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Flatness Measurement of Semiconductor Wafers Based on Frequency Scanning Interferometry

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Silicon (Si) and Silicon Carbide (SiC), as second and third-generation semiconductor materials, exhibit superior properties that make them highly suitable for high-temperature, high-voltage, and high-frequency applications. However, Si/SiC wafers are characterized by their thinness, high hardness, and brittleness, leading to significant challenges in the production process due to wafer warping and bending, which critically affect subsequent processing. Hence, the ability to rapidly, accurately, and comprehensively monitor and control the thickness, thickness variation, and flatness (including bow and warp) of SiC/Si wafers is a recognized challenge in the industry.To address these challenges, we have developed a frequency scanning interferometry-based system for measuring the flatness of semiconductor thin films. We propose a surface reconstruction algorithm based on an improved least-squares iterative method, identifying error sources such as harmonics and phase shifts, and enhancing the multilayer iterative optimization model to improve the accuracy and robustness of interferometric measurements. Additionally, we introduce the feasibility of an "oversampling" technique for semiconductor wafer measurements, enabling enhanced extraction of weak interference signals from multilayer structures. This approach mitigates the impact of multilayer surface harmonic aliasing on surface reconstruction, achieving high-precision, full-wafer, simultaneous measurement of both surfaces and thickness variations for different semiconductor materials.This paper further discusses the application and advantages of frequency scanning interferometry in measuring the thickness, thickness variation, and flatness of SiC/Si semiconductor wafers. It also explores the effects of different material properties and transmittance on the performance of frequency scanning interferometry.