Halbleiter-Nanophotonik

SFB 787

Einladung

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Thema: "Electronic and optical properties of polar and non-polar $In_xGa_{1-x}N$/GaN quantum wells: Influence of indium content, random alloy and well width fluctuations"

Abstract:
We present a detailed analysis of the electronic structure of c-plane $In_xGa_{1-x}N$/GaN QWs with indium contents of x = 0.1, 0.15 and 0.25. The study is carried out by means of an atomistic tight-binding model, including local alloy, strain and built-in field variations arising from random alloy fluctuations as well as well width fluctuations. We conclude that for as little as 10% indium in the QW, the valence band structure is strongly affected by localization effects. Also our data indicate that well width fluctuations could lead to electron wave function localization effects in addition to localization effects introduced by random alloy fluctuations. We find that not only hole ground states but also excited hole states show strong localization features. Based on our data we estimate that even at x=0.1, an energy range of order 100 meV into the valence band should be dominated by strongly localized states. This energy range increases with increasing indium content. Experimental data, such as the "S-shape" dependence of the PL peak position with temperature gives clear experimental evidence of the presence of this broad range of (excited) localized states.
Furthermore, we have applied our theoretical framework to non-polar InGaN/GaN QWs. Our results on nonpolar m-plane QW samples are compared in detail with (time-dependent) photoluminescence experiments, revealing for instance strong exciton localization effects, which explain the form of the measured photoluminescence decay transients. Additionally, the theoretical results confirm the experimentally observed high degree of optical linear polarization.

Gäste sind herzlich willkommen!

Prof. M. Kneissl und Dr. T. Wernicke