CO.CO.MAT
CONTROL OF QUANTUM CORRELATIONS IN TAILORED MATTER
SFB/TR 21 – STUTTGART, ULM, TÜBINGEN

Seminar

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Electron states in InGaAsN

Most of the III-V or II-VI semiconductors can be alloyed. The band-gap of for example InGaAs lies between the corresponding one of GaAs and InAs. The interpolation is quasilinear; the small deviation is expressed as bowing parameter. The mobility of the free carriers is little reduced even if the concentration of the mixing atom is about 50 %. The band structure and effective mass changes continuously as a function of concentration. These properties occur if the electronegativities of the mixing elements are very close. On the contrary, mixing elements with very different electronegativities leads to the appearance of an impurity band with very low mobility. In this case rather localized defect states are dominant. No significant change of the band structure of the host material is detectable. Nitrogen has 50 % higher electronegativity than P, As or Sb. As a result, the change of the band-gap is very far from an interpolation between GaAs (1.5 eV) and GaN (3.5 eV). 2% N in GaAs reduces the band gap to 1.2 eV. We studied transport in InGaAsN materials using classical cyclotron resonance (CR), optically-detected CR, time-resolved CR, and a special "constant power" optically-detected CR. We find that the electron effective mass is that of the host material InGaAs. The photoexcitation onset of free carriers (ODCRE experiments) is the band-edge of the InGaAs host material, not of InGaAsN. Comparison of various CR measurements indicates on nitrogen-induced potential barrier between GaAs and InGaAsN. Our conclusion is that the band-gap derived from optical properties do not correspond to that of extended states for electrons. Dilute nitrides are at the boundary between impurity doped and alloy semiconductors. We suggest that there is a coexistence of extended states of the host material and mesoscopic extended states around nitrogen clusters.

Wann? Dienstag, 11.07.2006, 13:00 Uhr

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