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Angle resolved X-ray spectrometry for dimensional and analytical nanometrology

Friday 30 August 2024 11:00 (20 minutes)

The rapid advancements in nanoelectronics have led to a profound increase in the complexity of three-dimensional nanostructures utilized in cutting-edge transistor architectures. As this complexity grows, the demand for precise metrology becomes paramount to ensure successful fabrication. X-ray fluorescence techniques, when employed in specific operational modes, emerge as a valuable tool, offering quantitative insights into semiconductor applications. Moreover, these techniques can be seamlessly integrated with metrology pads of typical sizes featuring homogeneous structures.
The implementation of reference-free XRF quantification schemes, alongside physically calibrated instrumentation and excitation spot sizes in the low micrometer [1] or even nanometer range [2], enables the quantitative determination of lateral elemental composition. Notably, this method surpasses electrons in terms of achievable information depth and can thus provide information about sub-surface features of nanoobjects, all achieved without the need for destructive sample preparation.
The application of Grazing Incidence [3] or Grazing Exit X-ray Fluorescence analysis [4] enhances sensitivity to sub-nanometer levels, allowing for precise measurement of dimensional properties in nanostructures. Critical parameters such as line widths or heights can be accurately determined through these techniques. Importantly, both approaches are non-destructive, offering statistically more relevant information compared to transmission electron microscopy, as they average over several nominally identical nanostructures.
In summary, we will show how employing advanced X-ray fluorescence methods can support navigating the intricate landscape of nanoelectronics metrology.

[1] P. Hönicke et al., Nanotechnology (2024) 35, 285702
[2] A. Wählisch et al., Small (2023) 19, 2204943
[3] P. Hönicke et al., Nanotechnology (2020) 31, 505709
[4] P. Hönicke et al., Small (2022) 18, 2105776

I plan to submit also conference proceedings

No

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