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Effect of free carrier absorption on the efficiency of nitride devices. EMMANOUIL KIOUPAKIS, University of California, Santa Barbara, ANDRÉ SCHLEIFE, IFTO, Friedrich-Schiller-Universitaet Jena, PATRICK RINKE, University of California, Santa Barbara, FRIEDHELM BECHSTEDT, IFTO, Friedrich-Schiller-Universitaet Jena, CHRIS G. VAN DE WALLE, University of California, Santa Barbara — Indium gallium nitride alloys are successfully being used in the fabrication of optoelectronic devices, such as light emitting and laser diodes, in the green to ultraviolet part of the optical spectrum. The wider application of these devices, however, is limited by their reduced efficiency in the green part of the spectrum. Several mechanisms have been suggested as the cause of this efficiency loss, such as Auger recombination and free carrier absorption. We use the band structure and dipole matrix elements from highly accurate many-body perturbation theory calculations in the GW approach (P. Rinke et al., Phys. Rev. B77, 075202 (2008)) to determine the optical absorption coefficient due to free carriers in InGaN. From this we obtain the corresponding photon mean free path and examine the role of free carrier absorption as a possible energy loss mechanism at high carrier concentrations. The computed values indicate that the effect is weak in light emitting diodes but it may become relevant for laser devices that operate at higher current densities.

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