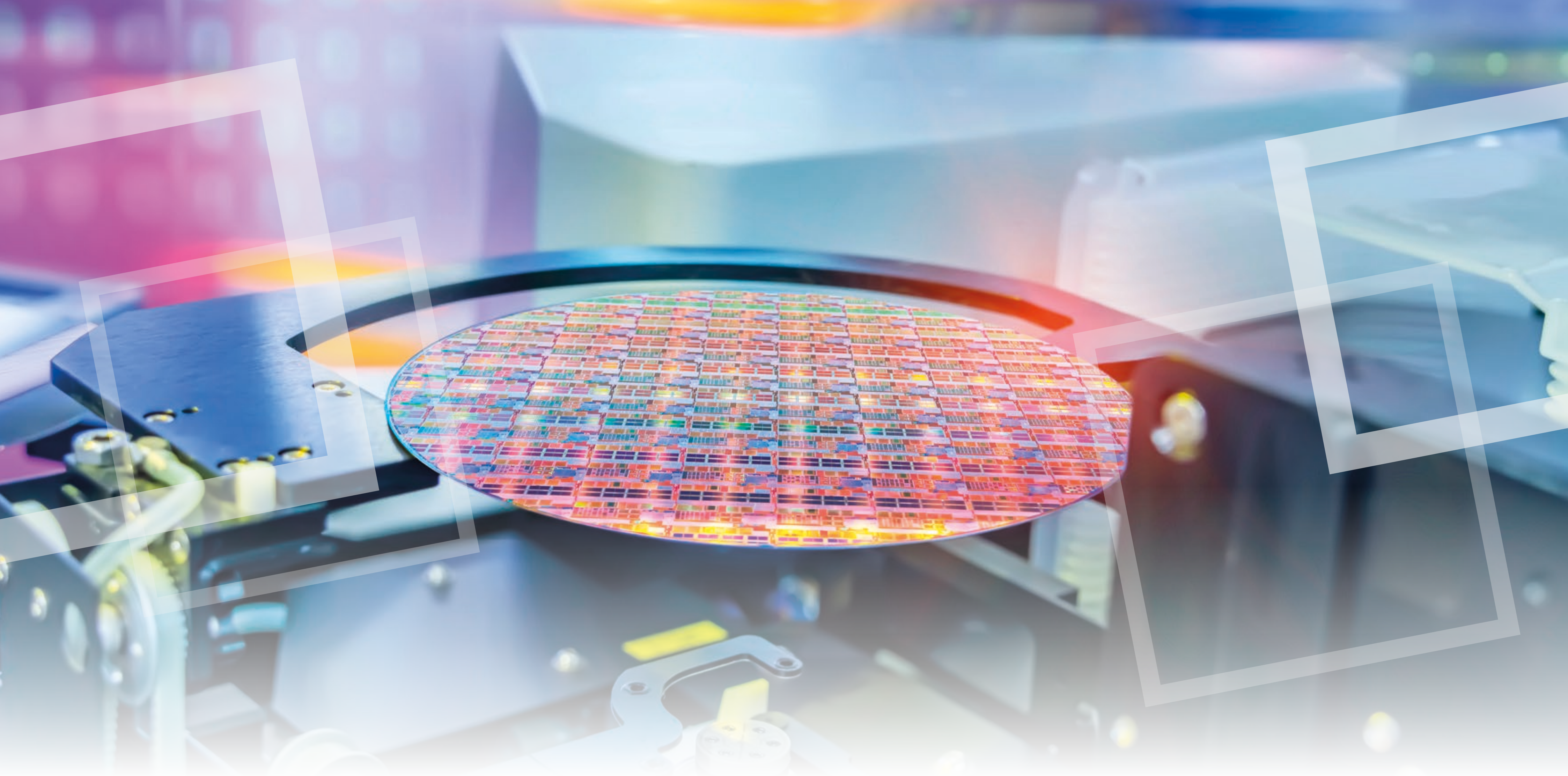


Semiconductor manufacturing

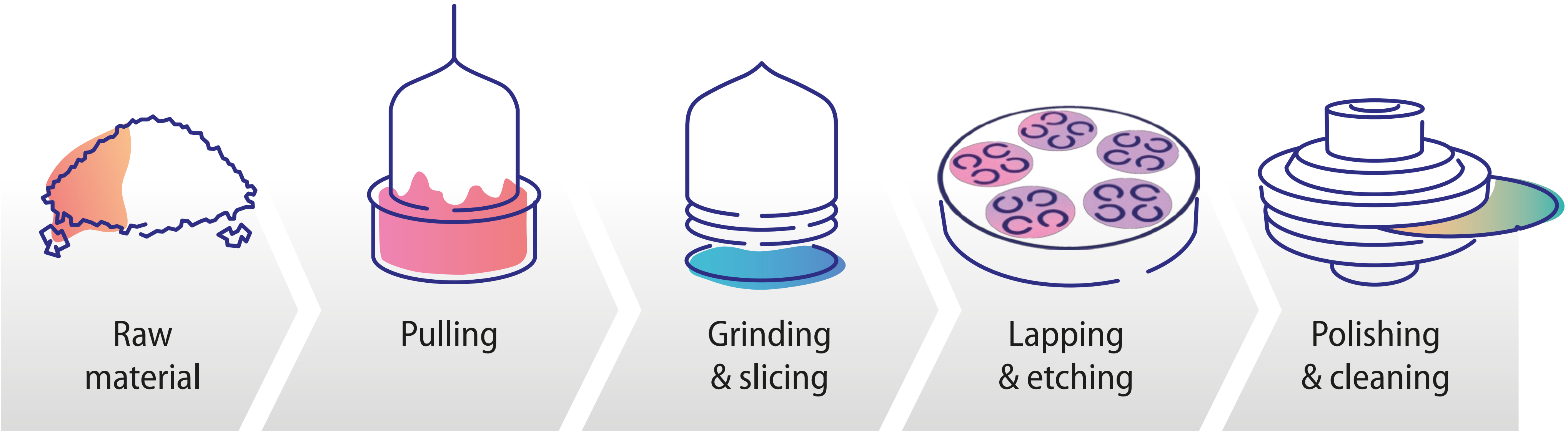
End-to-end metrology strategies for QC in the semiconductor industry

SENSOFAR

WAFER FABRICATION

To start with semiconductor device manufacturing, silicon or other substrate materials, such as silicon carbide (SiC) or diamond, are processed into highly uniform, defect-free wafers. These wafers are the foundation for building semiconductor devices and must meet strict requirements for purity, flatness, and cleanliness to ensure optimal performance in later manufacturing stages.

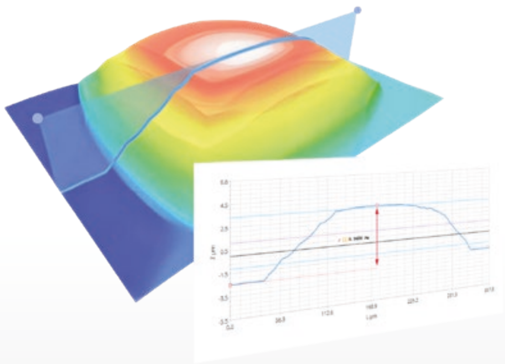
For silicon wafers, fabrication begins with crystal growth, where high-purity silicon is melted and formed into a single-crystal ingot. The ingot then undergoes grinding and slicing to shape it into precise dimensions before being cut into thin wafers. To remove saw damage and surface irregularities, wafers are subjected to lapping and etching, followed by polishing and cleaning to achieve a smooth, mirror-like finish.
This final process ensures that the wafers are free of contamination and defects, making them ready for front-end processing, where circuit structures are built onto the silicon surface.



RAW MATERIAL

Characterization of third-generation materials

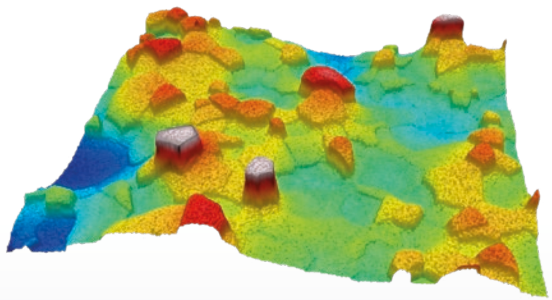
Third-generation semiconductor materials can withstand higher temperatures, voltages, and radiation levels, making them essential for advanced applications, especially in renewable energy and high-power devices. Some examples of these materials are Diamond, Silicon Carbide (SiC), Gallium nitride (GaN), and Halide Perovskite materials.



Diamond

Diamond is closely monitored for growth patterns that are critical to its performance.

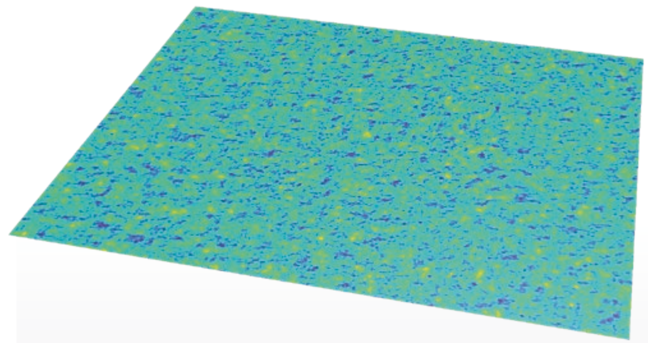
Morphological measurements, essential for assessing its structure, target precise dimensions often down to the micrometer or nanometer scale. Here, CSI technology proves invaluable—it excels at capturing details in surfaces with high aspect ratios and steep slopes, ensuring accuracy and minimizing measurement errors.



SiC

SiC wafers produced through Chemical Vapor Deposition (CVD) undergo topographical evaluation to assess the uniformity of lattice growth.

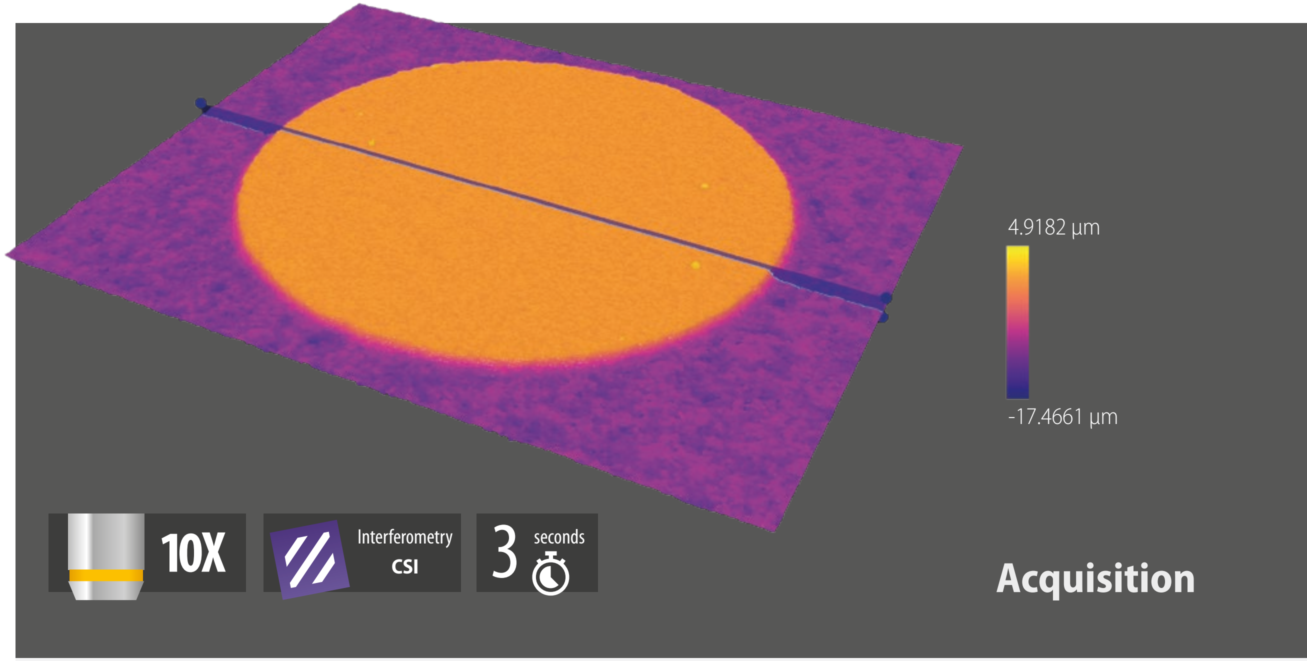
For this purpose, ePSI technology is especially effective, delivering high precision on ultra-smooth surfaces with varying heights. This approach provides essential insights that support quality control in SiC wafer production.

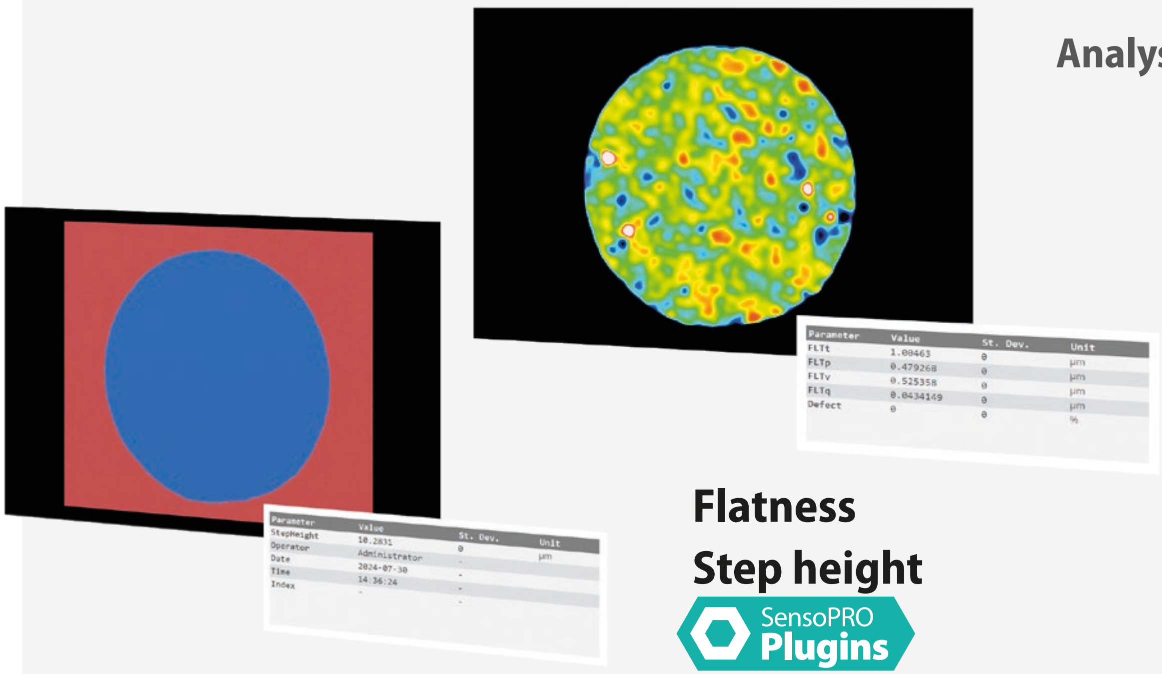


Perovskite

The surface roughness of perovskites is closely linked to the manufacturing quality.

For this exceptionally smooth material, PSI is the preferred measurement technique due to its low measurement noise, reaching as low as 0.01 nm.





RAW MATERIAL

Wafer loader flatness

Wafer loaders are essential equipment during wafer fabrication, and vacuum rings or suction cups are often used to grip the wafers securely. These structures are carefully designed to ensure even, uniform contact with the wafer. This prevents uneven gripping, which could cause the wafer to shift, vibrate, or even detach during handling. A uniform grip also avoids bending or stressing the wafer by applying consistent pressure across its surface.

Therefore, the flatness of the vacuum rings is crucial to the reliable performance of the wafer loader.

All vacuum rings must be at similar heights to ensure an even grip. Using CSI technology, the height of these rings can be measured in under 3 seconds to verify the uniformity of the group.

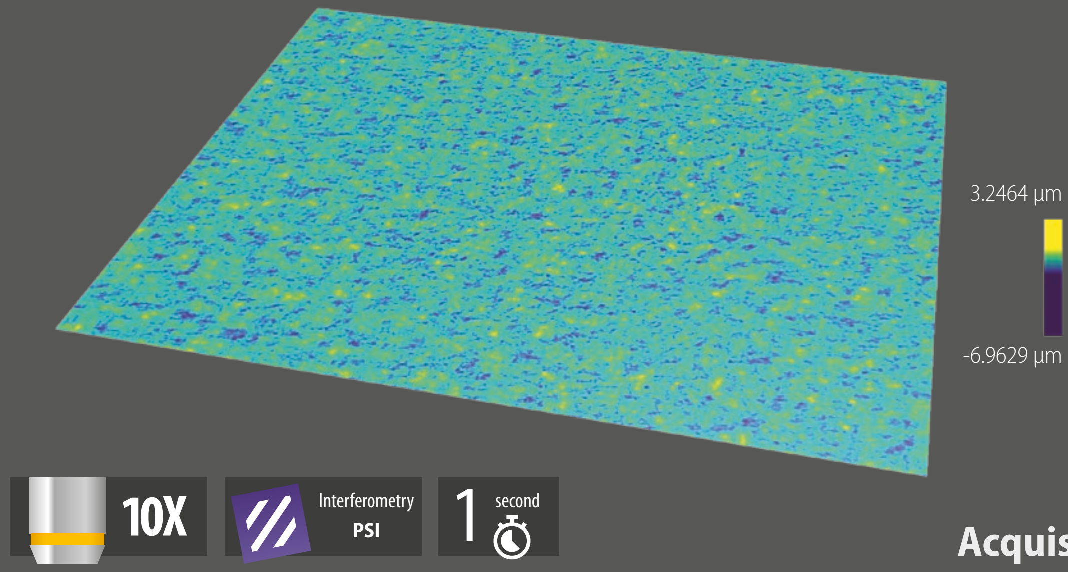
WAFER SURFACE PREPARATION

Wafer roughness

As wafers become thinner and more susceptible to surface imperfections, obtaining comprehensive, detailed, and accurate surface data is crucial to ensuring quality. At this stage of the manufacturing process, non-contact assessment is fundamental for quality control. It evaluates whether the bare wafer meets the necessary specifications and is fit to proceed to the next stages of production.

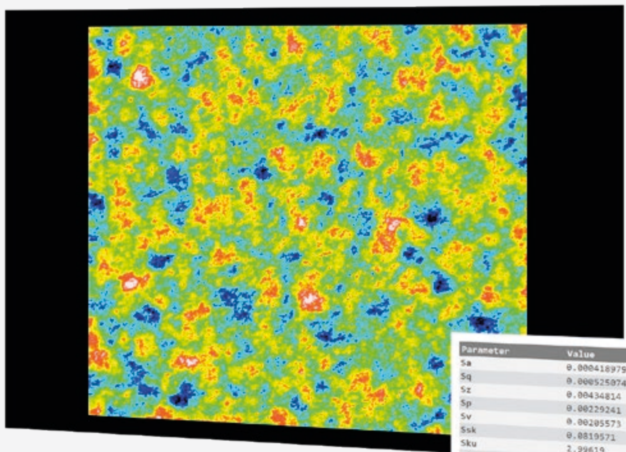
The surface finish of ultra-smooth surfaces, such as bare wafers, has roughness values on the nanometer and sub-nanometer scales. These roughness values must be measured with PSI technology, which has a mesurement noise as low as 0.01nm.

With our S neox, manufacturers obtain highly accurate results in seconds and use our analysis software to extract roughness parameters automatically. SensoVIEW and SensoPRO support multiple ISO standards, allowing for the extraction of key texture parameters in accordance with ISO 25178 and ISO 21290.



Acquisition

Analysis



Surface texture

SensoPRO Plugins

Parameter	Value	St. Dev.	Unit
Sa	0.000418979	0	µm
Sq	0.000525874	0	µm
Sz	0.00434814	0	µm
Sp	0.00229241	0	µm
Sv	0.00205573	0	µm
Ssk	0.0819571	0	
Sku	2.99619	0	
Sal	46.4328	0	µm
Str	0.834923	0	
Std	56.3	0	°
Sdq	0.000104958	0	
Sdr	5.57717e-06	0	%
S_ratio	1	0	
Smr	50.0783	0	%
Smc	0.000674906	0	µm
Sxp	0.00100877	0	µm
Sk	0.00137968	0	µm
Spk	0.000517429	0	µm
Svk	0.000469599	0	µm
Smr1	9.5585	0	%

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