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Composition and band gap of aluminum alloyed beta-gallium oxide determined by XPS —

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Beta-phase gallium oxide has a band gap of 4.85 eV, suggesting strong potential for high-power electronics applications. Its properties can be enhanced by increasing the band gap via aluminum alloying. Here, we discuss the structural, electronic, and surface properties of β -(Al_xGa_{1-x})₂O₃ bulk crystals and thin films grown by metal-organic vapor-phase epitaxy (MOVPE) with Al contents of up to 40 %. Their Al content was determined by X-ray photoelectron spectroscopy (XPS) and compared with values obtained from X-ray diffraction (XRD) and inductively coupled plasma optical emission spectroscopy (ICP-OES). Additionally, potential doping gradients towards the bulk have been investigated by acquiring spectra at different take-off angles and by XPS depth profiling, revealing different aluminum concentrations in the bulk and at the surface. Furthermore, we establish a correlation between Al content and electronic band gap, i. e., with changes in the optoelectronic properties, which were determined by a combination of XPS electron-loss spectra and optical absorbance measurements. Finally, Auger spectroscopy and XRD analysis confirm the excellent chemical and structural quality of β -(Al_xGa_{1-x})₂O₃ thin films.

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Type: Vortrag;Talk

Topic: Thin Film Properties: Structure, Morphology and Composition (XRD, TEM, XPS, SIMS, RBS, AFM, ...)

Keywords: high power electronics; beta aluminum gallium oxide; epitaxy; bandgap; XPS

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