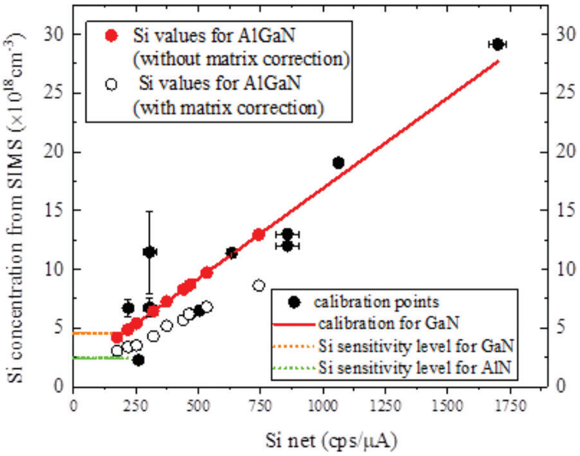
Highlights from Microscopy AND Microanalysis

Materials Applications

Quantification of Trace-Level Silicon Doping in $Al_xGa_{1-x}N$ Films Using Wavelength-Dispersive X-Ray Microanalysis by L Spasevski, B Buse, PR Edwards, DA Hunter, J Enslin, HM Foronda, T Wernicke, F Mehnke, PJ Parbrook, M Kneissl, and RW Martin, *Microsc Microanal* | https://doi.org/10.1017/S1431927621000568.

The paper addresses use of wavelength dispersive x-ray (WDX) spectroscopy in a commercially available EPMA instrument for measurement of trace levels of silicon atom concentrations in doped AlGaN semiconductor films (35–100 ppm). Doping with Si is the usual way to produce the n-type conducting layers. Consequently, controlled doping of these alloys is crucial for control of the electronic properties of the epitaxial layers and, hence, optimal device performance of LEDs and laser diodes. Due to reported discrepancies in quantitation of n-type silicon dopant between secondary ion mass spectrometry (SIMS) and the WDX technique, a novel calibration method was developed that consists of data derived from SIMS measurements and is applicable to the entire alloy range (GaN to AlN). This provides the means to measure the Si content and take into account variations in the ZAF corrections (Figure). This method presents a cost-effective and time-saving way to measure Si doping and also simultaneously measure other signals, such as cathodoluminescence (CL) and electron channeling contrast imaging.

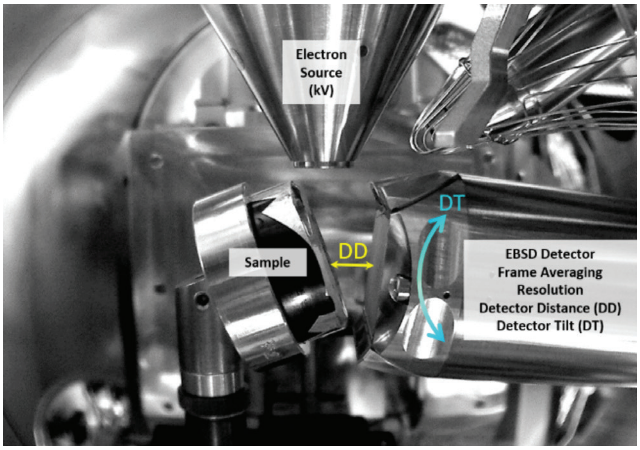


Values for Si concentration in $Al_xGa_{1-x}N$:Si layers plotted against the measured Si net signal. The line is the calculated calibration for GaN:Si. Points differ from this line according to the amount of AlN contained in the host material.

Techniques Development

An Acquisition Parameter Study for Machine-Learning-Enabled Electron Backscatter Diffraction by K Kaufmann and KS Vecchio, *Microsc Microanal* | https://doi.org/10.1017/S1431927621000556.

Electron backscatter diffraction (EBSD) is a scanning electron microscopy-based method involving the collection of information-rich 2D diffraction patterns. There has recently been significant interest in development of artificial intelligence-based techniques to extract crystallographic information (for example, lattice symmetry and orientation) from the raw diffraction patterns. Widespread adoption of these tools requires demonstrating robust performance to small and large changes to the diffraction patterns driven by variable experimental parameters. In this work, we study the change in classification accuracy when frame averaging, detector tilt, sample-to-detector distance, accelerating voltage, and pattern resolution are varied. The convolutional neural network (CNN) is trained with EBSD patterns collected from one fixed geometry. After fitting the model, new diffraction patterns are collected with each unique equipment geometry and from several different single and multi-phase samples. It is shown that the CNN's classifications are largely unaffected by most of the observed changes to the EBSD patterns. The noteworthy reductions in performance that are observed can be explained primarily by poor signal-to-noise ratios.



An annotated view of the experimental EBSD setup within the SEM. The varied parameters are superimposed on the electron column and EBSD detector.

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