Mechanism for photoluminescence in InAsN/InGaAs single quantum well

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Low nitrogen content zincblende III-V alloy semiconductors have recently attracted much attention due to their interesting physical properties and potential applications of optoelectronic devices. Especially, it leads to the development of technical application of long-wavelength laser diodes. For instance, InGaAsN grown on GaAs substrate is suitable for long-wavelength laser diodes at 1.3 μm, and InNAsP grown on InP substrate for 1.55 μm laser. Both of them are very important for optical fiber communication. In the midinfrared 2-5 μm optoelectronic devices, InAsN alloy could be a very promising material. By the advantage of highly strained multiquantum well lasers, it is possible to fabricate good quality material and push the laser emission of InAsN based devices to the desired wavelength. However, most of the previous reports were mainly concentrated on the dependence of the InAsN band gap on N composition. The study on the emission property is rather limited.

In this paper, we show that the InAsN single quantum well can exhibit photoluminescence at room temperature. The PL spectroscopies (Fig. 1) show red-shifted as the nitrogen content increases. Through a detailed study of the dependence of PL spectra on temperature, pumping intensity, and nitrogen content,

we point out that the occurrence of PL arises from the localized states due to potential fluctuations induced by the incorporation of nitrogen in InAs. Further evidence is supported by the comparison between the photoconductivity and photoluminescence spectra, which show that the Stokes shift increases with nitrogen content.

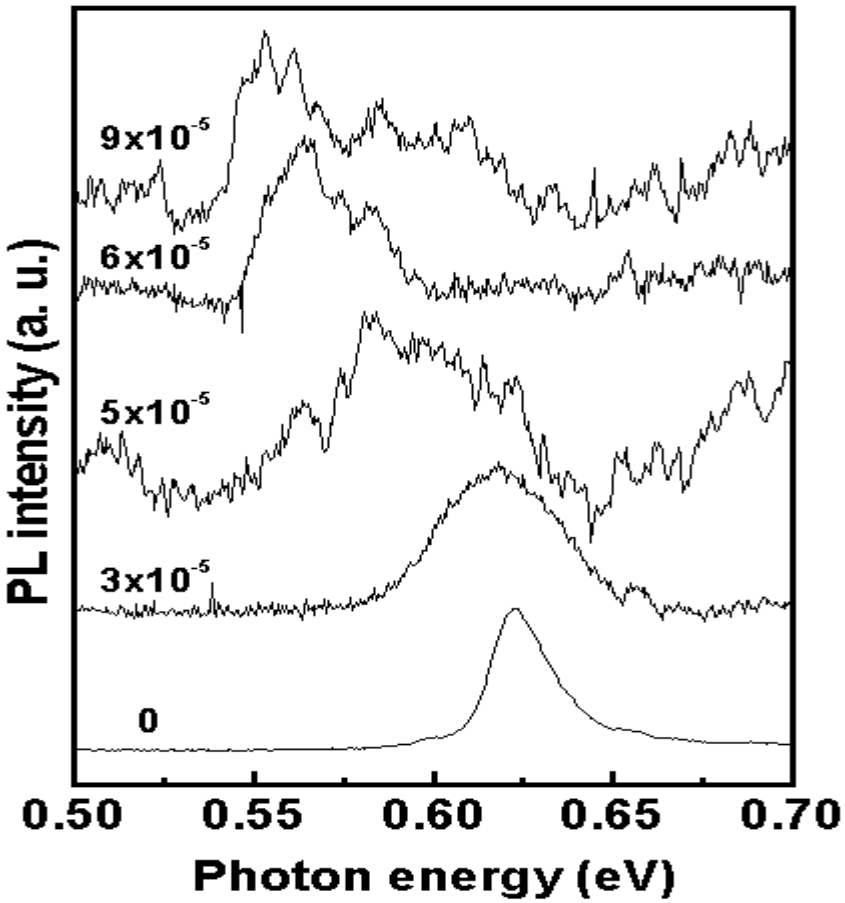

Fig. 1: Photoluminescence spectra of InAsN/InGaAs SQW structures as a function of nitrogen flux at 77K. The gas pressure is in mbar.