

PLE spectrum of undoped and Zn doped InGaN microcrystals

Hisashi Kanie, Takahiro Kawano, Kose Sugimoto, Ryoji Kawai

Dept. of Applied Electronics, Science Univ. of Tokyo,

Noda, Chiba, 278-8510, JAPAN.

kanie@klbws.te.noda.sut.ac.jp

We have developed new synthesis path of InGaN microcrystals from nitridation of gallium or indium sulfide by NH_3 and studied its structural properties by X ray diffraction and the optical properties by measuring photoluminescence and two-monochromator photoluminescence excitation spectrum. The InGaN crystals synthesized by the nitridation of the mixture of Ga_2S_3 and In_2S_3 showed a broad violet luminescence band and a corresponding excitation band that is the fundamental absorption of InGaN. We have developed a two step nitridation, where the InGaN crystals are synthesized by the second step nitridation of the mixture of In_2S_3 and GaN synthesized in the first step nitridation. The InGaN prepared by the two-step nitridation showed a broad blue luminescence and a corresponding excitation band in the band gap and had a large Stokes' shift. Because these features are characteristics of a localized center, we proposed the assignment of the center to In isoelectronic centers.[1-3] However, the PLE peak intensity corresponding to the fundamental absorption was low, we could not determine whether we can neglect the band gap potential fluctuation model, which is proposed to explain localization of the excitons at the luminescence centers for epitaxial grown InGaN films. As the intensity of the PLE signal at the fundamental absorption edge increase by doping GaN with Zn, we doped InGaN with Zn to observe the degree of fluctuation in the band gap potential for the InGaN grown in the two-step nitridation.

GaN crystals were grown by the nitridation of Ga_2S_3 under the NH_3 flow at 1080 °C. GaN was doped with Zn using ZnS as a Zn source during the nitridation. Undoped InGaN crystals were grown from the mixture of undoped GaN and In_2S_3 at 900 °C and Zn doped InGaN crystals were grown from the mixture of Zn doped GaN and In_2S_3 . Grown InGaN crystals have a wurtzite structure and the In contents determined from the c axis lattice constant were in the range from 0.1 to 2.1 %. All samples showed an blue emission band with a peak at around 2.8 eV at 77K under

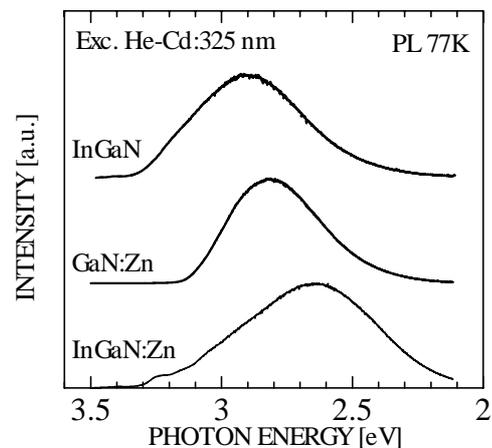


Figure 1. PL spectra of InGaN, GaN:Zn and InGaN:Zn

an excitation with a He-Cd laser 325 nm line, as shown in figure 1. The PLE spectra of the GaN:Zn, undoped InGaN and InGaN:Zn recorded by monitoring at 2.82 eV are shown in figure 2. The shape of the excitation peak at 3.47 eV for the InGaN:Zn crystals in figure 2 was compatible to that of the excitation peak of the GaN:Zn. We concluded that the fluctuation of the band gap potential is not large for the synthesized InGaN crystals. Three PLE peaks of InGaN:Zn were observed as shown in figure 3. We think the broad emission band in figure 1 consists of three bands: a DA pair band in the region from 3.27 to 3.10 eV, a blue band with a peak at 2.55 eV related to the Zn center, and a blue-green band with a peak at 2.43 eV related to the In localized center. We propose three models for the In localized center which are isoelectronic impurities, or localization of the hole by leading In[4], or the fluctuation of the band gap potential by In composition fluctuation.

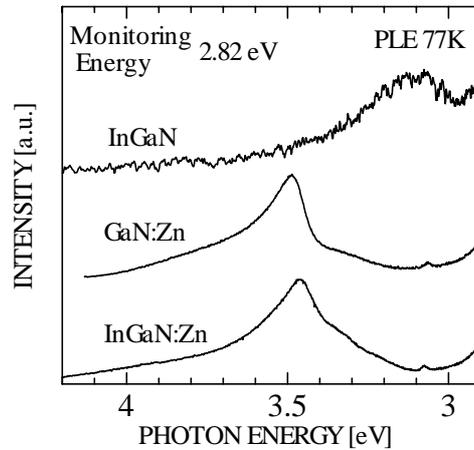


Figure 2. PLE spectra of InGaN, GaN:Zn and InGaN:Zn

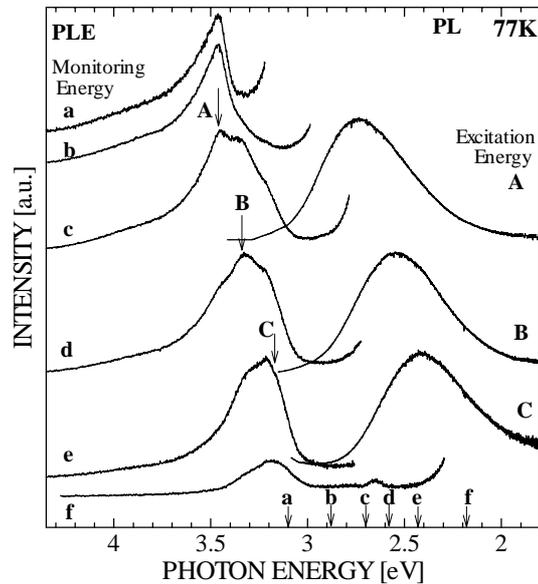


Figure 3. PLE and selective PL spectra of InGaN:Zn

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