

Anomalous free-charge-carrier properties in modulation-doped $\text{Al}_x\text{Ga}_{1-x}\text{As}/\text{GaAs}$ quantum well superlattices studied by magneto-optic ellipsometry



http://www.uni-leipzig.de/ellipsometrie

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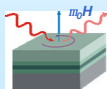
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HL17.42

Our message

- An anomalous temperature dependence in modulation doped $n\text{-Al}_x\text{Ga}_{1-x}\text{As}/\text{GaAs}$ -superlattices: drastic **increase** of the free-charge-carrier concentration with **decreasing** Temperature.
- A simple hydrodynamic rate model explains this behavior.
- Magneto-optic ellipsometry is used for contactless measurement of free-charge-carrier parameters m , N , μ in semiconductor layer structures

Fir MO-ellipsometry:

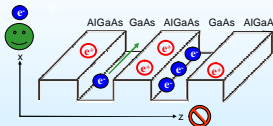


Contacts: NO!
Heterostructures: YES!



Motivation

spatial free-charge-carrier confinement



spatial confinement of modulation doped AlGaAs/GaAs superlattices at low temperatures

Fingerprints in the far-infrared optical response

Fir MO-ellipsometry

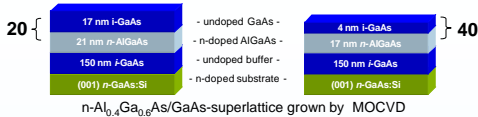
contact-less, nondestructive determination of phonon and free-charge-carrier parameters (concentration, effective-mass, mobility) in thin layer samples

free-charge-carriers dynamics during the condensation process



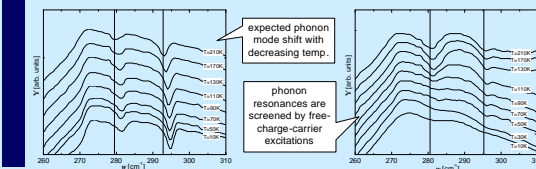
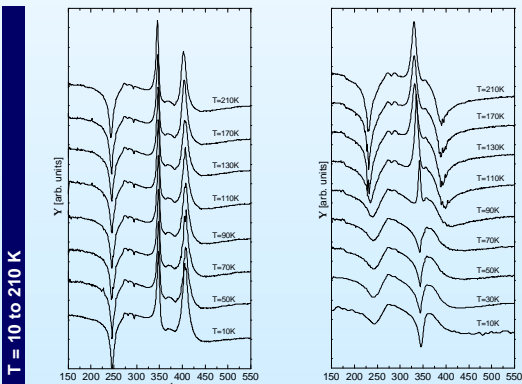
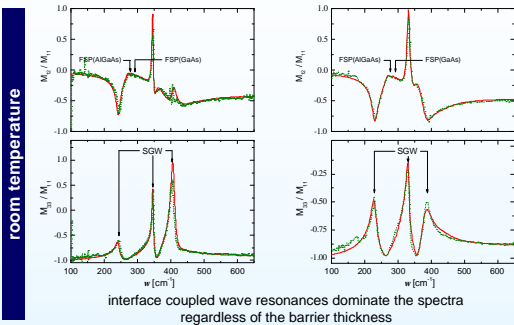
number of activated interface states depends on the quantum-well filling

Experimental results

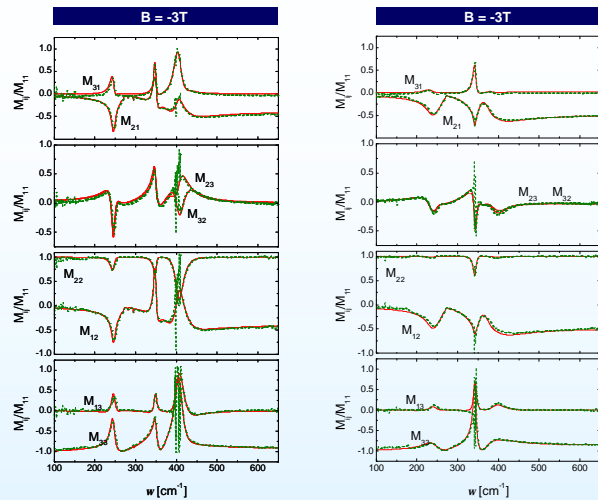


$n\text{-Al}_{0.4}\text{Ga}_{0.6}\text{As}/\text{GaAs}$ -superlattice grown by MOCVD

FIR ellipsometry



FIR-MO ellipsometry at 10K



hydrodynamic rate model

