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Optical phonon decay in GaN and AlN D. Y. SONG, P. PANDIT, A. CHANDOLU, M. BASAVARAJ, S. A. NIKISHIN, M. HOLTZ, Texas Tech University — The intrinsic phonon decay properties of high-quality crystalline III-nitrides are found to be critical to device self-heating. An excellent approach for examining self-heating, as well as for understanding the properties of phonons, is micro-Raman scattering. This talk reports micro-Raman studies of the A_1(TO), E_1(TO), $E_2$2, A_1(LO), and E_1(LO) symmetry phonons of GaN and the A_1(TO), E_1(TO), $E_2$2 and A_1(LO) symmetry phonons of AlN from 13 to 375 K. By applying anharmonic decay theory to the observed temperature dependences of the phonon energies and linewidths, the phonon decay mechanisms of these zone-center vibrations have been determined. Thermal expansion is taken into account using published temperature-dependent coefficients. Both GaN and AlN A_1(TO) and E_1(TO) vibrations are described by symmetric two-phonon decay. The GaN $E_2$2 decays via creation of three phonons, however, the AlN $E_2$2 decays symmetrically into two phonons. The GaN and AlN LO bands are interpreted by an asymmetric two-phonon decay. Phonon lifetimes are obtained based on the observed linewidths, and the dependence allows us to estimate the intrinsic phonon life time for each vibration. The authors acknowledge support for this work by the National Science Foundation (ECS–0609416 and ECS–0304224) and the J. F Maddox Foundation.

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