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The dependence of the refractive index of $Al_xGa_{1-x}N$ on temperature and composition at elevated temperatures

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ABSTRACT

The refractive index of hexagonal $Al_xGa_{1-x}N$ at room temperature and its temperature dependence at elevated temperatures have been determined with high accuracy by spectroscopic ellipsometry. Measurements have been conducted on samples with Al molar fractions $0 \leq x \leq 0.65$ and at temperatures in the range 290 K $\leq T \leq$ 580 K. The refractive index in the transparent spectral region has been determined as a function of photon energy, using the Kramers-Kronig relations with suitable approximations, and applying a multi layer model. An analytical expression for the composition and temperature dependent refractive index in the transparent region, above room temperature, has been obtained. The refractive index has been found to increase with increasing temperature. The shift of the refractive index is strongest for GaN and decreases for AlGaN with increasing Al molar fraction. The impact on the properties of GaN based waveguides is illustrated by a slab waveguide calculation.