Halbleiter-Nanophotonik

SFB 787

Einladung

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Zeit: **Mittwoch, 22. April 2015, 10:15Uhr**

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Thema: **"Doping of high-Al-content AlGaN grown by hot-wall MOCVD"**

Abstract:
High-Al-content $Al_xGa_{1-x}N$ (x>0.70) is the principal wide-band-gap alloy system to enable the development of light-emitters operating in the deep-ultraviolet (DUV) spectral region at λ<280 nm. Intense research and technology developments have taken place in the past few years; yet, the external quantum efficiency of the DUV LEDs with high Al-content is typically below 1%. One of the main material issues in the development of the DUV LEDs is the achievement of n- and p-type doped layers of high-Al-content AlxGa1-xN with low resistivity, which is required for the electrical pumping of the diodes. However, the doping process becomes significantly more complex with increasing Al content and the resistivity value can be as high as 10-100 Ω cm for n-type AlN doped by Si, and 10^7-10^8 Ω cm for p-type AlN doped by Mg.
Epitaxial growth of the high-Al-content $Al_xGa_{1-x}N$ and AlN by hot-wall MOCVD is developed in order to achieve layers with good structural properties and low content of residual impurities with the intention to minimize the level of carrier compensation. The hot-wall MOCVD system enables the use of a wide range of process temperatures, 1000-1600 °C, which is an advantage for the optimization of the material properties of high-Al-content $Al_xGa_{1-x}N$ and AlN.
In this talk, the recent development in the doping process of n- and p-type conductive $Al_xGa_{1-x}N$ (0.6<x<1) grown by hot-wall MOCVD will be presented. Electrical characterization of Si-doped $Al_xGa_{1-x}N$ in combination with complementary secondary ion mass spectroscopy (SIMS) and electron paramagnetic resonance (EPR) measurements have been an essential part of the work to research the effects of self-compensation of the shallow donor state of Si through the formation of so-called DX centers [1,2]. In addition, EPR measurements were used to support the studies of the incorporation kinetics of Si and O at various process temperatures and growth rates [3].

[1] X. T. Trinh *et al.*, Appl. Phys. Lett. **105**, 162106 (2014).
[2] D. Nilsson *et al.*, Phys. Status Solidi b 1–5 (2015).
[3] A. Kakanakova-Georgieva *et al.*, Appl. Phys. Lett. **102**, 132113 (2013).

Gäste sind herzlich willkommen!

Prof. Dr. M. Kneissl