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Deep UV time resolved optical studies of excitonic transitions in AlN epilayers N. NEPAL, M.L. NAKARMI, K.B. NAM, J.Y. LIN, H.X. JIANG, Department of Physics, Kansas State University, Manhattan, KS 66506-2601 — Optical properties of excitonic transitions in AlN epilayers have been studied. AlN epilayers were grown by metalorganic chemical-vapor deposition (MOCVD) and the optical properties were probed by deep ultraviolet (UV) time-resolved photoluminescence (PL) spectroscopy. Binding energies and lifetimes of the free-exciton (FX), neutral acceptor-bound exciton (I_1), and neutral donor-bound exciton (I_2) transitions have been measured. We found that the undoped AlN epilayer exhibits a strong band-edge emission line at 6.06 eV due to FX transition at 10 K. A PL emission line at 6.02 eV has been observed at 10 K in Mg-doped AlN, which is about 40 meV below the FX transition in undoped AlN epilayer. This transition has been assigned to the recombination of an exciton bound to neutral Mg acceptor (I_1) with a binding energy of, E_{bx}= 40 meV. The recombination lifetime of the I_1 transition in Mg doped AlN has been measured to be 130 ps. PL studies on Si-doped AlN have found that the I_2 transition (E_{bx}= 16 meV) with a recombination lifetime of 80 ps to be dominant transition at low temperatures. Our experimental study reveals a free-exciton binding energy of 80 meV in AlN, which is the largest exciton binding energy ever reported in semiconductors.

Neeraj Nepal
Department of Physics, Kansas State University, Manhattan, KS 66506

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