HL 14 Heterostrukturen

Zeit: Freitag 15:00–16:15 Raum: TU P-N229

HL 14.1 Fr 15:00 TU P-N229

Route to Bose-Einstein condensation of excitons in coupled quantum wells — •Roland Zimmermann — Institut für Physik der Humboldt-Universität zu Berlin

Spatially indirect excitons in coupled quantum wells (CQW) exhibit extremely long radiative lifetimes and a strong mutual repulsion of dipolar character. In a recent experiment [1] with a lateral trap potential, a substantial blue shift (5 meV) of the exciton emission line combined with a narrow angular characteristic normal to the quantum well plane has been reported. We present first theoretical results to explain these novel findings. For the CQW we calculate both the direct and exchange potential which enter the spin-dependent exciton Hamiltonian [2] and apply a dynamical T-matrix approach for the exciton propagator. The calculated emission is blue shifted but spectrally broad due to exciton-exciton scattering. The angle-resolved emission exhibits a sharp spike, which is a direct manifestation of off-diagonal long range order evolving at low temperatures.

[1] D.W. Snoke et al., arXiv:cond-mat/0410298 (2004)

[2] S. Ben-Tabou de-Leon and B. Laikhtman, Phys. Rev. B **63**, 125306 (2001)

HL 14.2 Fr 15:15 TU P-N229

Time-resolved photoluminescence of type-I and type-II (GaIn)As/Ga(NAs) heterostructures — •J. D. Heber, K. Hantke, C. Schlichenmaier, A. Thränhardt, T. Meier, B. Kunert, K. Volz, W. Stolz, S. W. Koch, and W. W. Rühle — FB Physik und WZMW, Philipps-Universität Marburg, Renthof 5, 35032 Marburg

A set of $(Ga_{0.77}In_{0.23})As/Ga(N_xAs_{1-x})$ heterostructures is studied by time-resolved photoluminescence. Four samples with nitrogen concentrations from $x = 0.48\%$ up to $x = 2.2\%$ are investigated at different temperatures and excitation densities. The experiments clearly show that the heterostructure band offset is type-I for $x = 0.48\%$ and type-II for $x = 2.2\%$. The situation is more complex for $x = 0.72\%$ and $x = 1.25\%$, since these samples are close to the transition from type-I to type-II and since disorder also influences the recombination dynamics. The experimental findings are analyzed using a detailed microscopic theory. The agreement between experiment and theory is very good and confirms that the $x = 0.72\%$ sample is type-I and the $x = 1.25\%$ sample is type-II.

HL 14.3 Fr 15:30 TU P-N229

Controlled motion of long-living excitons in tunable potential landscapes — •Andreas Gärtner[1], D. Schuh[2], and J. P. Kotthaus[1] — [1]CeNS and Department für Physik der LMU, München — [2]Walter Schottky Institut, TU München

The experiments to learn more about externally controlling the dynamics of long-living excitons are carried out in epitaxially grown heterostructures at temperatures below 4K. They contain two GaAs quantum wells (QWs) separated by a thin AlGaAs tunnel barrier. Lithographically patterned superficial gate structures allow the application of electrical fields tunable over a wide range.

An electron-hole pair generated optically usually relaxes quickly into a short-living excitonic state. However, in our QW samples spatially indirect excitons can be induced by an external electrical field: the exciton's constituents are located in adjacent QWs coupled by the tunnel barrier [1]. Experimentally we observe excitonic life times > 100 ns.

The excitonic energy can be controlled externally by applying electrical fields (quantum confined stark effect). Using adequately patterned metal gate structures various lateral excitonic potential landscapes $E_{\mathrm{exc}}(\mathbf{r}, t)$ can be formed causing a force $\mathbf{F} \propto \nabla E_{\mathrm{exc}}$ on an exciton [2]. We experimentally demonstrated excitonic drift over distances of several μm in temporally and spatially varying excitonic potential landscapes.

We also create traps for such long-living excitons by introducing additional superficial SiO_2 patters.

[1] Butov *et al.*, Nature **417**, 47 (2002)

[2] Zimmermann *et al.*, Phys. Rev. B **56**, 13414 (1997)

HL 14.4 Fr 15:45 TU P-N229

TE- and TM-polarization resolved spectroscopy on quantum wells under normal incidence — •M. Schardt[1,2], A. Winkler[1,2], G. Rurimo[2], S. Quabis[2], S. Malzer[1,2], G. Leuchs[2], and G. H. Döhler[1,2] — [1]Institute of Technical Physics I — [2]Max-Planck research group, Institute of Optics, Information and Photonics, University Erlangen-Nuremberg, Germany

We present TE- and TM-polarization resolved photocurrent measurements on quantum well pin diodes under normal incidence.
Usually, optical experiments performed in such a geometry yield information only about transitions involving in-plane (p_x- and p_y-) components of the hole wave functions because of the in-plane (TE-) polarization of the light. The lost information on transitions sensitive to the p_z components can be recovered by focussing a radially polarized laser beam through a microscope-objective with high numerical aperture (NA ≥ 0.9) [1]. With our setup, the electrical field vector at the focal tail has a significant component along the optical axis (TM-polarization!) which enables excitation of transitions sensitive to p_z components also. Experimental evidence of this feature has been performed by exploiting the selection rules for e-hh and e-lh transitions in a quantum well structure. We present a comparison of our recorded spectra with theoretical predictions obtained from simple geometric optics assumptions.

[1] S. Quabis et al., Optics Communications 179 (2000) 1-7

HL 14.5 Fr 16:00 TU P-N229

Atomically flat (110) GaAs interfaces by in-situ annealing — •Elisabeth Reinwald, Robert Schuster, Christian Gerl, Hans-Peter Tranitz, and Werner Wegscheider — Universität Regensburg, Institut für Experimentelle und Angewandte Physik, 93040 Regensburg

The growth of (110) GaAs using the cleaved-edge overgrowth method requires low substrate temperatures and high arsenic overpressure. These growth conditions are typically responsible for high surface and interface roughness. An in-situ annealing step reduces the roughness and large atomically flat surfaces can be achieved [1]. The deviation from an integer monolayer thickness results in characteristic islands or pits. The annealing step can be used to improve the quality of two-dimensional electron gases on (110) GaAs. Such high quality samples are necessary for creating a two-dimensional electron gas modulated in two perpendicular directions. In order to achieve this kind of modulation we use a superlattice modulation together with anodic oxidation with an atomic force microscope tip.

[1] M. Yoshita, H. Akiyama, L.N. Pfeiffer, K.W. West, Jpn. J. Appl. Phys. 40, L252 (2001)

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