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Large Optical Absorption Variation in Green GaInN/ GaN Multiply Quantum Well under High Charge Carrier Density. WEI ZHAO, MINGWEI ZHU, YUFENG LI, YONG XIA, JAYANTHA SENAWIRATNE, THEERADETCH DETCHPROHM, CHRISTIAN WETZEL, Rensselaer Polytechnic Institute — Blue GaInN/GaN multiple quantum well (MQW) light emitting diodes (LED) typically show a strong efficiency droop under high injection current density. The effect is even further pronounced for green LEDs. To identify the reason, 535nm emitting MQW epilayers were studied under a continuous wave high density photon excitation to simulate electrical injection conditions. Varying the excitation density over four orders of magnitude, the transmission and absorption were obtained. By comparing the signal of various sample structures, such as GaN/sapphire and full MQW/GaN/sapphire structures, the MQW effect could be isolated. At a wavelength of 514 nm and carrier injection density of 5 x 10^{22} cm^{-2} s^{-1}, the MQW showed an absorption enhancement as large as 20%. Following a standard derivation procedure, a very large nonlinear absorption coefficient of 2.6 cm/W was derived. The enhancement of absorption may indicate a new recombination process that becomes effective under high carrier density. The effect could play a role in the observed efficiency droop of LEDs and play a major role in the limitations of GaInN/GaN laser diodes. This work was supported by DOE/NETL.

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