Spectroscopic Ellipsometry Technical Group
Room C124 - Session EL2-MoA

Instrumentation

Moderators: Alain Diebold, SUNY Polytechnic Institute, **Nikolas Podraza**, University of Toledo

4:00pm **EL2-MoA-8 Advancing Metrology in Semiconductor Manufacturing: Challenges and Novel Ellipsometry Techniques**, *M. Lee, **Wookrae Kim**,* Samsung Electronics Co., Inc., Republic of Korea **INVITED**

Manufacturers of semiconductor devices must ensure uniformity in the critical dimension (CD) for proper device functionality. Precision and accuracy in semiconductor metrology and inspection are crucial to accurately measure even the smallest details of semiconductor structures. Minor imperfections in the CDs can result in device malfunctions, highlighting the importance of maintaining high levels of precision.

Ellipsometry has been a powerful method used in high volume manufacturing to provide 3D information on sample structures and achieve high measurement throughput. However, the continuous evolution of semiconductor devices with new designs, high aspect ratio contacts, and smaller cell sizes has given rise to new metrology requirements, presenting various technical challenges. As a result, further advancements in standard ellipsometry techniques are needed to meet these requirements and overcome the challenges they pose.

There are several specific challenges that need to be addressed. Firstly, the decreasing cell size in DRAM and SRAM makes smaller metrology spot sizes critically important. Secondly, the required metrology sensitivity and precision specifications become more stringent in high volume manufacturing (HVM). In the case of VNAND devices, the new cell-on-peri architecture restricts the use of the full wavelength of light from the tool, and the increasing aspect ratio of contacts limits the application of critical angle illumination in spectroscopic ellipsometry. Additionally, the number of measurement points on a wafer increases exponentially for advanced devices, necessitating innovative solutions to enable massive measurements. Finally, the time required to develop regression models is a significant drawback, particularly during the research and development (R&D) period.

To overcome these challenges, researchers have been developing various innovative techniques. These include high throughput imaging ellipsometry for massive measurements, highly sensitive pupil ellipsometry, infrared (IR) ellipsometry, and small spot ellipsometry, among others. I will present an overview of the challenges faced by ellipsometry techniques in semiconductor manufacturing and review the recently introduced novel ellipsometry techniques.

4:40pm **EL2-MoA-10 Mid-Infrared Ellipsometry for High Aspect Ratio Semiconductor Process Control Applications**, ***Troy Ribaudo**,* Onto Innovation **INVITED**

Optical critical dimension metrology (OCD) has been a critical process control tool in the semiconductor industry for many years. Traditional OCD measurement platforms operate within the ultraviolet to near infrared spectral range and combine Mueller Matrix spectroscopic ellipsometry spectra with RCWA simulations of complex 3-dimensional models to effectively measure subwavelength geometrical properties. In recent years, challenges regarding sensitivity and parameter correlation performance metrics have reduced the efficacy of the technique, specifically for some key VNAND technology applications with high aspect ratio structures. This situation has been remedied through the development of a spectroscopic ellipsometer which operates in the mid-infrared part of the electromagnetic spectrum. In both the lab and the field, it has been proven to outperform the existing OCD technologies for a number of those important applications.

In this talk, we shall describe the theoretical considerations that led to the change of spectral range on this unique OCD platform. We will also show a performance comparison of the two classes of OCD systems on the already explored high aspect ratio applications as well as simulations showing performance estimates as VNAND technology continues to evolve.Finally, a description of the technology roadmap for the product line will be described.

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