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Radiative and Auger recombination of degenerate carriers in InN[1] ANDREW MCALLISTER, DYLAN BAYERL, EMMANOUIL KIOUPAKIS, Univ of Michigan - Ann Arbor — Group-III nitrides find applications in many fields – energy conversion, sensors, and solid-state lighting. The band gaps of InN, GaN and AlN alloys span the infrared to ultraviolet spectral range. However, nitride optoelectronic devices suffer from a drop in efficiency as carrier density increases. A major component of this decrease is Auger recombination, but its influence is not fully understood, particularly for degenerate carriers. For nondegenerate carriers the radiative rate scales as the carrier density squared, while the Auger rate scales as the density cubed. However, it is unclear how these power laws decrease as carriers become degenerate. Using first-principles calculations we studied the dependence of the radiative and Auger recombination rates on carrier density in InN. We found a more complex dependence on the Auger rate than expected. The power law of the Auger rate changes at different densities depending on the type of Auger process involved and the type of carriers that have become degenerate. In contrast, the power law of the radiative rate changes when either carrier type becomes degenerate. This creates problems in designing devices, as Auger remains a major contributor to carrier recombination at densities for which radiative recombination is suppressed by phase-space filling.

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