DS 10: Focus Session: Highlights of Materials Science and Applied Physics III (joint session DS/HL)

Time: Friday 11:15–13:00 Location: H1

DS 10.1 Fri 11:15 H1

Free-Standing ZnSe-Based Microdisk Resonators - Influence of Edge Roughness on the Optical Quality and Degradation Reduction with Supported Geometry — •Wilken Seemann[1], Alexander Kothe[1], Christian Tessarek[1], Gesa Schmidt[2], Siqi Qiao[2], Nils von den Driesch[2], Jan Wiersig[3], Alexander Pawlis[2], Gordon Callsen[1], and Jürgen Gutowski[1] — [1]Institute of Solid State Physics, University of Bremen, Germany — [2]Peter Grünberg Institute (PGI-9), Forschungszentrum Jülich, Germany — [3]Institut für Physik, Universität Magdeburg, Germany

Free-standing microdisks with ZnCdSe quantum wells in ZnMgSe barriers are analyzed using micro-photoluminescence (μPL). Stimulated emission into whispering gallery modes (WGMs) is demonstrated. Deformation functions of the resonators are determined via scanning electron microscopy (SEM). A correlation between edge roughness and optical quality is found. These results are confirmed by calculations based on the boundary element method using the measured deformation functions.

To reduce degradation in the ZnSe structures a fabrication technique new to this material system is introduced. It yields "supported" disks with no underetching which enhances the mechanical stability of the resonator and its thermal contact to the substrate. SEM measurements reveal an excellent structural quality of these resonators. The formation of WGMs in supported ZnSe:Cl resonators is demonstrated in μPL and confirmed by theoretical calculations.

DS 10.2 Fri 11:30 H1

Pyramid formation by etching of InGaN/GaN quantum well structures grown on N-face GaN for nano optical light emitters — •Uwe Rossow, Savutjan Sidikejiang, Samar Hagag, Philipp Henning, Rodrigo de Vasconcellos Lourenco, Heiko Bremers, and Andreas Hangleiter — TU Braunschweig, Inst. f. Angewandte Physik

While growth processes of $In_xGa_{1-x}N$/GaN quantum well structures on the Ga-face of GaN buffer layers are already optimized to obtain high quantum efficiency, the growth on N-face has gained momentum only in the last years. Compared to Ga-face $In_xGa_{1-x}N$ layers are more stable on N-face and the surface can easily be structured by wet chemical etching, which usually leads to the formation of pyramids on the surface. This allows a new way to realize nano optical light emitters which offers the possibility to produce structures with similar emission properties. First we grow $In_xGa_{1-x}N$/GaN (single or multi) quantum well structures on N-face GaN. In a second step pyramids are formed by KOH etching. We demonstrate that pyramids with smooth side facets of the type $(1\bar{1}0\bar{1})$ and sharp tips in the nanometer range can be achieved without any sign of damage. TEM reveals that InGaN quantum dot-like structures are present in the pyramids and in photoluminescence narrow emission lines are observed. The etching process depends on electrolyte composition and temperature, defects at the surface and surface morphology. A better control of this process is required to achieve reproducible nano structures.

DS 10.3 Fri 11:45 H1

Bulk and interfacial effects in the Co/Ni$_x$Mn$_{100-x}$ exchange-bias system due to creation of defects by Ar$^+$ sputtering — •Tauqir Shinwari[1], Ismet Gelen[1], Yasser A. Shokr[1,2], Ivar Kumberg[1], Ikram Ullah[3], Muhammad Sajjad[3], M. Yaqoob Khan[3], and Wolfgang Kuch[1] — [1]Freie Universität Berlin, Arnimallee 14, Berlin 14195, Germany — [2]Faculty of Science, Department of Physics, Helwan University, 17119 Cairo, Egypt — [3]Department of Physics, Kohat University of Science and Technology, Kohat, Khyber Pakhtunkhwa 26000, Pakistan

A series of experiments is carried out to identify the contribution of interface and bulk antiferromagnetic (AFM) spins to exchange bias (EB) in ultrathin epitaxial ferromagnetic (FM)/AFM bilayer samples. These are single-crystalline AFM Ni_xMn_{100-x} and FM Co layers on $Cu_3Au(001)$, in which structural or chemical defects are introduced by controlled Ar^+ sputtering at the surface of the AFM layer or at a certain depth inside the AFM layer. Comparison of the magnetic properties measured by magneto-optical Kerr effect for sputtered and non-sputtered parts of the same sample then allows a precise determination of the influence of sputtering on the AFM layer during the sample preparation. The results show that the creation of defects in the bulk of the AFM layer enhances the magnitude of EB and its blocking temperature, but not the ones at the interface. We also observed that the deeper the insertion of defects in the AFM layer, the higher the EB field and the larger the coercivity. These findings are discussed as the effect of additional pinning centers in the bulk of the AFM layer.

DS 10.4 Fri 12:00 H1

Study of annealing effect on RF-sputtered Bi2Te3 thin films with full figure of merit characterization. — •Gyuhyeon Park, Maksim Naumochkin, Kornelius Nielsch, and Heiko Reith — Leibniz Institute for Solid State and Materials Research Dresden (IFW Dresden), Institute for Metallic Materials, Helmholtzstrasse 20, 01069 Dresden, Germany

Thermoelectric (TE) devices enable the direct conversion of heat into electricity and vice versa. The demand of micro TE harvesting or Peltier cooling devices for application in autonomous sensor systems required for the internet of things (IoT) will prospectively drastically increase in the coming years. Such microdevices are typically fabricated using electrodeposition or physical vapor deposition, where the successful optimization of the thermoelectric figure of merit, zT, which is the key enabler for the introduction of these devices to application. Accordingly, thin film fabrication methods and material investigation are of high interest. In this study, we report on the thermoelectric characterization of RF sputtered n-Bi2Te3 thin films with various thicknesses. For the in-plane Seebeck coefficient, Hall coefficient, electrical, and thermal conductivity measurement a thin film analyzer (TFA) has been used. We will discuss the influence of temperature effects on the transport properties, including in-situ annealing experiments and the relation to the structure, grain size, and chemical composition which was analyzed with XRD, SEM and EDX.

DS 10.5 Fri 12:15 H1

Passivating polysilicon recombination junctions for crystalline silicon solar cells — •Franz-Josef Haug[1], Audrey Morisset[1], Philippe Wyss[1], Mario Lehmann[1], Aicha Hessler-Wyser[1], Andrea Ingenito[1], Quentin Jeangros[1], Christophe Ballif[1], Shyam Kumar[2], Santhana Eswara[2], and Nathalie Valle[2] — [1]Ecole Poiytechnique Fédérale de Lausanne (EPFL), School of Engineering, PV-Lab, Switzerland — [2]Luxembourg Institute of Science and Technology (LIST), Materials Research and Technology Department, Luxembourg

We investigate polysilicon recombination junctions, whose n-type bottom layer also acts as passivating contact to the silicon surface. They are a key element in tandem devices with a silicon bottom cell, and they could be used to simplify the processing sequence of single-junction cells with interdigitated back contacts. Processing requires high temperatures to crystallize the layers, however, this step can also deteriorate the tunnelling junction by diffusion of dopants. We analyse depth profiles of the doping concentrations in the layers and diffusion across the interface between them by secondary ion mass spectrometry (SIMS) in dynamic mode. We show that undesired diffusion is suppressed by modifying the interface with C, O, or a combination of these. Moreover, we demonstrate that this modification does not interfere with the diffusion of H which is an essential element to passivate defects at the wafer surface. Thus, we find implied open-circuit voltages up to 740 mV for contact resistivities less than 40 mΩcm2, and we demonstrate tandem cells with efficiency above 20%.

DS 10.6 Fri 12:30 H1

Homoepitaxial diamond lateral growth: a new methodology for the next generation of power devices — •Fernando Lloret[1], Daniel Araujo[2], David Eon[3], and Etienne Bustarret[3] — [1]Department of Applied Physics, University of Cádiz, 11510, Puerto Real (Cádiz) Spain — [2]Department of Material Science, University of Cádiz, 11510, Puerto Real (Cádiz) Spain — [3]Univ. Grenoble-Alpes, CNRS, Institut Néel, 38000 Grenoble, France

Diamond is expected to be the base material for future power electronic devices. However, the technological steps and the particularities inherent to the material remain impassable issues for its industrial implementation. Shortcomings such as the high density of substrate defects and small substrate sizes (less than 1 cm2), the large number of required non-fully-controlled technology steps (etch and deposition or growth) or electrical problems related to the classical geometries (high electric fields, leakages*) can be overcome by using lateral growth. The progress of this promising diamond deposition methodology, capable of drastically reducing defects density, promoting selective doping and providing a wealth of alternative geometries for the device, is here reviewed.

DS 10.7 Fri 12:45 H1

Impact of electrical current on single GaAs nanowire structure — •Ullrich Pietsch[1], Danial Bahrami[1], Ali AlHassan[1], Arman Davtyan[1], Taseer Anjum[1], Ren Zhe[2], Rainer Timm[2], Lutz Geelhaar[3], Jesus Herranz[3], and Dmiri Novikov[4] — [1]University of Siegen, Siegen, Germany — [2]University of Lund, Lund , Sweden — [3]Paul Drude Institute, Berlin, Germany — [4]DESY, Hamburg, Germany

The impact of electrical current on the structure of single free-standing Be-doped GaAs nanowires grown on a Si 111 substrate has been investigated by X-ray nano-diffraction before and after the application of an electrical current. The conductivity measurements of same nanowires in their as-grown geometry have been realized via W-probes installed inside a dual beam focused ion beam/scanning electron microscopy chamber. Comparing reciprocal space maps of the 111 Bragg reflection before and after the conductivity measurement, we find a deformation of the hexagonal nanowire cross-section, tilting and bending with respect to the substrate normal. For electrical current densities above 347 A/mm^2, the diffraction pattern was completely distorted. Confirmed by SEM the reconstructed cross-section of the illuminated nanowire shows elongation of two pairs of opposing side facets accompanied by shrinkage of the third pair of facets. To explain our findings, we suggest material melting due to Joule heating during voltage/current application accompanied by anisotropic deformations induced by the W-probe.