

## **High Brightness Synchrotron Sources for X-ray Metrology in Semiconductor Manufacturing**

Richard J. Matyi

Colleges of Nanoscale Science and Engineering, SUNY Polytechnic Institute,  
Albany, New York

X-ray metrology techniques play an increasingly critical role in semiconductor industry research, development, and manufacturing. X-ray techniques are a natural choice for nanoscale metrology as they offer the ability to directly detect interactions with atoms and chemical bonds. These techniques can measure certain sample properties which are impossible by other means. X-ray technology is already used for many types of fab and lab metrology in the semiconductor industry, but is usually limited by throughput (speed) and spot size (i.e. the minimum achievable irradiated area on the sample surface). At present, usage of these techniques is either in a chip fab's failure analysis laboratory or in the cleanroom. In some cases samples must be sent out to synchrotron facilities as the required capabilities are not yet available, or practical, for commercial use at the fab. High brightness X-ray sources such as the NSLS-II provide improvements to traditional and emerging X-ray metrology techniques by increasing throughput to acceptable levels and reducing the test pad size requirements or spatial resolution by enabling smaller spot sizes. Additionally, they enable the development of new approaches to X-ray metrology. Here we will examine the range of both existing and emerging X-ray metrology approaches and tools by increasing throughput and decreasing the sample volume required for analysis. Metrology approaches (especially emerging ones) that have known dependencies on X-ray optical brightness (such as CD-SAXS) may warrant a renewed examination given the characteristics of the NSLS-II and similar high-brightness sources.