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Numerical Simulation of III-Nitrides Materials and Light Emitting Devices[1]

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The versatility of III-Nitrides semiconductors has led to their use in an increasing number of technologically important applications. Their ability to operate over a wide spectral range from the infrared to the deep ultraviolet has propelled this material system into the field light emitters and detectors. Furthermore, their desirable high field transport properties make III-Nitrides an ideal platform for power semiconductor devices. Along with the experimental activity to fabricate and characterize optoelectronic and electronics devices, a number of significant theoretical efforts are underway to understand the novel properties of this material system. This presentation will discuss the unique characteristics that the III-Nitrides material presents from the point of view of the carrier transport and optical properties. The quantum mechanical processes that are responsible for breakdown at high fields will also be discussed. In particular it will be show that these quantum mechanical effects have to be taken in to account to reproduce a number of experimental results. Furthermore, an analysis of the non-radiative recombination processes that are relevant in analyzing the quantum efficiency data of III-Nitride based light emitters will be presented. Finally the model used and the results obtained for the direct and assisted (phonons and electrons) Auger recombination rates and their impact on the calculated quantum efficiency of III-Nitrides based LEDs will be presented.

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