Halbleiter-Nanophotonik

SFB 787

Einladung

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Thema: **„ Growth issues and optical properties of nonpolar (Al,In,Ga)N films and quantum wells ”**

Wurtzite (Al,In,Ga)N materials and devices have cut open the new age of semiconductor optoelectronics. For example, blue LEDs, purple LDs, and high-power, high-frequency tran-sistors have been realized. One of the drawbacks of conventional c-plane heterostructures is that immobile sheet charges are formed at heterointerfaces due to sponteneous and piezo-electric polarization discontinuity along the polar c-axis, which induce the quantum-confined Stark effects (QCSEs) in QW structures. Therefore, the oscillator strength of electron-hole pairs in c-plane QWs, especially lattice-mismatched InxGa1-xN QWs of high x, suffers from detrimental lowering. To overcome this problem, the use of nonpolar planes is attractive, be-cause the c-axis is parallel to the interfaces and thus the QWs fabricated on nonpolar planes are free from the QCSE. However, as long as heteroepitaxial substrates such as r-plane Al2O3 or m-plane 6H-SiC were used, the a-plane and m-plane GaN contained high densitiy basal stacking faults (SFs) and threading dislocations (TDs) as high as 10^5 cm^-1 and 10^10 cm^-2, respectively. Those defective nonpolar QW LEDs generally exhibited low output power. A variety of lateral epitaxial overgrowth (LEO) techniques have been used to reduce the TD density. However, the basal plane SFs seldom vanish even in thick films or in windows and N-polar wings of nonpolar GaN prepared by LEO. Recently, good performance m-plane LEDs and LDs have been demonstrated using the low TD / SF density freestanding (FS) GaN substrates that were sliced from approximately 1-cm-thick c-plane FS-GaN.
In this presentation, overview of the superiority and issues in nonpolar (Al,In,Ga)N film growths and de-vices will be introduced. Structural and optical properties of GaN, InGaN, Al-GaN and QW structures will be shown, including the results of high-resolution x-ray analy-ses, steady-state and time-resolved PL measurements, spatially-resolved CL measurements, and gain measurements on those grown by MOVPE or NH3-MBE. Reasonably high equiva-lent internal quantum efficiency and short radiative lifetime for the near-band-edge emission are demonstrated for m-plane InGaN, while low incorporation efficiency of In is emphasized.

Gäste sind herzlich willkommen!
Prof. J. Christen