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### **Metrology Tools for Semiconductor Manufacturing**

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The nanoscale dimension of the devices and structures used to fabricate present and future generations of integrated circuits provide numerous challenges for measurement technology. There are two means by which measurement technology advance. First, existing measurement equipment often provides unexpected capability through advances in modeling and new applications. Examples of this include optical models for nanoscale materials for film thickness and X-Ray diffraction X-Ray reciprocal space maps (RSM) for measurement of SiGe/Si thin films and fin stress state and fin pitch. RSMs are sensitive to the key lithography issue of pitch walking. Pitch walking refers to the two pitch that occur when new double patterning lithography processes are used. The other means by which metrology advances is through new measurement equipment. An example of this is the Mueller Matrix spectroscopic ellipsometry equipment that is used for critical dimension measurement. Two examples of this will be shown including 3D shape and CD measurement of fins and measurement of structures fabricated using directed self-assembly of block co-polymers. This talk will cover the physical principles of the examples stated above as well as recent advances and breakthroughs in metrology.