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Sub-250nm room-temperature optical gain from AlGaN/AlN multiple quantum dot structures EMANUELE FRANCESCO PECORA, WEI ZHANG, Department of Electrical and Computer Engineering and Photonics Center, Boston University, LIN ZHOU, DAVID J. SMITH, Department of Physics, Arizona State University, JIAN YIN, ROBERTO PAIELLA, LUCA DAL NEGRO, THEODORE D. MOUSTAKAS, Department of Electrical and Computer Engineering and Photonics Center, Boston University — There are many pressing but yet unrealized applications for optoelectronic materials and devices that can function well into the deep-UV. Group-III nitrides, in particular AlGaN, are particularly suited to cover UV spectral ranges. An intense research effort is targeting the investigation and demonstration of deep-UV lasing from these materials. We developed AlGaN/AlN MQWs by Molecular Beam Epitaxy under a novel growth mode that introduces band structure potential fluctuations and high-density of nanocluster-like features within the AlGaN wells. A characterization of this material will be presented. The Variable-Stripe Length technique, a well-established methodology for measuring optical gain coefficient, is applied for a detailed quantification of the gain properties and polarization. We demonstrate optical gain in AlGaN nanostructures down to 230 nm at room temperature with a maximum net modal gain value of 118 $\pm$ 9 cm-1 at the highest excitation fluence of 15 μJ/cm2. The optical gain threshold was measured to be 5 $\pm$ 1 μJ/cm2 from which we estimate the density of optically excited carriers at the threshold to be 1.4 x 10^{17} cm-3, which is two orders of magnitude lower than what currently achieved by quantum well structures. Moreover, we demonstrate that gain is TE-polarized.

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