transistors (MESFET) with a channel mobility of 11.4 cm^2/Vs and on/off-ratios of 10^6 were fabricated. An average transmission of 70 % in the visible spectral range was achieved for the Ag_xO-based gate electrodes. Furthermore the MESFETs operate at low voltages, only about $\Delta U = 2.5\,V$ are required to switch between on- and off-state. This advantage of MESFETs (compared to MISFETs) was successfully transferred to integrated inverters, yielding a maximum gain of 200 at a supply voltage of 4 V and a low uncertainty level of 0.3 V.

HL 66.2 Fri 10:30 H17

Properties of transparent ZnO inverters under the influence of light and elevated temperature — •Tobias Diez, Alexander Lajn, Heiko Frenzel, Holger von Wenckstern, and Marius Grundmann — Universität Leipzig, Fakultät für Physik und Geowissenschaften, Institut für Experimentelle Physik II, Linnéstr. 5, 04103 Leipzig

Transparent electronics is an ambitious technology, which can be applied in transparent displays, e.g., as car wind-shield displays, in cell phones and electronic paper. In order to be able to manufacture these devices, transparent wide band-gap semiconductors, such as ZnO, have to be used. We fabricate normally-on metal-semiconductor field-effect transistors (MESFET) with reactive dc-sputtered Schottky-gate contacts and combine these to transparent inverters. They exhibit a transparency of about 69 % averaged over the device area and the visible spectrum. To explore the application relevant performance we investigate the change of the electrical properties of our transparent ZnO inverters under illumination with visible light. The uncertainty level, indicating the range of the input voltage with a ambiguous logical output, remains constant at about 0.3 V. Also the peak gain value is mainly unaffected by the incident light, except for blue light, for which a reduction of the gain is observed. Furthermore we investigate the temperature dependence of the inverter characteristics.

HL 66.3 Fri 10:45 H17

ZnO-based On-Chip Devices for Cell Potential Measurement — •F. Klüpfel, A. Lajn, H. Frenzel, H. von Wenckstern, G. Biehne, H. Hochmuth, M. Lorenz, and M. Grundmann — Universität Leipzig, Fakultät für Physik und Geowissenschaften, Abteilung Halbleiterphysik, Linnéstr. 5, 04103 Leipzig

External stimulation causes nerve cells to change their membrane potential. Measuring these electric cell activities is important to improve the understanding of nerve cell communication and has been demonstrated using multi-transistor arrays based on silicon technology [1]. However these devices do not allow transmission microscopy and thus complicate the determination of the cell locations during electric measurements. The development of such structures on transparent substrates like glass or sapphire promises simultaneous recording of cell potential changes and visual observation. We use a chip with transistors based on the transparent semiconductor ZnO grown by pulsed laser deposition and gold electrodes to contact the cells. Our metal-semiconductor field effect transistors (MESFETs) with reactively sputtered AgO Schottky gate contacts are already described in [2] and outperform the amplification properties of ZnO-based metal-insulator-semiconductor field effect transistors by far, making them most suitable for this purpose. In this talk the electrical properties of the MESFETs as well as their applicability for cell potential measurements will be discussed.

[1] A. Lambacher et al., Appl. Phys. A 79, 1607-1611 (2004)
[2] H. Frenzel et al., Appl. Phys. Lett. 92, 192108 (2008)

HL 66.4 Fri 11:00 H17

Appropriate choice of channel ratio in thin-film transistors for the exact determination of field-effect mobility — •Koshi Okamura, Donna Nikolova, Norman Mechau, and Horst Hahn — Institute of Nanotechnology, Karlsruhe Institute of Technology (KIT), Eggenstein-Leopoldshafen, Germany

For the evaluation of any kind of semiconducting materials for thin-film transistors (TFTs), the most important figure of merit is field-effect mobility. It is, however, sometimes extracted from the TFTs with the active semiconductor area undefined (unpatterned) and in the geometry of the small channel ratio; the effect of the fringing electric field at ends of source/drain electrodes are not taken into account. In this study, therefore, the effect of the fringing electric field on the field-effect mobility is systematically investigated. TFTs in the bottom gate configuration were fabricated by spin-coating a suspension of ZnO nanoparticles, as a function of different channel ratios, such as 2.5, 5.5, 12, 32 and 70. The field-effect mobility extracted from TFTs, with the active ZnO area undefined, at the small channel ratio of 2.5 showed the value by 418 % overestimated. In contrast, the field-effect mobility extracted from TFTs, with the active area defined, at the large channel ratio of 70 was nearly equivalent to the real value. These results reveal that the active semiconductor area of TFTs should be defined for the exact determination of the field-effect mobility; otherwise, the channel ratio should be chosen to be large enough to neglect the effect of the fringing electric field.

HL 67: Organic Semiconductors: Solar Cells II (Joint Session with DS/CPP/O)

Time: Friday 10:15–12:15 Location: H16

HL 67.1 Fri 10:15 H16

Organic-inorganic heterojunction with P3HT and n-type 6H-SiC: Determination of the band alignment and photovoltaic properties — •Roland Dietmüller, Helmut Nesswetter, Sebastian Schöll, Benedikt Hauer, Ian David Sharp, and Martin Stutzmann — Walter Schottky Institut, Technische Universität München, Am Coulombwall 3, 85748 Garching, Germany

The exact band alignment in organic/inorganic semiconductor heterojunctions is influenced by a variety of properties and difficult to predict. For the organic/inorganic heterojunction made of poly(3-hexylthiophene) (P3HT) and n-type 6H-SiC, the band alignment is determined via current-voltage measurements. For this purpose a model equivalent circuit, combining a thermionic emission diode and space-charge limited current effects, is proposed which describes the behavior of the heterojunction very well. From the fitting parameters, the interface barrier height of 1.1 eV between the lowest unoccupied molecular orbital (LUMO) of P3HT and the Fermi level of 6H-SiC can be determined. In addition from the maximum open circuit voltage of the diodes, a distance of 0.9 eV between the HOMO of P3HT and the conduction band (CB) of 6H-SiC can be deduced. These two values determine the Fermi level of 6H-SiC, which is about 120 meV below the CB, relative to the HOMO and LUMO of P3HT. The 6H-SiC/P3HT heterojunction exhibits an open circuit voltage of 0.55 eV at room temperature, which would make such a heterojunction a promising candidate for bulk heterojunction hybrid solar cells with 6H-SiC nanoparticles.

HL 67.2 Fri 10:30 H16

Hybrid solar cells based on semiconductor nanocrystals and poly(3-hexylthiophene) — •Holger Borchert, Florian Witt, Marta Kruszynska, Nikolai Radychev, Irina Lokteva, Folker Zutz, Marc Daniel Heinemann, Elizabeth von Hauff, Joanna Kolny-Olesiak, Ingo Riedel, and Jürgen Parisi — University of Oldenburg, Department of Physics, Energy and Semiconductor Research Laboratory, Carl-von-Ossietzky Str. 9-11, 26129 Oldenburg, Germany

Semiconductor nanoparticles are promising electron acceptor materials for polymer-based bulk heterojunction solar cells. Size-dependent optical properties enable adaptation of the absorption to the solar spectrum, and the possibility to use elongated nanoparticles should be favorable for efficient electron transport. Despite these potential advantages, efficiencies reported for such hybrid solar cells are still below those of organic polymer/fullerene cells. In the work to be presented, CdSe nanoparticles were prepared by colloidal chemistry and their usability for hybrid solar cells in conjunction with poly(3-hexylthiophene) (P3HT) as electron donor material was studied. Systematic studies of correlations between the device performance and blend morphology are presented. Furthermore, charge separation in the donor/acceptor systems was studied in detail by electron spin resonance (ESR) and photoinduced absorption spectroscopy (PIA). The studies revealed the existence of a large amount of trap states which might be the origin of the limitations for the device efficiency. First results with colloidally prepared CuInS2 nanoparticles are presented as well.