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Herstellung von ZnO mittels metallorganischer Gasphasenepitaxie

Alois Krost
Institut für Experimentelle Physik
Fakultät für Naturwissenschaften
Otto-von-Guericke-Universität Magdeburg
Postfach 4120, 39016 Magdeburg, Germany

ZnO is an interesting wide-gap semiconductor for a variety of electronic, optoelectronic, and sensor applications. Although ZnO substrates are available their fair quality and nucleation problems are still a problem for the homoepitaxial growth of ZnO. We present the growth of ZnO by metalorganic chemical vapor phase epitaxy on GaN on Si or GaN on sapphire templates. We developed a two step growth process and achieve high quality ZnO layers with XRD rocking curve FWHMs of the (0002) reflection of ~180“ and narrow cathodoluminescence of 1.3 meV of the dominant I8 emission. For the growth of ZnO we grow a low-temperature buffer layer using tert-butanol at 450°C and a second high-temperature ZnO layer is grown at 850-950°C using N_2O.

So far, all layers were n-type. For the application in devices p-type doping is still a major problem and has until now not worked out to be reliable enough to produce a p-n homojunction device. We have investigated several nitrogen sources as NH_3, UDMHy and NO for doping. While no or only a low amount of nitrogen can be incorporated using NO we observe a brownish colour of the samples when using NH_3 or UDMHy for higher dopant flows. With it we also find an increase in the electron carrier concentration from 10^{16} cm^{-3} to above 10^{18} cm^{-3}. Thus, these nitrogen precursors do not support p-type conductivity for higher flows. Because the crystalline quality degrades as can be seen in XRD measurements p-type doping is likely only possible in a small parameter window. For some samples grown with lower dopant flows we observe a decrease in the carrier concentration upon annealing. Especially when using UDMHy we observe N-correlated luminescence and phonon replica up to the fifth order. We will present details of the growth process and latest results on N-doping.