Tailoring Nitride Semiconductor Nanostructure Properties Towards Optoelectronic Applications

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For the purpose of achieving solid state light emitters in the short wavelength range and white light sources, we have deeply studied semiconductor nitride nanostructure quantum well (QW)-based InGaN/GaN systems grown by metalorganic chemical vapour deposition (MOCVD) and subject to post-growth treatments by implantation and thermal annealing.

It is known that phosphor-based white light devices suffer from low efficiency, for this reason, a monolithic system could be a possible solution. We have demonsrated [1] by photoluminescence analysis that warm white light emission can be efficiently emitted from a monolithic InGaN/GaN single quantum well (QW)-based high quality structure. Indeed, the control of the yellow/blue bands intensity ratio, responsible for the white emission, could be achieved after annealing at 1000 °C.

Furthermore, due to the green efficiency drop of the existing emitting solid state devices, quantum well intermixing was proposed as a possible solution to improve their efficiency. For this purpose, we have studied green emitting InGaN/GaN MQW system that was subject to nitrogen implantation and high temperature and high pressure annealing. Our results [2] demonstrate that the green emission band was found to be surprisingly stable upon annealing up to 1400 °C. Our findings are of high interest in the group III-nitride-based optoelectronic applications.

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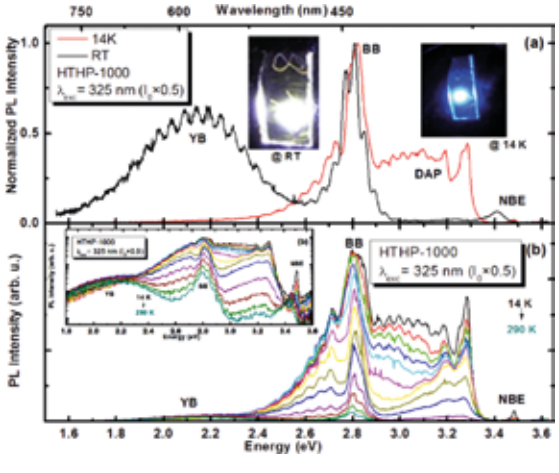

FIGURE 1
(a) 14 K and RT PL of the HTHP-1000 sample obtained with 325 nm laser excitation. Inset: photographs of the low and high temperature emissions (the bright circle in the center corresponds to the saturation of the camera's detector due to the laser spot). (b) Temperature dependence PL spectra of the HTHP-1000 sample obtained with 325 nm laser excitation. Inset: PL temperature dependence in logarithmic scale for clarity. [1]