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Semipolar GaN-based optoelectronic structures on large area substrates

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Green light emitting diodes based on group-III nitrides still suffer from fairly low performance as compared to shorter wavelength blue emitters. One possible reason is the lattice mismatch induced strain of the GaInN quantum wells in the active region in such devices having a comparably large in content. This causes the formation of huge piezoelectric fields within the GaInN quantum wells separating electrons and holes locally and hence reducing their recombination probability. By changing the main epitaxial growth direction from the conventional polar c-direction into less polar crystal directions, the internal fields can be strongly reduced. We currently study some hetero-epitaxial approaches which can be easily applied to large size sapphire wafers. In this review, we will describe such approaches which make use of the well-established growth of GaN in c-direction eventually leading to semipolar device structures. In the first approach, GaInN quantum well structures are grown on semipolar side facets of selectively grown GaN stripes with triangular cross-section. By decreasing the size and distance of such stripes to sub-micrometer dimensions, they can be embedded into n- and p-doped planar cladding layers. Moreover, we have used inclined c-plane side-facets prepared by etching grooves into adequately oriented sapphire wafers as nucleation sites for GaN. After coalescence of these striped nitride structures, they form large area planar semipolar nitride surfaces on which again LED structures can be grown. The formation of the commonly observed defects like dislocations and stacking faults was reduced by various methods leading eventually to excellent structural properties.

Biography

Ferdinand Scholz, born on November 19, 1954, obtained the Doctor degree for studies on MOVPE of GaInAs-InP quantum well structures from the University of Stuttgart in 1986. From then until 2003, he was engaged as head of the epitaxial group of the 4. Physikalisches Institut of the University of Stuttgart (Germany). In 2003, he obtained a Professorship at the University of Ulm. Main topics of his current research at the Institute of Optoelectronics are growth and investigations of group III nitrides, quantum well structures and nanorods and their applications in device structures.

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