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# Growth and Characterization of InGaN/GaN Multiple Quantum Well Structures used for Scintillation Detectors

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Growth and Characterization of InGaN/GaN Multiple Quantum Well Structures used for Scintillation Detectors

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High-luminosity scintillators with fast decay time are crucial in many applications. These scintillators are a key component for improved time-of-flight mass spectrometers and could be used as detectors in synchrotrons or particle colliders. Fast scintillators are necessary in scanning electron microscopes (SEM) for industrial inspection of nowadays electronics. Generally, the nitrides are perspective candidates due to the strong exciton binding energy (short decay time in order of nanoseconds) and good radiation resistence. GaN and related ternary alloys with indium have been used widely in optoelectronics devices. On the other hand, GaN can be used as a scintillator material due to high light yields (105 Photons/MeV) and very short decay time (below 1 ns for its near-band-edge transitions) [1].
With the epitaxial growth, GaN can be prepared in high crystallographic quality. Perfect homogeneous epitaxial layers result in better emission homogeneity over large area, lower nonradiative losses and suppressed inhomogeneous broadening of the emission profile. Due to 1-D quantum confinement the GaN scintillation efficiency can be significantly enhanced by employing InGaN/GaN multiple quantum well structure. On the other hand, thin epitaxial layers have low planar light extraction coefficient. These structures are very similar to structures used for UV-visible light emitting diodes. There are two main differences, no p-n junction is necessary and much thicker active region (higher QW number), according to the electron penetration depth, is needed [2].
We optimized InGaN/GaN heterostructures (grown with MOVPE) with different growth parameters to get strong excitonic luminescence and fast response in the nanosecond range. We observed influence of the QW thickness on the decay time. Structures with thinner quantum wells had shorter decay time due to the higher electron hole wavefunction overlap. Photo-, radio- and cathodoluminescence were used for characterization of our structures as well as time resolved radioluminescence. We will discuss presence of the defect luminescence band, which is undesirable in scintillation detectors due to the very long decay time in microsecond range. The upper part of the active region in 30 QW-structure had the best luminescence properties in respect of ratio exciton/defect luminescence. The influence of Si doped layer under the active region on scintillation properties was studied as well.

References
[1] P. Pittet et al., Optical Materials 31 (2009) 1421 - 4.
[2] A. Hospodkova et al., Nanotechnology 25 (2014) 455501-1 - 6.

## Has accepted

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