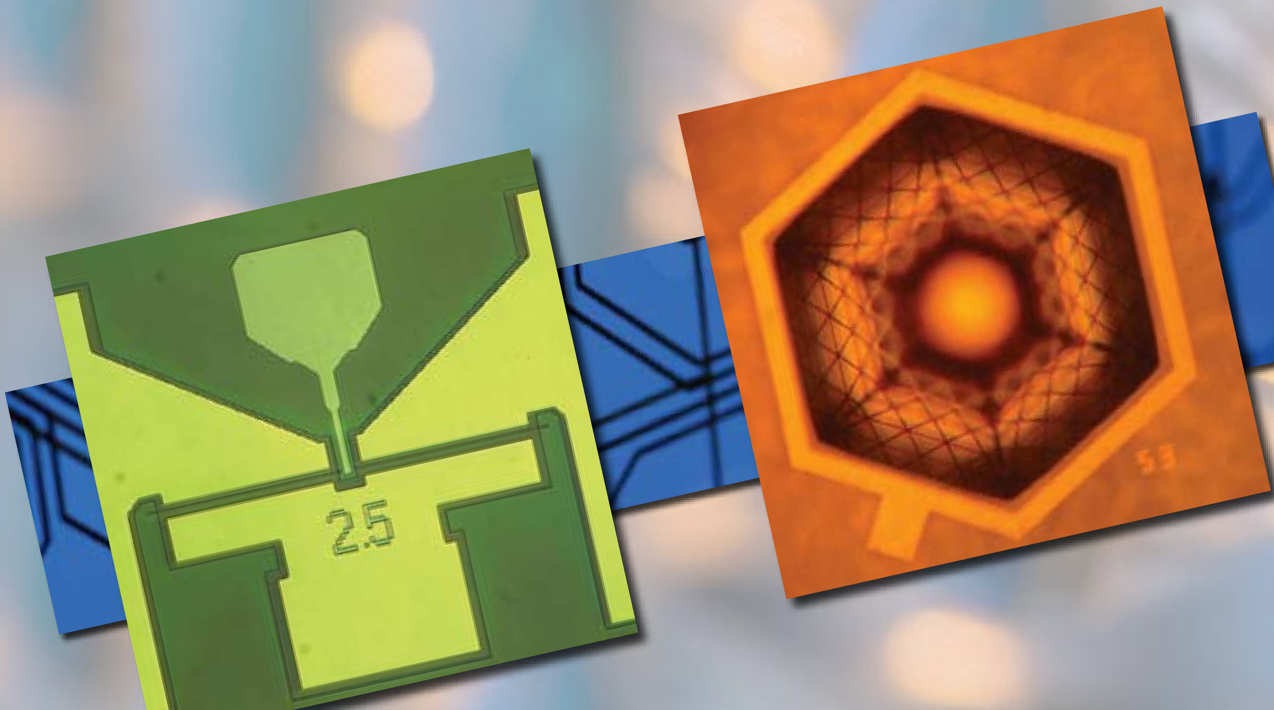
7th International Conference of Nitride Semiconductors

September 16-21, 2007 • MGM Grand Hotel • Las Vegas, Nevada, USA

Sponsored by TMS

FINAL PROGRAM



3:45 PM

HH5, N-Face InN Multiple Carrier Transport: *Tamara Fehlberg*[1]; Gregor Koblmueller[2]; Gilberto Umana-Membreno[1]; Chad Gallinat[2]; James Speck[2]; Brett Nener[1]; Giacinta Parish[1]; [1]University of Western Australia; [2]University of California, Santa Barbara

N-face indium nitride samples were grown on C-face SiC substrates via plasma-assisted molecular beam epitaxy using a GaN buffer layer. The temperature (20 - 300 K) and film thickness (500 - 2000 nm) dependence of multiple carrier transport has been measured via multiple magnetic field Hall measurements. Surface and bulk electron properties were extracted using a quantitative mobility spectrum analysis. Bulk electron mobility shows a clear temperature dependence, with a steep increase with temperature up to the peak mobility, a maximum well over 3000 cm^2/Vs at about 100 K in the thickest samples. Bulk electron concentrations are around $2 \times 10^{17} cm^{-3}$. Bulk and surface mobilities increase with sample thickness. Surface electron mobilities are over twice those of In-polar InN, with only a slight reduction in surface concentration. The temperature dependence of both bulk and surface mobilities are significantly different to that of all In-polar samples previously studied.

4:00 PM

HH6, GaN and InN Conduction Band States Studied by Spectroscopic Ellipsometry at Finite Temperatures: *Christoph Cobet*[1]; Munise Rakel[1]; Christoph Werner[1]; Rüdiger Goldhahn[2]; Norbert Esser[1]; [1]Institute for Analytical Sciences; [2]Technische Universität Ilmenau

We apply spectroscopic ellipsometry in the spectral range between 18-20eV in order to study the conduction bands in GaN and InN. In this spectral range the optical response is defined by excitations of localized core d-electrons to empty states. The imaginary part of the measured dielectric function is thus proportional to the conduction band density of states (DOS) with dominant p-symmetry. Further more, we can assign distinct maxima in dielectric function to specific transitions at high symmetry points in the Brillouin zone. In the presented work we compare e.g. the results for GaN- and InN, which reveal a surprisingly high agreement in respective DOS. A special attention is assigned to temperature effects on the DOS. By comparing the temperature evolution of excitation features measured between 18 and 20eV with those measured among the interband transitions at lower energies, we can study temperature shifts of valence and conduction band states separately.

4:15 PM

HH7, Conduction Band Nonparabolicity and Band Filling in InN under Hydrostatic Pressure: *Tadeusz Suski*[1]; Izabela Gorczyca[1]; Gijs Franssen[1]; Agata Kaminska[2]; N. E. Christensen[3]; A. Svane[3]; Andrzej Suchocki[1]; H. Lu[4]; W. J. Schaff[4]; E. Iliopoulos[5]; A. Georgakilas[5]; [1]Polish Academy of Science, Institute of High Pressure Physics; [2]Polish Academy of Science, Institute of Physics; [3]University of Aarhus, Department of Physics and Astronomy; [4]Cornell University, Department of Electrical and Computer Engineering; [5]FORTH, Institute of Electronic Structure and Lasers

The low value of about 0.7 eV of the InN band gap leads (via pronounced interaction between conduction band and valence band) to a low effective electron mass m* and a nonparabolic shape of the conduction band. The external pressure causes the band gap to increase and influences the conduction band nonparabolicity. This leads to significant effects of pressure and band filling on m* and the photoluminescence (PL) peak energy EPL. This was proved through experimental and theoretical studies. The PL peak pressure coefficient dEPL/dp is shown to depend on the electron concentration in accordance with ab-initio calculations. It decreases from about 27 meV/GPa to about 21 meV/GPa on the increase of electron concentration from 3.6×10^{17} to 1.1×10^{19} cm^{-3}.

4:30 PM Break

Session II: Nanostructures: Characterization

Thursday PM — Room: 314/315
September 20, 2007 — Location: MGM Grand Hotel Conference Center

Session Chairs: Eun Suh, Chonbuk University; Peter Clifton, Imago Scientific Instruments

2:30 PM

II1, Photoluminescence and Raman Spectroscopy of MBE-Grown InN Nanocolumns: *Jaime Segura Ruiz*[1]; Núria Garro Martínez[1]; Andrés Cantarero Sáez[1]; Christian Denker[2]; F. Werner[2]; Jörg Malindretos[2]; Angela Rizzi[2]; [1]Instituto de Ciencia de los Materiales. Universidad de Valencia; [2]IV. Physikalisches Institut, Georg-August Universitaet Goettingen

InN nanocolumns grown by molecular beam epitaxy on p-Si (111) substrates are studied by means of photoluminescence (PL) and micro-Raman spectroscopy. We find that slight variations in the growth conditions can modify the PL energy peak up to 100 meV. An increase in the PL energy also involves a reduction of the integrated intensity. Raman spectra show that, while the E_{2h} mode does not change significantly, the A_1(LO) mode is damped for samples with higher PL energy. Screening effects due to a high electron concentration could explain the attenuation of this polar mode. This overall phenomenology points out the existence of unintentional doping induced by local defects. The temperature and power excitation dependence observed for the PL signal shows clear signatures of localized states. The evolution of the integrated intensity with temperature is well fitted by a model assuming two activation energies, comprised in the 6-10 and 30-50 meV ranges.

2:45 PM

II2, Time-Resolved Photoluminescence Study of GaN Nanowires Grown by Catalyst-Free MBE: *John Schlager*[1]; Kris Bertness[1]; Paul Blanchard[1]; Norman Sanford[1]; [1]National Institute of Standards and Technology

We report steady-state and time-resolved photoluminescence (PL and TRPL) measurements on individual GaN nanowires (6 – 20 µm long, 30–500 nm in diameter) dispersed onto fused quartz substrates. PL intensity for the longer and thicker wires was higher than that of the shorter wires. The longer (> 12 µm) wires displayed a red shift of the dominant donor-bound A exciton emission attributable to the tensile strain induced by differential thermal expansion between the wires and the quartz substrates. The PL lifetimes ranged from 200 ps to over 2 ns, which compare well to those of low-defect bulk GaN. The lifetime dependence on pump intensity, emission wavelength, and temperature and the shapes of the decay curves indicated interesting exciton dynamics. Spatially resolved TRPL showed uniform temporal response across a single wire and varying response along wire complexes. Waveguiding and optically pumped laser action was observed in the longer nanowires.

3:00 PM

II3, Photocurrent Gain Enhancement in M-Axis GaN Nanowires: *Hsin-Yi Chen*[1]; Ruei-Shan Chen[2]; Chin-Pei Chen[2]; Li-Chyong Chen[3]; Kuei-Hsien Chen[2]; Ying-Jay Yang[1]; [1]Graduate Institute of Electronic Engineering, National Taiwan University ; [2]Institute of Atomic and Molecular Sciences, Academia Sinica; [3]National Taiwan University Center for Condensed Matter Sciences

The photoconductivity (PC) characterization has been done for the different sized GaN nanowires with common long-axis along orientations (m-axis) grown by thermal chemical vapor deposition (CVD). The excellent visible-blind and ultraviolet-absorbed performances have been demonstrated for the GaN single nanowire devices. The photocurrent gain, one of the PC parameters determining the photocurrent generation efficiency of a photoconductor, has been estimated and discussed for the individual GaN nanowires. The size-dependent study shows that the GaN nanowires with smaller diameter (d = 40-100 nm) exhibit the ultrahigh gain in the range of 10^4 -10^5 , which are over two orders of magnitude higher than that of the