



Tutorial 2A: Materials Characterization for Semiconductor Manufacturing

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Integrated device manufacturing is a multi-step process (>1000 steps) that requires extreme control of any parameter that can impact the respective devices functionality and/or reliability (dimension, composition, strain, ...). This control is carried out via inline metrology and/or near-line/off-line materials characterization (*"if you can't see it, you can't control it"*). This talk will cover the primary materials characterization techniques used in the industry as applied to process control through to process development (manufacturing through to R&D). This will follow a short introduction to drivers and physical limits. Inline metrology capabilities will be covered in the talk following this presentation.

Measurement methods to be covered include:

- Microscopies such as:
 - TEM/SEM
 - SPM
 - APT
- Spectroscopies such as:
 - XPS
 - Raman/PL
 - EDX and EELS
- Spectrometries such as:
 - SIMS
- Diffraction based techniques such as:
 - XRD
 - Besel & NBD as used in TEM



Paul A. W. van der Heide is the Director of the Materials and Component Analysis (MCA) Department at imec, in Leuven, Belgium. The scope of MCA is to **a)** support the characterization needs of imec (capabilities include APT, Raman, RBS, SIMS, SPM, TEM, XPS, ...), and **b)** explore, develop and implement the characterization capabilities required for tomorrow's industry. Prior to moving to imec, Paul held positions at GLOBALFOUNDRIES, Malta, NY, USA (where he headed the end-to-end analytical labs support for high volume semiconductor device manufacturing and R&D), Samsung, Austin, TX, USA (where he established and managed the surface characterization labs for supporting high volume device

manufacturing), and the University of Houston, TX, USA (where he lectured in Physical Chemistry and Surface Analysis, while also managing the MRSEC SIMS-XPS facility). Paul earned a Ph.D. in Physical Chemistry from the University of Auckland, New Zealand (topic concerned the design and construction of a magnetic sector SIMS instrument), has authored over 150 publications in international peer reviewed journals, has presented ~20 invited and 2 plenary talks, and is sole author of two books published through Wiley.

- Secondary Ion Mass Spectrometry: An introduction to principles and practices, Wiley (2014), <http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118480481.html>
- X-ray Photoelectron Spectroscopy: An introduction to principles and practices, Wiley (2011), <http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118062531.html>