PP-TOFMS: Use Cases in Semiconductor Technology

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Abstract

Plasma profiling time of flight mass spectrometry (PP-TOFMS) enables elemental profiling of semiconductor structures with high depth resolution in short acquisition times, without the expensive and time-consuming sample preparation required for e.g. TEM. In addition, PP-TOFMS offers improved depth resolution and a direct elemental information by detecting all elements in parallel during profiling.

This is in contrast to, for example, electrochemical capacitance-voltage (ECV) or cathodlouminescenc (CL), where only the indirect impact of composition on electrical (ECV) or optical (CL) properties is analysed. We demonstrate that PP-TOFMS is able to resolve the layer structure of semiconductor thin film samples on the nanometer scale at depths up to some microns and allows the determination of a relative elemental composition with an accuracy of about 10 rel. %. Several possible use cases in III-Nitride technology are demonstrated, ranging from the analysis of epitaxially grown LED-structures to the observation of modifications in metal-semiconductor contacts before and after rapid thermal annealing (RTA).

PP-TOFMS results are validated using numerous complimentary analysis techniques such as x-ray diffraction (XRD), scanning transmission microscopy (STEM) with energy-dispersive x-ray spectroscopy (EDX), as well as cathodoluminescence spectroscopy (CL). Our results clearly demonstrate the high potential of PP-TOFMS to become a valuable new tool for quality control of epitaxy and chip processing.

References

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