DS 39: Layer Deposition Processes & Layer Growth

Time: Thursday 17:00–18:00 Location: H8

DS 39.1 Thu 17:00 H8

Twin assisted growth of silicon on glass from low temperature solution and the onset of a morphological instability — •Robert Heimburger, Thomas Teubner, Nils Dessmann, Torsten Boeck, and Roberto Fornari — Leibniz–Institut für Kristallzüchtung, Max–Born–Straße 2, 12489 Berlin

Low temperature solution growth of microcrystalline silicon on glass substrates is considered in the light of supersaturation conditions and underlying growth mechanisms.
Silicon crystallites grown from liquid indium by means of steady–state solution growth at 600°C are terminated by {111} facets. Often, individual grains consist of one or more Σ3 twin–boundaries. Alternating ledges and reentrant edges formed at multiple twin boundaries are found to locally enhance growth rate leading to anisotropic platelike structures. This can be explained by the presence of a self–preserving elementary step at the reentrant edges enabling fast growth even at low supersaturation without the need for 2D–nucleation. Additionally, if the size of a perfect crystal exceeds a certain value, the formation of hoppers in the middle of {111} facets is observed. This morphological instability is interpreted by means of a supersaturation inhomogeneity arising within the diffusion boundary layer of the nutrient solution which causes solute depletion at the center of growing facets. As crystals exceed a critical size, this depletion cannot be longer compensated by an increased interstep distance. This leads to a significant decrease of growth rate at the centers.

DS 39.2 Thu 17:15 H8

Atomic layer deposition of HfO_2 onto SiO_2 substrates investigated in-situ by non-contact UHV/AFM — •Krzysztof Kolanek, Konstantin Karavaev, Massimo Tallarida, and Dieter Schmeisser — Brandenburgische Technische Universität, LS Angewandte Physik-Sensorik, Konrad-Wachsmann-Allee, 17, 03046, Cottbus, Germany

We investigated in-situ the atomic layer deposition (ALD) of HfO_2 onto SiO_2 substrates with ultra high vacuum (UHV) non-contact atomic force microscope (NC-AFM). The ALD process was started after detailed analysis of the initial Si(001)/SiO_2 substrate. The ALD cycles, made by using tetrakis-di-methyl-amido-Hf (TDMAHf) and water as precursors, were performed on the SiO_2 substrate maintained at 230 °C. We studied the relation between the film growth and the root mean square surface roughness, surface skewness, kurtosis, fractal dimension and correlation length. In the initial stages of the ALD process with our analysis of the surface height histograms we were capable of determination: HfO_2 layer thickness, surface coverage and surface roughness of a substrate and deposited material. Observation of the surface height histograms evolution during deposition allowed us to verify conformal and effective ALD growth on SiO_2 substrate. With this detailed analysis of the surface topography we confirmed the completion of the first HfO_2 layer after four ALD cycles.

DS 39.3 Thu 17:30 H8

Epitaxial growth of FeAl films on Al_2O_3 by pulsed laser deposition — •Moritz Trautvetter, Ulf Wiedwald, and Paul Ziemann — Institut für Festkörperphysik, Universität Ulm

FeAl alloys at equiatomic composition are very interesting systems due to their chemical stability and their multiple magnetic properties depending on chemical ordering. For many applications thin films are desirable. We present a method to grow epitaxial FeAl thin films on differently-cut sapphire (0001),(11$\bar{2}$0),(1$\bar{1}$02) substrates by pulsed laser deposition. By varying the preparation temperature, the film morphology can be tuned from very smooth films (300 K) to columnlike growth (900 K). Moreover, chemical ordering in the B2 structure can be achieved by film deposition at elevated temperatures or alternatively by post-annealing of smooth films deposited at ambient temperatures. The epitaxial relations were measured by X-ray diffraction and electron backscatter diffraction. The phase change from the bcc structure towards the B2 structure is accompanied by a ferromagnetic/paramagnetic phase transition. The magnetic properties of the different phases of the FeAl films are examined by SQUID magnetometry and AC-susceptibility.

DS 39.4 Thu 17:45 H8

Modeling of the relaxation kinetics of metastable tensile strained Si:C alloys — •Felix Ulomek[1], Ina Ostermay[2], Thorsten Kammler[3], and Volker Mohles[1] — [1]Institut für Metallkunde und Metallphysik, RWTH Aachen — [2]Fraunhofer-Center Nanoelektronische Technologien, Königsbrücker Straße 180, D-01099 Dresden — [3]GLOBALFOUNDRIES Dresden Module One LLC & Co. KG, Wilschdorfer Landstraße 101, 01109 Dresden

In order to enhance the performance of CMOS transistors, embedded epitaxial layers of Si:C can be used. In the present work, Si:C layers with Carbon contents up to 1.9 at-% and in-situ Phosphorus doping up to 4×10^{20} At/cm^3 have been investigated. Due to the low solubility of Carbon in Silicon (0.0004 at.-% at the melting point), all layers considered in this work are metastable and tend to relax. Since it is crucial to the application to retain the strain of those layers, the responsible mechanisms must be understood. The relaxation during thermal treatment was studied by high resolution X-ray diffraction and was found to behave differently, depending on Carbon content and Phosphorus doping concentration. In this work, we propose a relaxation mechanism based on a kick-out reaction of substitutional Carbon which is accelerated by Phosphorus content through transient enhanced diffusion. We simulate the time evolution of layer relaxation as a function of alloying content, layer thickness and temperature. Parameters for the reaction kinetics are obtained by fitting to the experimental data.