HL 107: Poster: Emerging oxide semiconductors / Oxides other than ZnO and its relatives

Time: Thursday 17:00–20:00 Location: P1

HL 107.1 Thu 17:00 P1

Structural properties of $Cu_2O_{1-x}S_x$ alloys from first principles — •Raphael Knecht, Marcel Giar, Markus Heinemann, and Christian Heiliger — I. Physikalisches Institut, Justus-Liebig-University, D-35392 Giessen, Germany

We present *ab initio* investigations of the structural parameter in $Cu_2O_{1-x}S_x$ alloys by a substitutional supercell approach. To simulate a random arrangement of sulfur and oxygen in the anion lattice several different arrangements (configurations) for the same sulfur concentration are considered. The different sulfur concentrations are simulated in a 3x3x3 supercell and for each configuration the equilibrium lattice parameter is determined by calculating the hydrostatic pressure for different lattice parameters. We compute the lattice parameters in a concentration range from pure Cu_2O up to $Cu_2O_{0.61}S_{0.39}$ and compare our results with experimental data in the same concentration range.

HL 107.2 Thu 17:00 P1

Growth of Cuprous Oxide by Plasma-Assisted Molecular Beam Epitaxy — •Max Kracht, Jörg Schörmann, Martin Eickhoff, and Philip Klement — I.Physikalisches Institut JLU-Giessen, Heinrich-Buff-Ring 16, 35392 Giessen, Deutschland

The research on cuprous oxide (Cu_2O) is a topic with growing interest, since this intrinsic p-type material with a direct optical band gap of 2.17 eV consists of abundant elements only and has suitable properties for photovoltaic applications. Up to now the growth of high quality single crystalline thin films is quite challenging. Here we report on the growth of Cu_2O thin films by plasma assisted molecular beam epitaxy (PAMBE) on MgO and sapphire. High resolution X-ray diffraction (HRXRD) shows epitaxial crystal growth on both substrates. On MgO two different orientations occur with the (100) and (110) planes parallel to the MgO(100) substrate surface, which can be influenced by the copper to oxygen ratio. On sapphire substrates the utilization of a MgO buffer leads to the formation of (111)-oriented crystallites. Electrical and optical properties were determined by Hall-effect and photoluminescence measurements.

HL 107.3 Thu 17:00 P1

TEM investigation of structural changes in epitaxial $(In,Sn)_2O_3$ and $(Sn,In)O_2$ films — •Stephan Scholz[1], Anna Mogilatenko[1,2], Holm Kirmse[1], Oliver Bierwagen[3,4], Mark E. White[4], Min-Ying Tsai[4], Martin Schmidbauer[5], James S. Speck[4], and Saskia F. Fischer[1] — [1]Humboldt-Universität zu Berlin, 10099 Berlin, Germany — [2]Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, 12489 Berlin, Germany — [3]Paul-Drude-Institut für Festkörperelektronik, 10117 Berlin, Germany — [4]University of California, Santa Barbara, CA 93106, USA — [5]Leibniz-Institut für Kristallzüchtung, 12489 Berlin, Germany

Transparent conducting oxides in In_2O_3-SnO_2 pseudo-binary system are used in many optoelectronic applications, e.g. solar cells, flatscreens and touchscreens. In single-crystalline In_2O_3 and SnO_2 films, the conductivity extrema with regard to the In:Sn ratio are accompanied by crystal structure degradation [1][2]. Thus, analysis of growth-induced defects and possible structural changes in thin oxide films is important for understanding the electrical properties of these materials.

We have applied transmission electron microscopy to characterize structural changes and compositional homogeneity in epitaxial $(In,Sn)_2O_3$ as well as $(Sn,In)O_2$ films grown by plasma-assisted molecular beam epitaxy. The obtained information contributes to the understanding of the mechanisms that lead to conductivity saturation in indium-tin-oxides. [1] O. Bierwagen and J. Speck, Phys. Status Solidi A. doi:10.1002/pssa.201330224 (2013). [2] M. White, O. Bierwagen, M. Tsai, and J. Speck, APEX **3**, 051101 (2010)

HL 107.4 Thu 17:00 P1

Towards realization of bipolar devices based on In2O3: Epitaxy of Be doped InAs on In2O3 — •Fariba Hatami[1], Ted Masselink[1], Martin Schmidbauer[2], Patrick Vogt[3], and Oliver Bierwagen[3] — [1]Inst. für Physik, Humboldt-Universität zu Berlin, Berlin, Germany — [2]Leibniz-Inst. für Kristalzüchtung, Berlin, Germany — [3]Paul-Drude-Inst. für Festkörperelektronik, Berlin, Germany

In2O3 is an important transparent semiconducting oxide and has a great potential for applications in transparent microelectronics, optoelectronics, and short wavelength photonics. In2O3 exists only as n-type material. Even nominally undoped material is n type. This characteristic limits the application of In2O3 to the unipolar devices. A hybrid structure based on p-doped III-V semiconductors and In2O3 opens the possibility of realization of bipolar devices. This work presents the gas-source molecular-beam epitaxy growth of Be doped InAs on In2O3(111). In2O3 films with high crystalline quality were grown by PA-MBE on Y-stabilized ZrO2(111) wafers. The InAs layers were grown at different growth conditions and temperatures. According to the x-ray analysis InAs in all samples has zinc-blende structure and with increasing growth temperature the InAs film grows epitaxially and it changes from polycrystalline to monocrystalline.

HL 107.5 Thu 17:00 P1

First principles investigation of influence of point defects on the magnetic properties of zinc ferrite — •Waheed A. Adeagbo[1], Sanjeev K. Nayak[1], Martin Hoffmann[1,2], Arthur Ernst[2,3], and Wolfram Hergert[1] — [1]Institute of Physics, Martin Luther University Halle-Wittenberg, Halle, Germany — [2]Max Planck Institute of Microstructure Physics, Halle, Germany — [3]Wilhelm-Ostwald-Institut für Physikalishe und Theoretishe Chemie, Universität Leipzig, Leipzig, Germany

We investigate the role of point defects (vacancies and impurities) in inducing local ferromagnetic order in $ZnFe_2O_4$, which is otherwise an antiferromagnetic system. Our studies are performed by the first-principles density functional theory using the VASP package with GGA and GGA+U. Lattice defects such as anion (V_O) and cation (V_{Fe}, V_{Zn}) vacancies and vacancy complexes (V_{Fe-O}, V_{Zn-O}), substitution of Mg at the tetrahedral Zn site and the interstitial Fe at the empty tetrahedral site are some of the defects under our consideration. In a recent experimental work, by characterization of nanoparticles and thin films of $ZnFe_2O_4$ samples from XMCD measurements [1], it is deduced that V_O is responsible for enhancement of local ferromagnetic ordering. In a similar line, the influence of other defects on the magnetic properties of both normal and inverse spinel are of interest. The stability of the defects at different experimental growth conditions are estimated by analysis of the defect formation energies at various chemical potentials of the constituting elements in our calculations.
[1] C. E. Rodríguez Torres *et al.*, Phys. Rev. Lett. (2013) (submitted).

HL 107.6 Thu 17:00 P1

TEM and FIB-based EBIC investigations to study photovoltaic properties of a complex oxide pn-heterojunction — •Patrick Peretzki[1], Pablo Marín Perera[1], Benedikt Ifland[2], Daniel Mierwaldt[2], Philipp Saring[1], Christian Jooss[2], and Michael Seibt[1] — [1]IV. Physikalisches Institut, Georg-August-Universität Göttingen, Germany — [2]Institut für Materialphysik, Georg-August-Universität Göttingen, Germany

The perovskite-structured p-doped manganite $Pr_{1-x}Ca_xMnO_3$ (PCMO) combined with n-doped $SrTi_{1-y}Nb_yO_3$ (STNO) is presently explored as a model system for manganite-based pn-heterojunctions. It is expected that the rapid thermalization of low-energy photoexcitated charge carriers can be quenched by making use of hot-polaron type correlated states with long lifetimes and/or long diffusion lengths, opening the possibility of converting a broad range of the solar spectrum. In this work, PCMO/STNO interfaces are investigated by Electron Beam Induced Current (EBIC) cross-section measurements by combining SEM-based EBIC with Focused Ion Beam preparation in dual beam instruments. As SEM-based EBIC is resolution-limited because of the probe size and the broad carrier generation volume, TEM lamellae are prepared from the material, which reduces the generation volume to a minimum and results in precise EBIC images of the PCMO/STNO interface. We thank the DFG for funding the research through CRC1073.

HL 107.7 Thu 17:00 P1

Ab initio investigations of $Zr_{1-x}Ce_xO_2$ — •Michael Bachmann and Christian Heiliger — I. Physikalisches Institut, Justus Liebig University Giessen, D-35392, Germany

The phase diagram of $Zr_{1-x}Ce_xO_2$ has been investigated with Ra-

man spectroscopy [1] but is still yet not fully understood. We perform DFT supercell calculations of $Zr_{1-x}Ce_xO_2$ for the different phases with different cerium concentrations. For each concentration we calculate supercells with different configurations. We present concentration dependent lattice constants, bandgaps and Raman spectra. All quantities are obtained by thermodynamic and statistic weighting.
[1] Yashima et al. J.Am. Ceram. Soc. 77 1067 (1994)

HL 107.8 Thu 17:00 P1

Ab-initio investigation of intermediate tin oxides — •Bianca Eifert and Christian Heiliger — I. Physikalisches Institut, Justus Liebig University Giessen, D-35392, Germany

Tin forms two stable oxides, a monoxide and a dioxide. Both are of great interest for applications as diverse as optoelectronics and electrochemistry. Electronically, the two oxides are quite different: Tin dioxide (SnO_2) is a wide-bandgap n-type semiconductor, while tin monoxide (SnO) is usually regarded as a semimetal or a small-bandgap p-type semiconductor. SnO_2 has been investigated in some depth both experimentally and theoretically, but SnO is less well-examined. Moreover, SnO disproportionates into Sn and SnO_2 at elevated temperatures, forming intermediate oxides of varying stoichiometry in the process. The preferred stoichiometries and crystal structures of these metastable phases are still unknown. In the present work, we use density functional theory (DFT) to determine and compare possible crystal structures as well as their stabilities relative to SnO and SnO_2 in order to suggest whether one of these structures might be grown experimentally. We also present calculations for the electronic structure of these intermediate oxides.

HL 107.9 Thu 17:00 P1

Growth and characterization of cuprous oxide thin films by chemical vapor deposition — Johannes Bieber, •Elisabeth A. Zolnowski, Gunther Haas, Yinmei Lu, Benedikt Kramm, Martin Becker, and Bruno K. Meyer — I. Physics Institute, Justus-Liebig-University Giessen, Heinrich-Buff-Ring 16, 35392 Giessen, DE-Germany

In the future all the forms of fossil energy will have to be replaced, due to the fact that these resources are limited. Solar cells have already been an important part of renewable energies, but to enlarge the competitiveness, they should be cheaper and more efficient than the present ones. A possible material which could comply with these requirements is cuprous oxide. It is a sustainable, cheap and nontoxic optoelectronic p-type semiconductor with a direct band gap of about 2.1 eV. It has been predicted that Cu_2O is promising for solar cell applications, with a theoretical energy conversion efficiency of 20%. Therefore we tried to optimize the growth of cuprous oxide thin films by chemical vapor deposition (CVD) and investigated their crystalline, electrical and optical properties under different growth conditions, respectively.

HL 107.10 Thu 17:00 P1

Optical spectroscopy of doped Cu_2O thin films — •Julian Benz[1], Philipp Hering[1], Torsten Henning[1], Uwe Kaiser[2], Wolfram Heimbrodt[2], Bruno K. Meyer[1], and Peter J. Klar[1] — [1]I. Physikalisches Institut, Justus-Liebig-Universität, Heinrich-Buff-Ring 16, 35392 Gießen — [2]Department of Physics and Material Sciences Center, Philipps-University of Marburg, Renthof 5, 35032 Marburg, Germany

Although the semicondutcing nature of cuprous oxide (Cu_2O) is already known since the early 20th century, little research was done besides studies of its excitonic properties. Recently the interest in Cu_2O, as a sustainable material, revived due to its potential use in photovoltaics. Here we report on the influence of doping on the optical properties of Cu_2O. We investigated series of RF sputtered thin films of Cu_2O doped with nitrogen and hydrogen, respectively. The photoluminesence (PL) of the samples was measured in a temperature range from 4 K to 300 K. The spectra will be interpreted with respect to the electrical properties. Furthermore the lifetime of the defect related luminescence was studied by means of time resolved PL spectroscopy. The results obtained are compared with those of a mechanical polished, natural Cu_2O single crystal.

HL 107.11 Thu 17:00 P1

High-quality SnO_2 thin films grown by chemical vapor deposition — •Yinmei Lu, Martin Becker, Benedikt Kramm, Johannes Bieber, Jie Jiang, Angelika Polity, and Bruno Meyer — 1. Physics Institute, Justus-Liebig-University Giessen, Germany

SnO_2 films with thicknesses of 10 - 1800 nm were deposited on c-sapphire, r-sapphire and quartz glass substrates with or without a SnO_2 buffer layer via chemical vapor deposition (CVD), using SnI_2 powder and oxygen gas as source materials, and at substrate temperatures ranging from 300 to 800 °C. The crystal structure and morphology of the films were studied by X-ray diffraction (XRD) and scanning electron microscopy (SEM), respectively, which reveal a high crystallinity of films with a smooth and homogeneous surface. For the ultra-thin films grown on c sapphire, the XRD rocking curve of SnO_2 (200) diffraction showed a small full width at half maximum (FWHM) of 0.02° (72 arcsec), indicating an almost perfect epitaxial growth of SnO_2 on c-sapphire. Optical properties of the films with different thicknesses were compared via transmittance measurements, which reveal thickness-dependence of the band gaps of the films. Both secondary ion mass spectrometry (SIMS) and X-ray photoelectron spectroscopy (XPS) were used to examine the composition and element states of the films. Electrical the properties of the films grown under different oxygen flows were investigated with Hall effect measurements. At room temperature, the Hall mobility, carrier density, and resistivity are in the ranges of (2.31 - 41.39) cm^2/Vs, (0.902 - 41.4)$\cdot 10^{18}$ cm^{-3} and ($6.09 \cdot 10^{-3}$ - 2.99) Ωcm, respectively.

HL 107.12 Thu 17:00 P1

Nitrogen doping in SnO_2 thin films grown by chemical vapor deposition — •Jie Jiang, Yinmei Lu, Johannes Bieber, and Bruno Meyer — 1. Physics Institute, Justus-Liebig-University, Giessen, Germany

As a direct band gap semiconductor, tin oxide (SnO_2) is a promising candidate for constructing next generation ultraviolet light emitting diodes (LEDs) and photodetectors, due to its large band gap of 3.6 eV, high exciton binding energy of 130 meV, and high carrier mobility of about 250 cm^2/Vs at room temperature. An essential step to fabricate SnO_2-based optoelectronic devices is to obtain high quality p-type SnO_2 films. Nitrogen is theoretically predicted to be an excellent p-type dopant in SnO_2 owing to its suitable electronegativity and ion size, high solubility limit, and non-toxicity. At the same time, only a few experimental investigations were performed on N-doped SnO_2. For this reason, we deposit the N-doped SnO_2 thin films on c-sapphire and r-sapphire substrates via chemical vapor deposition (CVD), using SnI_2 powder and NO_2 (or NH_3) gas as source materials. The crystal structure, morphology, electrical properties and optical properties of the films were measured and investigated by X-ray diffraction (XRD), scanning electron microscopy (SEM), Hall effect measurements and transmittance measurements, respectively.

HL 107.13 Thu 17:00 P1

three dimensional character of the near-E_F band of cleaved In_2O_3(111) single crystals — •valentina scherer[1], christoph janowitz[1], zbigniew galazka[2], and recardo manzke[1] — [1]Humboldt-Universität zu Berlin, Institut für Physik, Newtonstr. 15, 12489 Berlin, Germany — [2]Leibniz-Institut für Kristallzüchtung, Max-Born-Straße 2, 12489 Berlin, Germany

The near-E_F band of the in situ cleaved (111) surface of high quality n-type In_2O_3 single crystals obtained from the melt was investigated by high-resolution ARPES along major symmetry lines of the Brillouin zone. Several criteria to pin down Fermi level crossings and Fermi momenta were applied. To good approximation the near-E_F band is of three-dimensional character in momentum space and simply monitors the dispersion of the bottom of the conduction band bent below the Fermi energy. The results are explained without explicit reference to two-dimensional models by the assumption of a degenerate semiconductor due to high n-type doping ($n = 1.3 \times 10^{18} cm^{-3}$).

HL 107.14 Thu 17:00 P1

Electronic and optical properties of Ga_2O_3 — •Jürgen Furthmüller and Friedhelm Bechstedt — IFTO, FSU Jena, Max-Wien-Platz 1, D-07743 Jena, Germany

We present *first-principles* calculations of the electronic structure and optical properties of the monoclinic β-Ga_2O_3 phase which is the only stable polymorph under ambient conditions. In addition, we also study the metastable rhombohedral α-Ga_2O_3 (corundum-type) structure and compare the properties of the two polymorphs. Quasi-particle band structures on G_0W_0 level and excitonic spectra on BSE level are presented. It is demonstrated that these two polymorphs of Ga_2O_3 differ mainly in their optical anisotropies. Isotropically averaged optical properties and in particular densities of states look quite similar. This can also be shown for more complicated polymorphs on DFT level

(where a treatment on GW and BSE level is imposible).

HL 107.15 Thu 17:00 P1

A spectroscopic comparison of AOS thin films and TCO single crystals — •Jörg Haeberle[1], Diana Gaspar[2], Pedro Barquinha[2], Stephan Machulik[3], Christoph Janowitz[3], Zbigniew Galazka[4], and Dieter Schmeisser[1] — [1]Angewandte Physik/Sensorik, Brandenburgische TU Cottbus-Senftenberg,K.-Wachsmann-Allee 17, 03046 Cottbus, Germany — [2]Department of Materials Science Faculty of Sciences and Technology,New University of Lisbon and CEMOP-UNINOVA, Campus de Caparica,2829-516 Caparica, Portugal — [3]Humboldt-Universität zu Berlin, Institut für Physik, Newtonstraße 15, 12489 Berlin, Germany — [4]Leibnitz-Institut für Kristallzüchtung, Max-Born-Str. 2, 12489 Berlin, Germany

Amorphous oxide semiconductors (AOS) and transparent conductive oxides (TCO) are today one of most attractive fields of research in many industrial products, like e.g. high definition, low cost, transparent, and flexible displays. We got the unique possibility to measure a-GIZO and a-SnOx thin films and compare their electronic properties with those of In2O3, Ga2O3, ZnO, and SnO2 single crystals. We use resPES to study the electronic properties. We report on the core levels, the VB PES data, partial Integrated Yield (pIY) and the XAS absorption data. From these we are able to derive the elemental ratio, the pDOS as well as the band scheme. At the O1s resonance we observe multiple Auger processes from which we deduce that a band of localized defect states is located between the Fermi energy and the CBM. The resonant profiles taken at the corresponding metal edges indicate that metal states are involved in the DOS.

HL 107.16 Thu 17:00 P1

3ω thermal conductivity measurements of $\beta - Ga_2O_3$ bulk crystal — •Martin Handwerg, Christine Bülow, Rüdiger Mitdank, and Saskia F. Fischer — Neue Materialien, Institut f. Physik, Humboldt-Universität zu Berlin, D-10099 Berlin

Ga_2O_3 belongs to the group of transparent conducting oxides with scarce information about thermal and electric properties. Here, the thermal conductivity λ of a $\beta - Ga_2O_3$ bulk-crystal is determined by using the 3ω-method. Therefore, a lineheater in 4 point geometry is placed above the crystal. An AC-heating current causes an increase of the temperature followed by an increasing heater resistance. The rising temperature generates an AC-signal with three times the frequency of the input current. This 3ω-voltage depends on the input frequency, which is related to the thermal penetration depth. In a common measurement setup a thermal penetration depth up to 1 mm below the heater can be reached. The thermal conductivity is calcuated by the slope of $U_{3\omega}(\ln f)$ and the heater parameters [1].

As a result of the $U_{3\omega}$ measurements of an 1 mm thick Ga_2O_3 [100] crystal the thermal conductivity was determined for a temperature interval between 4.2 K and 300 K. The temperature-dependent behaviour of the thermal conductivity fits with the theoretic explanations for insulators. Comparing the $U_{3\omega}$-method for thermal conductivity measurments at room temperature with optical methods there are consistent results with $\lambda = 13.6\,\mathrm{Wm^{-1}K^{-1}}$.

[1] D. Cahill *et al*, Physical Review B **35** (1987)

HL 107.17 Thu 17:00 P1

Structural and electrical investigations of Si-doped $(In_xGa_{1-x})_2O_3$ thin films — •Anna Werner, Stefan Müller, Holger von Wenckstern, and Marius Grundmann — Universität Leipzig, Semiconductor Physics Group, Institut für Experimentelle Physik II, Leipzig, Germany

For the realization of solar-blind photodetectors the semiconductor β-Ga_2O_3 is due to the large band gap E_g of 4.9 eV especially suitable. Alloying β-Ga_2O_3 with indium allows to decrease E_g significantly and allows to control E_g and makes wavelength-selective photo detectors feasible. In this contribution we present structural and electrical properties of $(In_xGa_{1-x})_2O_3$ thin films grown by pulsed laser deposition on c-plane saphire substrate in dependence of the alloy composition. For our investigations we used a wafer having a continuous composition spread. The In content varies between $x = 0.008 - 0.69$. Additionally the wafer is doped with 0.1% silicon to improve the electric conductivity. The lateral composition gradient was realized by ablating a segmented PLD target [1]. The thin film has monoclinic crystal structure and is (-201) oriented. The incorporation of In increases the spacing between (-201) planes. Transmission measurements exhibit a decrease of E_g with increasing In content. We investigated the properties of Schottky contacts fabricated in front-front geometry on a stripe of the wafer containing the complete range of In compositions. For that we used reactively sputtered PdO_x Schottky contacts and determined their characteristic parameters in dependence on the In content.

[1] H. von Wenckstern *et al.*, CrystEngComm. **15**, 10020 (2013)

HL 107.18 Thu 17:00 P1

Electrical characterization of Si-doped β-Ga_2O_3 thin films grown by pulsed laser deposition — •David Diering, Florian Schmidt, Stefan Müller, Daniel Splith, Holger von Wenckstern, and Marius Grundmann — Universität Leipzig, Institut für Experimentelle Physik II, Abteilung Halbleiterphysik, Linnéstraße 5, 04103 Leipzig

Its large band gap of 4.9 eV makes β-gallium oxide (Ga_2O_3) an auspicious candidate for high power electronics and transparent optoelectronic devices. In order to investigate the electrical properties of β-Ga_2O_3 thin films we have applied current-voltage (I-V) characterization and space-charge spectroscopic methods (C-V, AS, TAS, DLTS) to Schottky contacts (SCs). The thin films have been grown by pulsed laser deposition at approx. 650 °C and an oxygen partial pressure of 10^{-3} mbar. Using Ga_2O_3 targets with 0.1 wt% and 1 wt% SiO_2 the thin films have been fabricated on c-plane sapphire substrates and (00.1) ZnO/ZnO:Ga templates. The SCs have been formed by DC sputtering of Cu. The temperature dependent measurements have been conducted in the temperature range from 10 K to 330 K. First TAS measurements indicate a defect state with a thermal activation energy of $E_t = 216$ meV with an apparent capture cross-section $\sigma_a = 7 \times 10^{-17}\,\mathrm{cm^2}$.

HL 107.19 Thu 17:00 P1

Raman scattering in $(In,Ga)_2O_3$ thin films — •Christian Kranert, Christian Dähne, Jörg Lenzner, Holger von Wenckstern, Rüdiger Schmidt-Grund, and Marius Grundmann — Universität Leipzig, Institut für Experimentelle Physik II, Semiconductor Physics Group, Leipzig, Germany

Raman scattering in the $(In,Ga)_2O_3$ material system greatly benefits from excitation with ultraviolet (UV) laser light. For pure β-Ga_2O_3 and Ga-rich alloys with the same crystal structure, the increased scattering cross section due to the high photon energy enhances the feasibility of Raman measurements carried out on thin films with thicknesses down to 100 nm or even less. In case of pure In_2O_3, resonant excitation near the band gap enables the observation of most Raman active modes, which have not yet been reported.

In this contribution, we make use of the above mentioned advantages of UV excitation to characterize the $(In,Ga)_2O_3$ material system by Raman scattering. We present the dependence of the energy of several phonon modes on the indium concentration in the Ga-rich β-phase. The obtained results allow a precise determination of the composition based on the Raman spectrum. We further give the energy and symmetry of previously not observed phonon modes in bixbyite-type In_2O_3. These show a distinct sensitivity to the growth parameters. Consequently, UV Raman scattering appears to be a promising method for the characterization of such films.

HL 107.20 Thu 17:00 P1

NIR-VUV dielectric function of $(In,Ga)_2O_3$ thin film with lateral composition spread — •Hannes Krauss, Tammo Böntgen, Holger von Wenckstern, Jörg Lenzner, Rüdiger Schmidt-Grund, and Marius Grundmann — Universität Leipzig, Institut für Experimentelle Physik II, Leipzig, Germany

We present the dielectric function spectra of $(In,Ga)_2O_3$ in the full composition range obtained by means of spectroscopic ellipsometry. By model analysis of the experimental data using parametric model dielectric function approaches we derive the refractive index dispersion in the visible spectral range and the energies of electronic transitions as a function of the composition and temperature. A clear red shift of the transition energies with increasing In content is found.

The $(In,Ga)_2O_3$ thin film with compositional spread was deposited on 2" a-plane sapphire substrates by means of pulsed laser deposition. A two-fold segmented target was used where one half was pure Ga_2O_3 and the other In_2O_3. Target and substrate were then rotated synchronously to facilitate a continues gradient of the Ga/In ratio on the substrate [1].

[1] H. von Wenckstern *et al.*, CrystEngComm **15**, 10020 (2013).

HL 107.21 Thu 17:00 P1

Properties of MIS-diodes based on Si-doped β-Ga_2O_3 — •Anna Reinhardt, Holger von Wenckstern, and Marius Grund-

MANN — Universität Leipzig, Institut für Experimentelle Physik II, Semiconductor Physics Group

In the field of high-power electronics gallium oxide (Ga_2O_3) has a tremendous potential for future power device applications due to its large bandgap of 4.9 eV and its theoretically high breakdown field of about 8×10^8 V/m. For the development of Ga_2O_3-based power devices such as metal-insulator-semiconductor field-effect transistors (MISFET) the realization of MIS-diodes is essential.

We present our results on MIS-diodes deposited on silicon doped β-Ga_2O_3 thin films fabricated using pulsed-laser deposition. The electrical properties of the MIS-diodes were varied via the dielectric thickness and the oxygen partial pressure during contact deposition. Current-voltage measurements (IV) reveal leakage current densities of down to $10^{-9}\,\mathrm{Acm}^{-2}$. In order to determine the dielectric constant of the insulator we performed quasi-static capacitance-voltage measurements. Furthermore, the possible origin of conduction through the insulator is investigated by means of temperature-dependent IV-measurements.