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Technical Article

Semiconductor manufacturing: how piezoelectric sensors improve quality and yield

Semiconductors are essential in everyday devices such as smartphones and computers, as well as in many industries such as automotive and medtech. As key for digitalization and electrification, semiconductor manufacturing must meet the ever-increasing demands of miniaturization, new materials and new production processes. To maintain and improve yield and quality manufacturers rely on tight process control. As force is a critical physical production value, real-time dynamic force measurement based on piezoelectric sensors is crucial for achieving efficiency gains.

Semiconductors are not all developed with the same requirements in mind: While AI microchips for smartphones need to be as small and powerful as possible, power semiconductors for cars need to be able to function at extreme temperatures and last for a long time. No matter what they are used for, producing them is increasingly difficult due to miniaturization, new materials and production processes. One factor that can impact yield is mechanical stress. Caused by semiconductor production processes like grinding, sawing, CMP, bonding, handling and testing mechanical stress can result in fine cracks or other microscopic defects on both wafer and microchip. Dynamic force measurement featuring piezoelectric sensors has proven to be essential for keeping mechanical stress in check. Measuring force is an opportunity for optimization, minimizing the influence of disruptive factors and increasing efficiency without sacrificing the finished microchips' performance and power. Production processes like bonding need to control force, temperature and displacement.

Optimizing semiconductor manufacturing with piezoelectric sensors

Thanks to piezoelectric sensor technology, dynamic force measurement solutions from Kistler provide exceptionally precise measurement data. The piezoelectric sensor operates as follows: when a mechanical force is applied to the piezoelectric material, it generates an electrical charge that is directly proportional to the applied force. By measuring this force, manufacturers can achieve highly accurate measurements across a wide force range from 0.1 N to 100 kN.

Advantages of piezoelectric sensors in semiconductor manufacturing:

- Precision and reliability: Exact and repeatable measurements
- Sensitivity: capable of detecting small forces
- Robustness: long-lasting performance (24/7)
- Digitalization: supports modern Ethernet network

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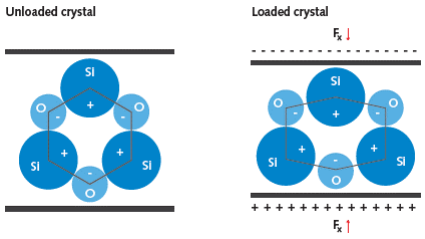
- Regulatory compliance: operates in cleanroom environments, vacuum, magnetic fields and fulfills standards

The piezoelectric sensor meets the requirements of the semiconductor industry, offering a reliable measurement solution. The key to optimizing semiconductor production processes is to work with experts in dynamic force measurement right from the start. If you are not familiar with piezoelectric measurement, we are happy to assist you with the selection of measurement chains, their integration and, if required, helpful services. Feel free to contact us!

Image material (please name the Kistler Group as picture source)



Piezoelectric sensors are based on piezoelectric (PE) materials such as quartz crystals that generate an electrical charge in response to a mechanical load.

Piezoelectric measurement technology from Kistler ensures high-resolution monitoring and control of the forces applied during semiconductor manufacturing processes – no matter how small. All the components of the piezoelectric measuring chain are available from Kistler, the one-stop shop.

Ever smaller and, at the same time, more efficient and more powerful: microchips have to meet increasing expectations. Therefore, process reliability has to meet growing requirements. The key to these challenges: dynamic force measurement.

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About the Kistler Group

Kistler is the global market leader for dynamic pressure, force, torque and acceleration measurement technology. Cutting-edge technologies provide the basis for Kistler's modular solutions. Customers in industry and scientific research benefit from Kistler's experience as a development partner, enabling them to optimize their products and processes so as to secure sustainable competitive edge. Unique sensor technology from this owner-managed Swiss corporation helps to shape future innovations not only in automotive development and industrial automation but also in many newly emerging sectors. Drawing on our extensive application expertise, and always with an absolute commitment to quality, Kistler plays a key part in the ongoing development of the latest megatrends. The focus is on issues such as electrified drive technology, autonomous driving, emission reduction and Industry 4.0. Some 2,200 employees at more than 60 facilities across the globe are dedicated to the development of new solutions, and they offer application-specific services at the local level. Ever since it was founded in 1959, the Kistler Group has grown hand-in-hand with its customers and in 2023, it posted sales of CHF 465 million. About 9% of this figure is reinvested in research and technology – with the aim of delivering better results for every customer.

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