

Powering Process & Reliability Improvements in Semiconductor Manufacturing

Semiconductors are famous for their exceptional production challenges. Process engineering is performed at the nanoscale, the tiny devices are manufactured in thousands of steps in sterile cleanrooms, potentially harmful gaseous chemicals are involved, market growth is constant, and quality assurance is an imperative due to the nature of their applications. Effectively managing the demands and mitigating weaknesses requires advanced intelligence.

Semiconductor processing chips are embedded in places where high accuracy and reliability are expected, such as computers, smartphones, automobiles, energy systems, and solar cells. Their fabrication consists of many steps, from producing, oxidizing, and etching the wafer to depositing hundreds of thin films on the wafer to form the components of the electrical circuit. Afterward, the completed integrated circuits are sent to a back-end packaging facility for assembly and testing. Several points in this process would benefit from Tignis' physics-driven analytics platform.

Since every semiconductor analytics use case varies to some extent, the software platform encapsulates all the components necessary to build custom "intelligent" solutions, quickly and reliably, right on the premises. Tignis also offers schemas and models designed specifically to support the semiconductor industry. For instance, fabricators can license the platform to build their custom analytics solution across their entire manufacturing process; tool makers can license the platform to provide tool or tool cluster analytics; and fabless semiconductor companies can analyze results from their fab partners.

Importantly, semiconductor companies can retain full control over their data. The platform can be deployed either on the fab floor, in a private cloud, or in a public cloud.

Game-changing AI/ML and Digital Twins

Artificial intelligence (AI) and machine learning (ML) provide the power behind Tignis analytics. The solution automatically collects available machine or system data, learns usage patterns, identifies anomalies, and alerts the right people who can quickly troubleshoot and correct the condition. Furthermore, from a digital twin of the connected asset or system, users can virtually test and improve corrections, changes, and predictions about future performance before moving forward.

"Increase your process efficiency, quality, and yield through Tignis AI and ML product suite."

Tignis has been helping the semiconductor industry with applications such as:

Process Control

Hundreds if not thousands of parameters must be controlled on each process step for a single wafer. Determining the optimal settings for each step using physical models typically involves manually solving equations and running computationally slow simulations. Tignis harnesses the power of digital twins to control semiconductor process equipment and provide simulation-quality decisions in real time for every wafer.

Using ML technology, it builds a surrogate digital twin model from a high-fidelity simulation such as a finite element model. This surrogate model emulates the simulation in milliseconds instead of minutes or hours, enabling a machine to explore possible outcomes and optimize all the parameters in real time. It then continuously improves by learning from post-process measurement study, or metrology.

Yield Monitoring

The percentage of functional chips on a wafer determines its productivity. Tignis helps to determine why some chips fail by pulling and analyzing all the data for the components that could potentially affect the process, such as which lithography machine and chamber it went through, who was the operator, and what were the environmental conditions at the time. AI and digital twin technology help to understand, monitor, and diagnose yield problems so they can be quickly corrected.

And Beyond!

Further opportunities include monitoring semiconductor facility utilities to ensure the air inside keeps perfectly clean, cool, and clear of hazardous byproducts, as well as to maximize energy efficiency. The advanced analytics offered by Tignis can provide a sustainable path to overcome these and other semiconductor business challenges.

Predictive and Prescriptive Maintenance

Semiconductor fabrication equipment is very specialized and can cost from \$5 million to \$300 million per machine. When maintenance is needed, experts who work at other companies are often flown in from other countries for repairs. The costs of unplanned downtime are extended when service is delayed, such as when travel restrictions include quarantines. Tignis enables early intervention for issues that would otherwise cause downtime.

Tignis analytics automatically detect degrading asset and system conditions, providing time for predictive maintenance to avoid failures and increase the useful life of critical assets. The analytics improve over time with ML, enabling faster condition detection and root cause analysis, improved self-diagnosis, and more-precise prescriptive recommendations to reduce the mean time between failures (MTBF).

See what Tignis can do for your business.

For more information on applying analytics to your 24/7 monitoring data, visit www.tignis.com.