lithium Niobate: Impact of the Electrostatic Boundary Condition KYOUNG-KEUN LEE, GON NAMKOONG, WALTER HENDERSON, W. ALAN DOOLITTLE, Georgia Institute of Technology — Lithium niobate (LN) is a promising substrate for GaN high electron mobility transistors (HEMTs) for "smart" integrated electronics with optical modulators in fiber optical systems. Recent efforts[1][2] have demonstrated GaN high electron mobility transistors using LN substrates and that the strong polarization discontinuity between the LN/GaN layers can be used to control the polarity of the GaN, including the demonstration of periodically poled GaN on periodically poled LN. Herein, the origin within the substrate, the fundamental nature and strength of the polarization discontinuity for determining the polarity of the GaN epitaxial layers are described. Kelvin force microscopy, x-ray diffraction and chemical etching studies show a strong correlation between LN inversion domain density resulting from non-uniform lose of Li_20 from LN when heated in vacuum. This affects the polarization of III-Nitride films grown on these multi-domain LN substrates, strongly influencing the channel mobility due to polar scattering. Methods for reducing the inversion domain density in GaN/LN will be described and correlated with the HEMT channel mobility.

[1]W. A. Doolittle, G. Namkoong, A. Carver, W. Henderson, and A. Brown, Proc. of Mat. Res. Soc. Fall, Boston MA, Dec. 2-6, Vol 743, L1.4, (2002)
[2]S. M. Madison, W. Henderson, K. M. Patel, G. Namkoong, K.-K. Lee, S. E. Ralph, and W. A. Doolittle, 2004 Dig. IEEE Lasers and Electro-Optic Soc. (LEOS) Sum. Top. Meetings, November 2004

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