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Electrical and optical properties of Mg doped $Al_{0.7}Ga_{0.3}N$ Alloys M.L. NAKARMI, N. NEPAL, J.Y. LIN, H.X. JIANG, Department of Physics, Kansas State University, KS — Al-rich AlGaN alloys are ideal materials for the development of chip-scale optoelectronic devices such as deep ultraviolet (UV) emitters and detectors operating at wavelengths down to 200 nm. Mg doped Al-rich $Al_xGa_{1-x}N$ epilayers with Al content as high as 0.7 are required as an electron blocking layers in deep UV LEDs ($\lambda < 300$ nm). However, little has been reported regarding how to achieve p-type $Al_xGa_{1-x}N$ epilayers with x > 0.3. Achieving Al-rich AlGaN with high conductivities remains as one of the foremost challenges for the Nitride community. We report on the growth and studies of the electrical and optical properties of Mg doped $Al_xGa_{1-x}N$ epilayers for x $\sim$ 0.7 grown on AlN/sapphire templates by metal-organic chemical vapor deposition (MOCVD). We found the epilayers to be semi-insulating at room temperature and confirmed p-type conduction at high temperatures (> 700 K) with a resistivity of about 40 Ωcm at 800 K. From the temperature dependent Hall-effect measurement, the Mg acceptor activation energy was estimated to be about 0.4 eV for $Al_{0.7}Ga_{0.3}N$ alloys. Deep UV photoluminescence (PL) was employed to probe the impurity transitions. We found that the intensity of the 4.2 eV emission line in $Al_{0.7}Ga_{0.3}N$ is strongly correlated with the resistivity of the materials. Fundamental limit for achieving p-type Al-rich AlGaN alloys and the effects of the Mg doped $Al_{0.7}Ga_{0.3}N$ electron blocking layer on the deep UV LED performance will also be discussed.

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