# Visible luminescence of BGaN-based structures: towards defects-related LEDs

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Boron containing $Me^{III}N$ nitrides are currently of interest because boron can affect the physical properties of GaN-based ternary (BGaN, BAlN) and quaternary (BInGaN, BAlGaN) alloys. Theoretical studies indicate that boron can provide the ability to tune the bandgap width, lattice parameters and dielectric constant of the compounds. Therefore, $BMe^{III}N$ compounds can be useful be useful for production of new electronic or optoelectronic devices.

We fabricated and characterized BGaN-based epitaxial structures on sapphire substrates with various buffer and active layers grown by MOCVD for LED applications. Photoluminescence and Raman spectra were measured to demonstrate red lighting and the residual stress within the LED structures. Crystals structure and morphology of the layers were characterized by XRD and TEM methods, and electrical parameters by Hall measurements. As was recently revealed, the B concentration in BGaN depends on growth temperature [1]. It was shown that the B concentration in BGaN determined to be about 2.5% at., decreases with increasing growth temperature. Such layers are highly insulating with a sheet resistance of $8\times10^{10}$ Ω/sq. A typical photoluminescence appears in the broad red range, which can be attributed to a defect center with an activation energy of 1,35 eV [2]. In this work, we intentionally doped BGaN layers with Si or Mg, using appropriate precursors, to form n- or p-type semiconductor. Additionally, p-n junctions with BGaN were produced in the form of multilayer epitaxial stacks. Because of many structural defects formed in BGaN grown at temperature close to 900°C or higher, indium was incorporated into the layer to attenuate the contraction of the BGaN lattice parameters. Such an In-induced contraction can lead to lattice-matched crystal growth. Fig.1 shows the PL spectra with red luminescence over a wide range, including the yellow component, while the bandgap edge emission is almost eliminated. The yield of red luminescence is higher for B-rich BGaN:Mg grown at 800°C, but for BGaN:Si the yield is higher for samples grown at 1050°C. Comparative studies of BGaN and BInGaN layers suggest next steps to improve structural and electrical parameters of the layers required for red defect- related LEDs.

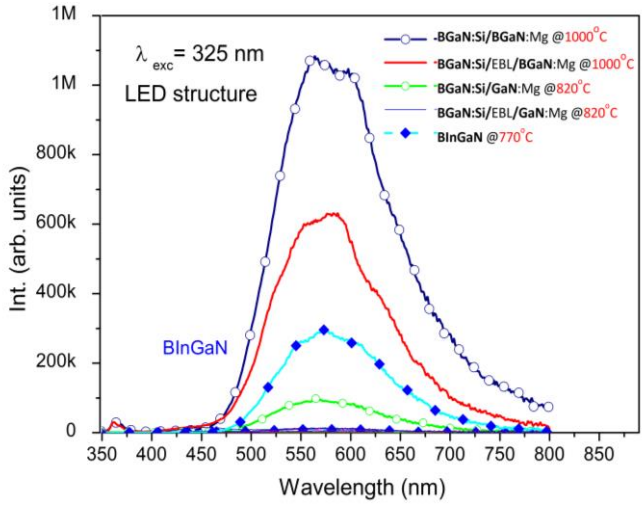


Fig. 1. PL spectra of LED structures with BGaN or BInGaN epilayers grown on sapphire (0001).

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[2] E. B. Mozdzynska, P. Kaminski,, R. Kozłowski, at al., J. Mater. Sci. **57**, 17347 (2022)