

TLS-Dicing®

ENABLING DICING TECHNOLOGY FOR FAST, CLEAN, AND COST-EFFECTIVE WAFER DICING

TLS-Dicing® (Thermal Laser Separation) is a unique technology that uses thermally induced mechanical forces to separate brittle semiconductor materials, such as silicon (Si), silicon carbide (SiC), germanium (Ge), etc., into dies with outstanding edge quality while increasing manufacturing yield and throughput. Compared to other separation technologies, TLS-Dicing® enables a clean process, micro-crack-free edges, and higher resulting bending strength.

As TLS-Dicing® is capable of dicing speeds of up to 400 mm per second, it might increase the process throughput tenfold. This enables true high-volume production processes, especially for SiC-based devices.

In addition, TLS-Dicing® reduces the dicing cost per wafer by up to an order of magnitude or more compared to other wafer dicing approaches.

SiC chip - 110 µm thick

Si chip - 380 µm thick

TLS-Dicing® Process

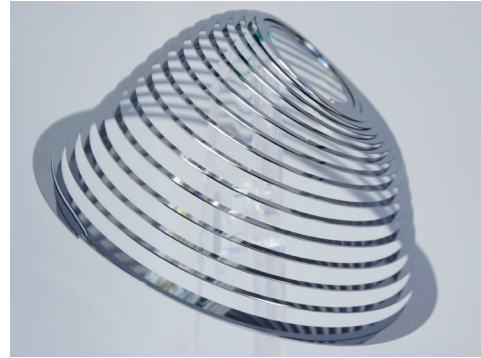
TLS-Dicing® is a laser-based cleaving process that provides:

Perfect edge quality of diced chips

- Nearly no chipping and micro-cracks
- Highest bending strength for silicon
- Best electrical characteristics

Cost advantages and efficiency

- High-throughput due to high process speed
- Low-cost of ownership due to no tool wear and minimal consumables
- Zero-kerf cleaving with nearly no particle generation

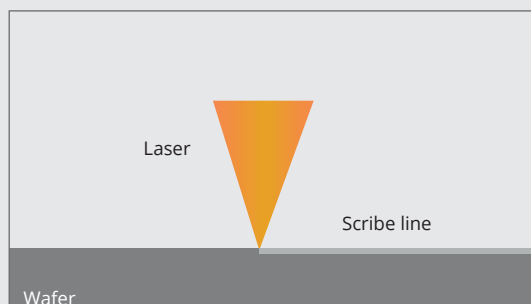


Demonstration of bending strength for Si

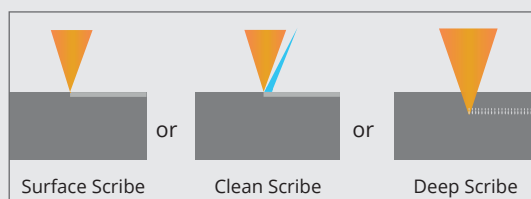
TLS-Dicing® is a two-step separation process to cleave brittle semiconductor materials.

Step 1 - Scribing to target the cleaving direction

Different scribing technologies can be used to increase the straightness of the TLS cleaving line in semiconductor dicing: For SiC wafers a continuous **Surface Scribe** or a so-called **Clean Scribe** that removes particles in situ can be used. However, for silicon wafers there are higher requirements regarding particles and bending strength. Therefore, a continuous scribe, which is performed beneath the surface is used. This technology is called **Deep Scribe** and minimizes effects on the edges of the cut dice.

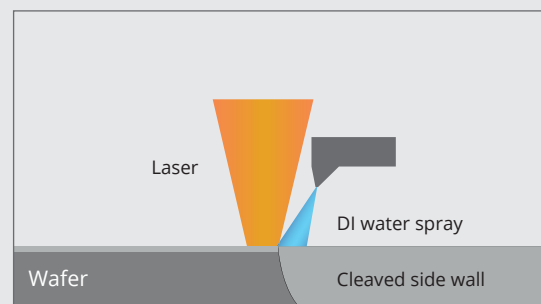


Methods of Scribing:

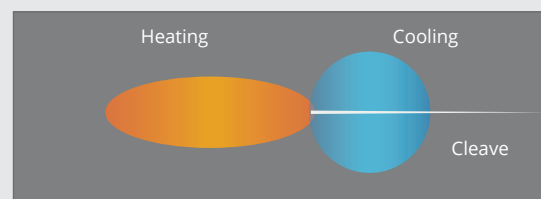


Step 2 - Cleaving for complete wafer separation

With TLS-Dicing® the wafer is cleaved along the dicing street that has been defined by the scribing process (step 1). The cleaving is initiated by a continuous-wave laser that locally heats up the material and thus thermally induces mechanical stress. Immediately afterwards, a water aerosol cools down the material. This temperature gradient introduces a tensile stress that is capable of running one controlled cleave independent of the lattice plane through the material. This cleaving process results in high edge quality without scratches, micro-cracks or chipping, and runs with up to 400mm/s. The complete wafer material is fully separated by one laser pass.



Top view:



Principle of TLS-Dicing®