DS 9: Layer Deposition (ALD, MBE, Sputtering, ...)

Time: Monday 15:00–16:30 Location: H39

DS 9.1 Mon 15:00 H39

MBE growth of ϵ-Ga_2O_3 by using a Sn catalyst-layer — •Alexander Karg[1], Max Kracht[2], Sebastian Benz[2], Fabian Michel[2], Marcus Rohnke[3], Stephan Figge[1], Jörg Schörmann[2], Marco Schowalter[1], Jürgen Janek[3], Andreas Rosenauer[1], and Martin Eickhoff[1] — [1]Institute of Solid State Physics, University of Bremen, Bremen, Germany — [2]Institute of Experimental Physics 1, Justus Liebig University, Giessen, Germany — [3]Physical-Chemical Institute, Justus Liebig University, Giessen, Germany

MBE-growth of ϵ-Ga_2O_3 on c-plane Al_2O_3 by MBE is only possible in metal-rich growth conditions, which normally leads to the formation and subsequent desorption of the volatile suboxide Ga_2O, thus hampering layer-growth. Additional supply of Sn during growth expands the growth window and enables the formation of ϵ-Ga_2O_3 in this regime.

To further investigate the role of Sn during growth we significantly reduced the Sn exposure time and deposited an ultrathin (<1 ML) Sn layer before Ga_2O_3 growth.

We found that this Sn layer is sufficient to enable the formation of ϵ-Ga_2O_3 thin films without Sn incorporation, demonstrating the catalytic role of Sn in the growth process. The impact of this technique for processing technology of ϵ-Ga_2O_3 devices will also be discussed.

DS 9.2 Mon 15:15 H39

Influence of surface modification on electrochemical performance of Ni-rich NCM cathodes for Lithium ion batteries — •Rajendra Singh Negi and Matthias T. Elm — Center for Materials Research, Justus-Liebig-University Gießen, Germany, Heinrich-Buff-Ring 16, 35392 Gießen

Ultrathin Al2O3 coatings were applied to Ni-rich NCM powder using atomic layer deposition (ALD) in order to create a protective barrier layer at electrode-electrolyte interface. The results of FIB-scanning electron microscopy and transmission electron microscope images show a homogeneous and conformal Al2O3 coating on the surface of Ni-rich NCM powder. C-rate and cycling tests show that the Al2O3 coating Improves the electrochemical performance with a higher capacity retention as compared to pristine cathodes at room temperature under 0.5C. The superior performance is attributed due to the suppression of side reactions at the interface between the active cathode powder and the electrolyte.

DS 9.3 Mon 15:30 H39

Epitaxial growth of SrTiO3 thin films by MOVPE — •Aykut Baki, Julian Stöver, Klaus Irmscher, Toni Markurt, Martin Albrecht, and Jutta Schwarzkopf — Leibniz-Institut für Kristallzüchtung, Max-Born-Straße 2 12489 Berlin, Germany

SrTiO3 represents a prototype of complex perovskites. It provides a high dielectric constant and a switchable/tunable resistivity, which makes it potentially interesting for resistive switching memories (ReRAM). A large number of studies exists about physical thin film deposition by pulsed laser deposition (PLD). However, SrTiO3 thin films are rarely deposited by metal-organic vapor phase epitaxy (MOVPE), although this method provides the epitaxy of smooth and defect-poor thin films since growth takes place near the thermodynamic equilibrium. The approach of our study is to grow defect-free epitaxial SrTiO3 films and to fundamentally investigate on the correlation between deposition conditions and film properties. Well-ordered SrTiO3 thin films are epitaxially grown by MOVPE on (100) SrTiO3, (110)o DyScO3 and (110)o NdGaO3 substrates under different strain conditions by the use of Sr(tmdh)2-tetraglyme and Ti(iso-propoxid)2(tmdh)2 precursors. The structural properties of SrTiO3 thin films grown under a wide range of growth parameters by MOVPE and PLD are analyzed by high-resolution X-ray diffraction, transmission electron microscopy, atomic force microscopy and their impact on electrical properties are shown by resistivity and capacitance-voltage measurements.

DS 9.4 Mon 15:45 H39

Cu- and Mn-doping in ferroelectric K0.5Na0.5NbO3 epitaxial films grown by PLD — •Daniel Pfützenreuter, Martin Schmidbauer, Julian Stöver, Klaus Irmscher, Detlef Klimm, and Jutta Schwarzkopf — Leibniz-Institut für Kristallzüchtung, Max-Born-Str. 2, 12489 Berlin

(K,Na)NbO3 is a lead-free ferro- and piezoelectric material potentially used for e.g. sensor or memory applications. Pulsed laser deposition (PLD) of K0.5Na0.5NbO3 thin films with reproducible high crystalline quality requires the use of phase pure and dense targets. Therefore, an optimized target preparation routine based on solid-state sintering was developed. Raw materials are ground to a mean grain size of 10 μm and pressed into a target applying an isostatic pressure of 2000 bar. Subsequently, a two-step sinter routine ensures the formation of a pure perovskite phase. Here, a calcination step at 850 °C and a subsequent sinter step at 1050 °C are executed. Besides pure K0.5Na0.5NbO3 also the impact of Cu- and Mn-doping on the sinter procedure has been studied. Aliovalent doping on KxNa1-xNbO3 ceramics has been reported to have a significant impact on electrical properties of the material, however, studies on thin films are rarely published. Therefore, doped K0.5Na0.5NbO3 targets were prepared and applied for thin film growth with PLD. Under optimized growth conditions, deposition of K0.5Na0.5NbO3 thin films resulted in well-ordered epitaxial films. The impact of Cu- and Mn-doping on thin films has been studied with respect to structural and electrical properties of the films.

DS 9.5 Mon 16:00 H39

Ion-beam sputtered oxide buffer layers as a viable alternative to thin films grown with atomic layer deposition — •Martin Becker, Florian Kuhl, Philip Klement, Angelika Polity, Jörg Schörmann, Peter J. Klar, and Sangam Chatterjee — Institute of Experimental Physics I and Center for Materials Research, Heinrich-Buff-Ring 16, Justus Liebig University Giessen, D-35392 Giessen, Germany

Sputtering deposition techniques are well suited to fabricate polycrystalline oxide thin-films on different substrates as they reliably offer homogeneous and reproducible layer growth at high deposition rates. Conventional RF and DC sputtering, however, are subject to limitations based on substrate heating and impurity incorporation. Ion-beam sputter-deposition (IBSD) tackles these issues and yields thin films of high compactness and adherence. Therefore, in many applications, IBSD has become a viable alternative to conventional plasma-based deposition.

Here, we report on a system for the ion beam processing of semiconductors with the focus on buffer layer growth. Its task is to increase the quality of the growth of the functional layer itself by creating a smoother surface or providing a surface triggering a preferential crystal orientation of the functional layer. We discuss different oxide-based model systems. Further, we will compare the results with buffer layers grown with atomic layer deposition (ALD), since in most cases ALD is the method of choice when it comes to the ability to produce accurate thicknesses and uniform surfaces.

DS 9.6 Mon 16:15 H39

Correlation between sputter deposition parameters and I-V curves in memristive devices — •Finn Zahari[1], Sven Gauter[2], Julian Strobel[3], Julia Cipo[2], Felix Georg[2], Thomas Mussenbrock[4], Lorenz Kienle[3], Holger Kersten[2], and Hermann Kohlstedt[1] — [1]Nanoelectronics, Faculty of Engineering, Kiel University, Germany — [2]Plasma Technology, Department of Physics, Kiel University, Germany — [3]Synthesis and Real Structure, Faculty of Engineering, Kiel University, Germany — [4]Electrodynamics and Physical Electronics, Electrical Engineering and Information Science, BTU Cottbus-Senftenberg, Germany

Neuromorphic analogue systems are recently highly investigated to realize novel bio-inspired computing architectures which may have advantages in power dissipation and scalability over traditional transistor technologies. Double barrier memristive devices (DBMD) with the layer sequence $Nb/Al/Al_2O_3/NbO_x/Au$ are promising candidates to emulate synaptic behavior in analog circuits. Selector-device free crossbar-arrays based on DBMDs have been already realized for pattern recognition tasks. The recognition performance of such systems strongly depends on the individual electrical I-V characteristics of the DBMDs. In this contribution we show evidence that crucial parameters of the process plasma, such as floating potential of the substrate, electron temperature and energy influx, are strongly correlated with the I-V characteristics of the individual devices. These results are supported by transmission electron microscopy (TEM). Our findings enable a new pathway for the development of plasma engineered memristive devices.