DS 26: Thin Oxides and Oxide Layers 2

Time: Thursday 16:15–17:15 Location: H14

DS 26.1 Thu 16:15 H14

Studying the differences of Ga2O3 grown by conventional molecular-beam epitaxy (MBE) and suboxide MBE (S-MBE)
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The growth of Ga2O3 by conventional MBE, i.e., when supplying elemental Ga and active O, is limited by the formation and subsequent desorption of its volatile suboxide, Ga2O. During suboxide MBE (S-MBE), a recently developed new MBE variant, suboxides (here: Ga2O) are supplied during growth, bypassing the reaction limiting steps experienced during conventional Ga2O3 MBE growth by conventional MBE, and extending its kinetic and thermodynamic limits. S-MBE enables the synthesis of Ga2O3 at much higher growth rates ($> 1\ \mu$m h-1) and displays improved crystallinity and surface morphology compared with Ga2O3 thin films grown by conventional MBE.

This talk presents a direct comparison of Ga2O3 thin films grown by conventional MBE versus Ga2O3 thin films grown by S-MBE. We will show the impact of both MBE variants on the crystallinity and surface morphology of Ga2O3/Al2O3 heterostructures.

DS 26.2 Thu 16:30 H14

Comparative Study of a Ga2O3 nucleation layer and its impact on Ga2O3 growth on Al2O3 by molecular beam epitaxy
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Ga2O3 is a wide bandgap semiconductor and is seen as a promising candidate for e.g. future high-power electronics, and UV-detectors. The availability of single crystalline substrates makes the material attractive for device fabrication. Because of easier access, the majority of experiments were carried out by heteroepitaxy on e.g. Al2O3 substrates. In this study, the influence of the Al2O3 substrate on the nucleation and layer growth is investigated and compared with the use of a beta-Ga2O3 buffer layer to mimic homoepitaxial conditions. It was found that the effective Me to O ratio on the surface differs substantially and the amount of the available species (especially active oxygen) for growth could be estimated with respect to the different growth surfaces (0001) Al2O3 and (-201) beta-Ga2O3. This study was transferred to In2O3 growth to determine the different oxidation efficacies of the cations Indium and Gallium. Furthermore, the influence of the plasma power on the nucleation behavior of Ga2O3 and In2O3 as well as its influence on the growth kinetics itself and the layer properties will be discussed.

DS 26.3 Thu 16:45 H14

The effect of post-growth annealing of titanium dioxide thin films prepared by a sol-gel process on the photocatalytic activity
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TiO2 thin films revealed competitive performance for photocatalytic applications[1,2]. Here, a set of TiO2 thin films are synthesized using a sol-gel process and spin coated on p-type Si(100) substrates with a native oxide layer. The as-deposited thin films are annealed at various temperatures from 400 to 800 °C for 3 hours in ambient conditions.

Characterization is performed using various methods[3] on phases (UV-Raman & X-Ray diffractometry), film thickness and optical constants (Spectroscopic ellipsometry), morphology(Atomic Force Microscopy). Photocatalytic results on photodegradation of acetone to CO2 are obtained in a self-designed gas (reactant)-solid (photocatalyst) reaction chamber. The decrease/increase of acetone/CO2 is monitored via in-situ Fourier Transform Infrared Spectroscopy.

Quantitative data analysis is performed and correlated to indicate the effect of post annealing on the optical and structural properties of the titanium dioxide thin films and their photocatalytic activities.

1. Song,H et al, Conf. Lasers Electro-Optics,CLEO 2019
2. Nalajala et al, C.S.RSC Adv. 9 2019.
3. Gartner,M et al, Sol-Gel Sci. Technol. 2021

DS 26.4 Thu 17:00 H14

Oxidation behavior of SMART alloys and MAX phases materials and applicability in solar receivers.
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In the concept of materials for high-temperature application, two types of are being investigated: SMART alloys and MAX phase materials. W-Cr-Y SMART alloys were first designed for future fusion power plants. Studies suggests that SMART alloy containing Cr and Y is capable of forming a Cr2O3 layer and maintaining it at 1273K which avoids the generation of tungsten oxide. MAX Phase materials are able to provide great properties like oxidation resistance at high temperatures. Cr2AlC and Ti2AlC are two MAX phases that, in initial studies, provided a good oxidation response. Studies showed that Cr2AlC MAX phase and W-Cr-Y SMART alloy when exposed to 1273K and in humid atmosphere present good resistance to oxidation. Both were capable of withstand more than 20 hours in these conditions with a gain of mass lower than 0.3g/cm2. The main objective of this research is to evaluate the feasibility of both MAX phase materials and propose a new W-Al-Y SMART alloy, using them as solar receivers in concentrated solar power plants.