

Metrology for Advanced Transistor Devices and Materials

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Abstract:

In this talk, we discuss the measurement of materials and devices critical to the next generation of integrated circuits. Specifically, this presentation will cover measurements for new dielectric materials and nanowire/nanosheet transistors known as Gate – all – Around (GAA) transistors. As transistor dimensions shrink, the dielectric layer in the transistor gate must evolve to increase its dielectric constant. This is typically done by changing the crystal phase of so called High - K dielectric layers. The X-ray methods used to determine the phase of the material will be presented. Another difficult measurement challenges is non-destructively determining the feature dimensions and shape for complicated 3D structures. This presentation will also review Mueller Matrix Spectroscopic Ellipsometry based scatterometry which uses the Rigorous Coupled Wave Approximation (RCWA) to solve Maxwell's equations for a model structure and the resulting Mueller Matrix elements are compared to experimental results. Here we use the structures used in GAA transistors fabrication as an example of challenging measurements.(1, 2, 3) In this talk, we present simulations aimed at understanding the sensitivity to changes in feature shape and dimension for the structures used to fabricate GAA transistors. Simulations of the multi-layer fins show a clear sensitivity to fin shape and Si layer thickness which is enhanced by the use of the full Mueller Matrix capability vs traditional spectroscopic ellipsometry. We also discuss experimental measurement of nanowire test structure demonstrating the ability to measure the etching of multiple sub-surface features.