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Effects of polarity on material's quality of Al-rich AlGa_xN alloys

T.M. AL TAHTAMOUNI, N. NEPAL, J.Y. LIN, H.X. JIANG, Kansas State University — AlGa_xN alloys have the capability of tuning the direct band gap in a large energy range, from about 3.4 to 6.1 eV, which makes them very useful for ultraviolet (UV) and deep UV (DUV) optoelectronic device applications. Although recent progresses have led to the realization of several operational DUV devices such as light emitting diodes operating at wavelengths < 300 nm, high performance DUV optoelectronic devices working at $\lambda \leq 280$ nm still suffer from many serious problems such as stability and reliability. One of the important growth parameters that affects the properties of III-nitrides is the growth polarity. In this work, Al-rich Al_xGa_{1-x}N alloys ($x \sim 0.8$) with different polarities were grown on sapphire substrates by metal organic chemical vapor deposition (MOCVD). Various characterizations techniques were used to study the structural, electrical, and optical properties of these alloys. It was found that the material quality is significantly influenced by the growth polarity. Samples with Al-polarity have a much higher crystalline quality and better surface morphology than those of N-polarity. Additionally, photoluminescence spectra of Al-polarity samples exhibit only the band edge transition, while those of N-polarity also comprise a deep level impurity transition.

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