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Sub-250nm room temperature optical gain from AlGaN materials with strong compositional fluctuations EMANUELE FRANCESCO PECORA, WEI ZHANG, HAIDING SUN, A. YU. NIKIFOROV, JIAN YIN, ROBERTO PAIELLA, THEODORE D. MOUSTAKAS, LUCA DAL NEGRO, Boston University — Compact and portable deep-UV LEDs and laser sources are needed for a number of engineering applications including optical communications, gas sensing, biochemical agent detection, disinfection, biotechnology and medical diagnostics. We investigate the deep-UV optical emission and gain properties of $Al_xGa_{1-x}N/Al_yGa_{1-y}N$ multiple quantum wells structure. These structures were grown by molecular-beam epitaxy on 6H-SiC substrates resulting in either homogeneous wells or various degrees of band-structure compositional fluctuations in the form of cluster-like features within the wells. We measured the TE-polarized amplified spontaneous emission in the sample with cluster-like features and quantified the optical absorption/gain coefficients and gain spectra by the Variable Stripe Length (VSL) technique under ultrafast optical pumping. We report blue-shift and narrowing of the emission, VSL traces, gain spectra, polarization studies, and the validity of the Schalow–Townes relation to demonstrate a maximum net modal gain of 120 cm^{-1} at 250 nm in the sample with strong compositional fluctuations. Moreover, we measure a very low gain threshold (15 $\mu J/cm^2$). On the other hand, we found that samples with homogeneous quantum wells lead to absorption only. In addition, we report gain measurements in graded-index-separate-confined heterostructure (GRINSCH) designed to increase the device optical confinement factor.

Emanuele Francesco Pecora
Boston University

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