HL 30 II-VI Halbleiter III

Zeit: Samstag 15:00–16:30 Raum: TU P164

HL 30.1 Sa 15:00 TU P164

Characterisation of vapor transport grown ZnO bulk crystals — •Detlev M. Hofmann[1], Joachim Sann[1], Daniel Pfisterer[1], Angelika Polity[1], Valentin Laguta[1], Albrecht Hofstaetter[1], Bruno K. Meyer[1], Thomas Frank[2], Gerhard Pensl[2], R. Tena-Zaera[3], J. Zuninga-Perez[3], and Vincente Munioz Sanjose[3] — [1]I. Physikalisches Institut, Justus-Liebig-Universität, Heinrich-Buff-Ring 16, 35392 Giessen, Germany — [2]Institut für angewandte Physik, Universität Erlangen-Nürnberg, Staudtstr. 7, Gebäude A3, 91058 Erlangen, Germany — [3]Dpto. Fisica Aplicada y Electromagnetismo, co. Dr. Moliner n°50, 46100 Burjassot Valencia, Spain

The samples were as grown, or treated in post growth annealing experiments at temperatures between 900°C and 1200°C in vacuum, O_2 or Zn atmospheres. Samples annealed in Zn atmosphere are redish and become transparent after O_2 annealing. In luminescence experiments we find deep emission bands related to the oxygen vacancies and to residual copper, in the excitonic range several donor bound excitons are observed. The energy positions of the excitons are similar to the H-related and the Al-related donor bound excitons and that of I_7. The presence of residual donors is confirmed by EPR and ENDOR. DLTS shows that the traps commonly labeled E3 (E_{CB} - 430 meV) and E4 (E_{CB} - 530 meV) are in the material and that E4 increases after the Zn anneal. The results are used to construct a level scheme of the centers in the material in order to explain the optical and electrical properties. This work was financially supported by the EU-SOXESS-network.

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Luminescence bands in acceptor doped ZnO — •Daniel Pfisterer[1], Joachim Sann[1], Frank Leiter[1], Arndt Zeuner[1], Christian Neumann[1], Bruno K. Meyer[1], Detlev M. Hofmann[1], and Nikolaj Romanov[2] — [1]I. Physikalisches Institut, Justus-Liebig-Universität, Heinrich-Buff-Ring 16, D-35392 Giessen — [2]A.F. Ioffe Physico-Technical Institute, RAS, 194021 St. Petersburg, Russia

We have used electron paramagnetic resonance (EPR) and optically detected magnetic resonance (ODMR) to characterise various ZnO samples doped with group I acceptors (Li, Na) or the group V nitrogen acceptor, as well as ZnO powders thermally treated in nitrogen atmosphere. For the group I acceptors the PL response of the ODMR shows that Li and Na cause deep luminescence bands. The spectra are compared to the emission caused by oxygen vacancies. An omnipresent resonance at g = 2.006 is related to an emission at 1.65 eV and is likely to be caused by Zn-vacancies. The isolated nitrogen acceptors (N^-) are found to quench the donor acceptor pair recombination at 3.26 eV.

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High reflectivity semiconductor bragg-mirrors for II - VI microcavities — •N. Rousseau, C. Arens, A. Pawlis, D. Schikora, and K. Lischka — Universität Paderborn, Department Physik, Warburger Strasse 100, 33095 Paderborn

ZnSe/ZnMgSe distributed Bragg reflectors in the green spectral range have been grown on GaAs (1 0 0) substrates by molecular beam epitaxy. It has been studied the influence of the number of stacks on the reflectivity and on the roughness for a given concentration of the ZnMgSe alloy (15%). Optical and structural properties were investigated using reflectance, HRXRD, RHEED, and photoluminescence. A calculation based on the transfer matrix model was applied to the design of these II−VI DBRs. ZnSe/ZnMgSe DBRs containing between 13 and 32 stacks of alternated quarter-wavelength layers were obtained. As a result of growth optimization, a maximum reflectance of 81% at 510nm was measured for 32 pairs of ZnSe/Zn(0.85)Mg(0.15)Se.

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Temperature-dependency of the fundamental band-gap properties of (0001)ZnO thin films — •Nurdin Ashkenov, Rüdiger Schmidt-Grund, Daniel Fritsch, Wolfram Czakai, Mathias Schubert, Holger Hochmuth, Michael Lorenz und Marius Grundmann — Fakultät für Physik und Geowissenschaften, Institut für Experimentelle Physik II, Universität Leipzig, Linnéstraße 5, 04103 Leipzig, Germany

We report on the temperature dependencies of the fundamental band-to-band transition energies, amplitudes and broadenings of (0001)ZnO thin films grown on (0001)Al_2O_3 substrate by Pulsed Laser Deposition. Spectroscopic ellipsometry (SE) data are measured at temperatures between 300 K and 830 K, and are supplemented by the photoluminescence data between 4.4 K and 300 K. SE data are analyzed by using model dielectric function approaches augmented by excitonic contributions. The increase of the valence band splitting upon temperature is indicative for a change of the crystal-field-splitting parameter. For ZnO, the phonon dispersion must be considered appropriately in order to model the temperature dependence of the fundamental band-to-band transition energy. We obtain strong contributions due to optical phonons at elevated temperatures, whereas acoustic phonons dominate the electron-phonon coupling at low temperatures. The experimentally determined bandgap energies are compared with those calculated by the Empirical Pseudopotential Method.

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Room-temperature ferromagnetism in Mn-alloyed ZnO — •Heidemarie Schmidt[1], Mariana Diaconu[1], Holger Hochmuth[1], Michael Lorenz[1], Gabriele Benndorf[1], Daniel Spemann[1], Annette Setzer[1], Pablo Esquinazi[1], Andreas Pöppl[1], Holger von Wenckstern[1], Karl-Wilhelm Nielsen[2], Rudolf Gross[2], Herbert Schmid[3], Werner Mader[3], Gerald Wagner[4], and Marius Grundmann[1] — [1]Universität Leipzig, Fakultät für Physik and Geowissenschaften, 04103 Leipzig, Germany — [2]Walther-Meißner-Institut für Tieftemperaturforschung, 85748 Garching, Germany — [3]Rheinische Friedrich-Wilhelm Universität Bonn, 53117 Bonn, Germany — [4]Universität Leipzig, Institut für Mineralogie, Kristallographie und Materialwissenschaft, 04275 Leipzig, Germany

Following [1] we prepared textured, soft ferromagnetic Mn-alloyed ZnO thin films by pulsed laser deposition at low growth temperatures around 500°C and ambient oxygen partial pressures larger than 0.1 mbar for future spintronics applications. The homogeneity and intrinsic nature of magnetic domain formation can be probed by magnetic force microscopy. At 300 K the saturation magnetization and coercive field of optimized films amount to 0.013 emu/g and 234 Oe, respectively. Atomic force microscopy and SQUID measurements reveal that the grain size for large coercive fields in 1 μm thick Mn-alloyed ZnO films ranges between 130-160 nm. The existence of a critical grain size in textured ferromagnetic films can be explained on the basis of Brown's micromagnetic model. [1] P. Sharma et al., Nature Materials **2**, 673 (2003).

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Thermische Dissoziation von gebundenen Exzitonenkomplexen in ZnO — •S. Giemsch, F. Bertram, S. Petzold, Th. Hempel, J. Christen, A. Dadgar und A. Krost — Institut für Experimentelle Physik, Otto-von-Guericke-Universität Magdeburg, PF 4120, D-39016 Magdeburg

Die thermische Dissoziation von gebundenen Exzitonenkomplexen wurde in MOCVD gewachsenen ZnO Schichten mittels temperatur- und anregungsdichteabhängigen, sowie zeitaufgelösten Photolumineszenzmessungen (PL) untersucht. Der bandkantennahe Bereich des PL-Spektrums bei T=4.2 K besteht aus scharfen exzitonischen Linien (freies und gebundene Exzitonen: FX, I2/I3, I8, I9) sowie deren Zweielektronensatelliten (TES). I8 (FWHM < 1.6 meV) dominiert deutlich das Spektrum. In temperaturabhängigen PL-Messungen werden thermisch aktivierte Lumineszenzprozesse beobachtet, die zu zusätzlichen Linien (z.B. Band-Störstelle) bei höherer Temperatur führen. Die Bindungsenergien der beobachteten Exzitonen und Störstellen wurde bestimmt. Es finden sich teilweise erhebliche Unterschiede zu den in der Literatur gefundenen Werten. Die Relaxations- und Rekombinationskinetik wird mit zeitaufgelösten ps-PL-Messungen detailliert untersucht.