# HL 43 GaN: Devices I

Time: Thursday 11:00–12:15 Room: BEY 118

HL 43.1 Thu 11:00 BEY 118

**Biocatalytic Activity of Enzymes Immobilized on Group III-Nitride Surfaces** — •Barbara Baur, Georg Steinhoff, Hans-Georg von Ribbeck, Yvonne Gawlina, Florian Furtmayr, Martin Stutzmann, and Martin Eickhoff — Walter Schottky Institut, Technische Universität München, 85748 Garching, Germany

AlGaN/GaN electrolyte gate field effect transistors (EGFETs) have a great potential as sensor devices for electronic detection of biochemical processes, as they combine excellent electronic characteristics with biocompatibility and long term stability in liquid electrolytes. In addition, they show a high pH sensitivity, which enables the quantitative electrical detection of enzymatic biocatalytical reactions accompanied by local pH changes. In this context, we describe the covalent immobilization of different enzymes on GaN surfaces. The influence of the pH-value in the chemical medium during the immobilization processes has been investigated. Adjustment of the pH-value results in selective covalent immobilization at crosslinker molecules on a self assembled monolayer of aminopropyltriethoxysilane (APTES) deposited on the surface. At the same time, the non-specific physisorption due to electrostatic interaction can be suppressed, as proven by fluorescence microscopy. The influence of the immobilization process on the enzyme activity and long-term stability is analyzed by photometric measurements. The biocatalytic activity of immobilized penicillinase and urease is detected electronically, employing the ion sensitivity of the underlying AlGaN/GaN EGFETs.

HL 43.2 Thu 11:15 BEY 118

**Field dependent PL-spectra and emission efficiency of InGaN/GaN-LED-heterostructures** — •Harald Braun[1], Ulrich T. Schwarz[1], Werner Wegscheider[1], Elmar Baur[2], Uwe Strauss[2], and Volker Härle[2] — [1]Naturwissenschaftliche Fakultät II- Physik, Universität Regensburg Universitätsstr. 31, 93053 Regensburg, Germany — [2]OSRAM Opto Semiconductors GmbH, Wernerwerkstr. 2, 93049 Regensburg, Germany

To improve the efficiency of blue and green InGaN/GaN-based LEDs we use field-dependent photoluminescence (PL) experiments to characterize internal electric fields, carrier capture, internal efficiency, and non-radiative recombination. The shape of InGaN/GaN-QWs depends strongly on the external electric field applied to the p-n-junction. We show that applying a forward bias the comparability between PL and EL can be improved, which is important when using PL-data for optimizing EL-efficiency of InGaN/GaN heterostructures. Also, by comparing the field-dependence of the peak-position with simple one-dimensional simulations we determine the size of the piezoelectric fields in InGaN/GaN-quantum wells. From the tunnelling of carriers through the barriers, which causes a strong decrease of the PL-intensity with increasing reverse bias, we estimate the offset-ratio of the InGaN-bandgap.

HL 43.3 Thu 11:30 BEY 118

**Physical Model to explain and predict performance of AlGaN/GaN-based MIS-HFETs** — •Gero Heidelberger[1], Michel Marso[1], Alfred Fox[1], Juraj Bernát[1], Hans Lüth[1], and Peter Kordoš[2] — [1]Institute of Thin Films and Interfaces and cni - Center of Nanoelectronic Systems for Information Technology, Research Centre Jülich, D-52425 Jülich, Germany — [2]Institute of Electrical Engineering, Slovak Academy of Sciences, SK-84104 Bratislava, Slovakia

AlGaN/GaN-based Metal-Insulator-Semiconductor Heterostructure Field Effect Transistors (MIS-HFET) have been shown to be a promising candidate for high power and high frequency applications. Nevertheless, the underlying interface physics is not entirely understood yet. In particular, the conditions underneath the gate are unknown if it is separated by material such as $SiO_2$, $HfO_2$ or $DyScO_3$. In this work we present a model of the electrical behaviour of a MIS-HFET taking into account the problems arising from the metal-insulator-semiconductor structure. By means of this model we can predict essential DC and RF power measures knowing the geometrical and material data of the device. Furthermore, the model is suitable to explain results we gained from a comparative study of unpassivated, passivated HFETs and MIS-HFETs where we were able to demonstrate the superiority of the MIS-HFET concept with regards to DC and RF power performance.

HL 43.4 Thu 11:45 BEY 118

**Dependence of exciton energy on dot size in GaN/AlN quantum dots** — •David Williams[1], Aleksey Andreev[2], and Eoin O Reilly[1] — [1]Tyndall National Institute, Lee Maltings, Cork, Ireland — [2]Advanced Technology Institute, University of Surrey, Guildford GU2 7XH, UK

We show analytically that the exciton energy in nitride quantum dots (QDs) decreases linearly with increasing dot height, provided that the height to radius ratio remains constant. This behaviour is due to the strong polarization fields present in nitride dots, with the constant of proportionality given by the slope of the polarization potential. We also present a useful analytical approximation for the electron and hole wavefunctions in nitride QDs in terms of Airy functions, which provides reliable estimates for the actual energies and wavefunctions.

HL 43.5 Thu 12:00 BEY 118

**Physical Model to explain and predict performance of AlGaN/GaN-based MIS-HFETs** — •Gero Heidelberger[1], Michel Marso[1], Alfred Fox[1], Juraj Bernát[1], Hans Lüth[1], and Peter Kordoš[2] — [1]Institute of Thin Films and Interfaces and cni - Center of Nanoelectronic Systems for Information Technology, Research Centre Jülich, D-52425 Jülich, Germany — [2]Institute of Electrical Engineering, Slovak Academy of Sciences, SK-84104 Bratislava, Slovakia

AlGaN/GaN-based Metal-Insulator-Semiconductor Heterostructure Field Effect Transistors (MIS-HFET) have been shown to be a promising candidate for high power and high frequency applications. Nevertheless, the underlying interface physics is not entirely understood yet. In particular, the conditions underneath the gate are unknown if it is separated by material such as $SiO_2$, $HfO_2$ or $DyScO_3$. In this work we present a model of the electrical behaviour of a MIS-HFET taking into account the problems arising from the metal-insulator-semiconductor structure. By means of this model we can predict essential DC and RF power measures knowing the geometrical and material data of the device. Furthermore, the model is suitable to explain results we gained from a comparative study of unpassivated, passivated HFETs and MIS-HFETs where we were able to demonstrate the superiority of the MIS-HFET concept with regards to DC and RF power performance.