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The influence of crystallographic orientation on the optical properties of wurtzite InGaN/GaN quantum wells STANISLAV KHATSEVICH, DANIEL RICH, OFER MOSHE, Ben-Gurion University — We have examined the effects of crystal orientation on the properties of excitonic emission from wurtzite InGaN/GaN quantum wells (QWs) with piezoelectric polarization using exciton binding and transition energy calculations. We show numerical results for the band gaps, effective heavy-hole masses, piezoelectric polarizations and fields, exciton wavefunctions, exciton binding and transition energies and radiative lifetimes of excitonic emission as a function of the QW crystallographic growth planes. Band-edge and effective-mass parameters for a continuum of GaN crystallographic orientations, on which InGaN/GaN QWs are grown, were obtained from In-composition- and strain-dependent $\boldsymbol{k}\cdot\boldsymbol{p}$ calculation for InGaN, using the $\mathbf{6}\times\mathbf{6}$ $\boldsymbol{k}\cdot\boldsymbol{p}$ Hamiltonian in appropriate $\{hkil\}$ representations. We have performed calculations for a continuum of technologically relevant QW growth planes $\{h-h0l\}$ oriented at various angles relative to the (0001) c-plane. The decrease of the electric field in the InGaN/GaN QW growth direction leads to an increased exciton transition energy and oscillator strength, which results in an increase of the exciton binding energy and decrease of the excitonic radiative lifetime. These results indicate that InGaN/GaN QW materials grown on$\{h-h0l\}$-oriented planes in a wide variety of angles can be used for optimized operation of optoelectronic devices.

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