An optical instability phenomena in the optical emission of InGaN devices

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Abstract— Recent advances in studies for InGaN/GaN have led to high-brightness green and blue light emitting diodes (LED). These wide band gap materials are currently used for many applications, for example full color displays, white (RGB) light sources or for the creation of shorter wavelength devices for optical data storage.

In this presentation, we will report our observations of intriguing optical instability (blinking phenomenon) in the photoluminescence of InGaN single quantum well devices. Similar fluorescence blinking has been observed in three dimensional confined systems (quantum dots) as CdSe, ZnCdSe, InP and GaAs, however the phenomenon is difficult to be explained in our case where the photoluminescence is generated in a system that is quantum confined only in a single direction (quantum well).

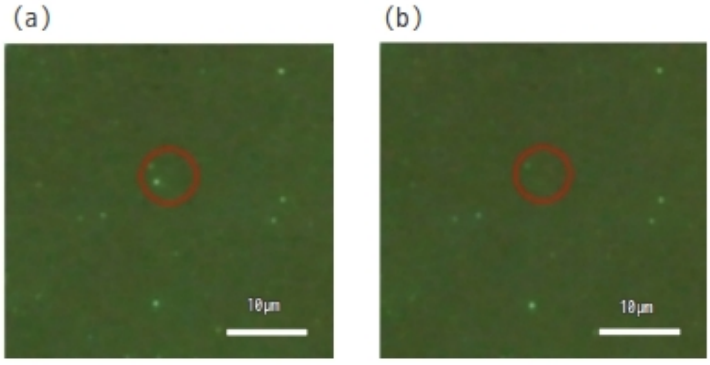

Figure 1: Optical microscope PL images of a 510 nm InGaN sample. A instability blinking point is circled in two figures (a) and (b) taken about a few second apart. The sample was excited by Ultra violet Hg lamp (about 425 nm).

We will describe in detail the optical phenomena observed, characterize its chaotic behavior with Fourier and correlation anlysis. Also, we give a tentative theoretical explanation of the optical instability by the use of a turbulent model of carrier propagation that results in an optical unstable photon emission that is compatible with our results.

We believe that the elucidation of the phenomena will contribute to the effort of understanding fundamental phenomena of photon emission and pave the way for the realization of new and more efficient optical devices.

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