Eliminating False Positives in Semiconductor Wafer Inspection

The critical need for low noise and power stability

Overview

Semiconductor wafer fabrication processes often produce unnecessary waste of materials and time due to inefficiencies in inspection.Laser noise, when used as a measurement method for wafer inspection, can be an incredibly accurate metrology process in such environments. However, variation in certain laser properties may falsely identify errors on the wafer, leading to the creation of false-positives, and therefore, an avoidable increase in rejections, and ultimately, wasted material and processing time.

This issue can largely be eliminated by utilising an ultra-low noise laser with long-term power stability and one that is designed specifically for such demanding 24/7 inspection applications.

Background

In high-end metrology applications, measuring feature size is a key metric in semiconductor process monitoring. An efficient method for performing this measurement is by rapidly scanning a laser line across a wafer substrate, using the laser as the probe. The reflected signal is subsequently measured, and laser noise, on interaction with the sample, indicates the feature size. The lower the laser noise, the higher the precision in accurately characterising the measurements of these features.

How is a low noise laser created?

Low noise specifications are achieved largely by designing a specific low noise cavity at the heart of the laser, working in tandem with an onboard electronic control subsystem designed specifically to support low noise. Novanta's Laser Quantum systems feature a patented, low noise cavity based on a SANOFF filtering technique. SANOFF is a selective mode-stripping function designed to reduce laser mode competition, leading to ultra-low noise specifications.

The electronic subsystem incorporates a series of further noise reduction features that operate in conjunction with the optimised cavity design in order to deliver high levels of signal purity and consistency. One such feature is a realtime feedback function, where the laser beam signal is monitored in realtime by an ultrafast photo diode. Any residual noise present in that signal is then compensated in real time at the pump diode, effectively cancelling out any residual noise peaks before they reach the sample. This function works together with the optical design to create an ultra-low noise laser that is able to actively, and intelligently maintain ultra-low noise levels irrespective of surroundings.

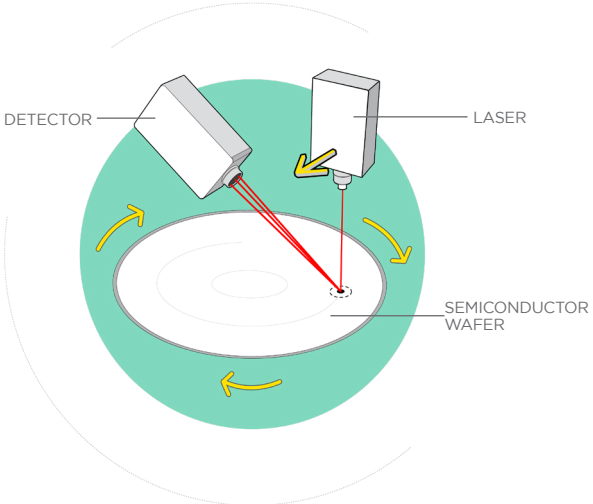

Figure 1: Showing the set up of semiconductor wafer inspection

Power Stability

High-level and long-term power stability in a laser is also a critical parameter in this application, with integrated realtime power feedback being a prerequisite of a reliable, consistent system. All Novanta Laser Quantum lasers are designed with an advanced power management architecture designed to feedback micro fluctuations in power to the controller, enabling power stability to remain constant. The ability to customise the automation of this feedback loop affords OEMs the ability to perform micro adjustments from PID settings in order to precisely manage dead band issues in the most demanding applications.

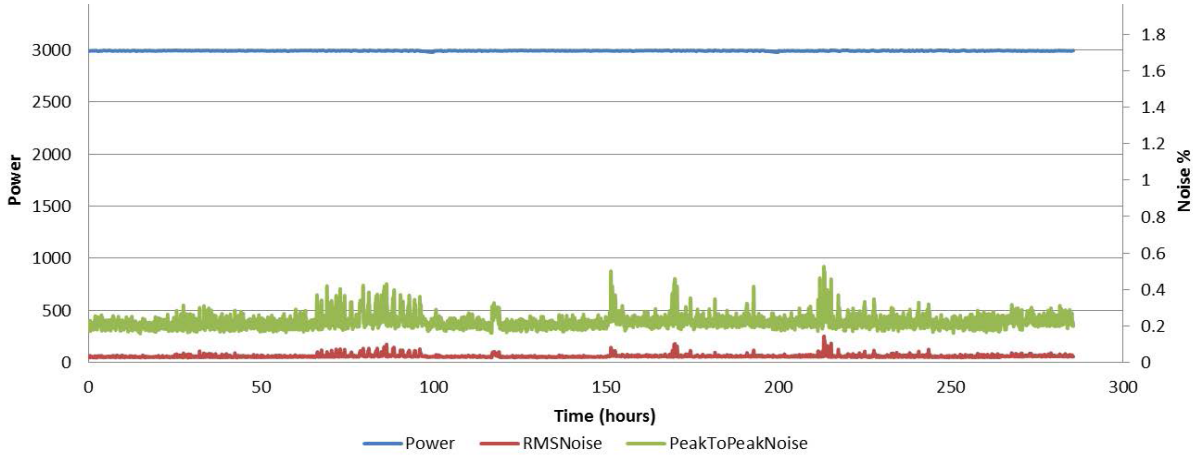

Figure 2: Showing the set up of semiconductor wafer inspection

Reliability

As a lead function within a mission critical application, the laser system must be capable of delivering reliable consistency. Novanta is a manufacturer of embedded OEM systems, and every system is designed to deliver this mission critical performance as standard. Every laser manufactured is subjected to a rigorous testing regime that simulates a wide variety of demanding performance environments including temperature cycling and vibration testing amongst many more. It is one of the many design philosophies within Novanta that its laser systems are tested under higher power cycling conditions in order to ensure that additional power can be made available when necessary, and to ensure a long lifetime of consistent performance.

The axiom laser system features all the technology described in this application paper making it ideally suited to the most demanding applications where power stability, low noise and consistent performance are required.

Interested in speaking to one of our knowledgeable representatives?

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