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GaInN-based LED structures on selectively grown semi-polar crystal facets

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In order to overcome the problems of reduced recombination probability due to internal piezoelectric fields in strained GaInN quantum wells, we have developed a method to grow semipolar GaInN-based LED structures on $\{1\bar{1}01\}$ side facets of selectively grown GaN. This enables to grow semipolar device structures over the full area of a 2" wafer while still making use of the well developed growth of optimized c-plane GaN buffer layers. This talk will describe our recent work concerning the growth by metalorganic vapor phase epitaxy along with some sophisticated characterization studies. For the selective growth, we have studied stripe and hexagonally shaped geometries. We found a strongly facet dependent growth mechanism leading to very flat surfaces on $\{1\bar{1}01\}$ facets as opposed to their $\{11\bar{2}1\}$ counterparts along with a different indium incorporation efficiency. An increased indium uptake on semi-polar $\{1\bar{1}01\}$ facets as compared to conventional c-plane layers helped to shift the LED emission to longer wavelengths beyond 500 nm in the green spectral range despite the significantly reduced field-dependent Stark shift. The significant reduction of the internal electric field could be verified by several methods. Hexagonally shaped mask geometries are more favorable for large area device applications and for the reduction of dislocations. However, by locally resolved cathodoluminescence, we found a quite strong local variation of the emission wavelength over the formed inverted pyramid facets which is also visible in locally resolved measurements of the carrier recombination times. First results on stripe periods on a sub-micrometer scale may pave the way for the direct realization of DFB lasers on c-plane GaN.