Laser Application

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<th>Ablation Process</th>
<th>DFL7161</th>
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<td>DFL7341</td>
<td>DFL7360FH</td>
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<td>Laser Lift-Off</td>
<td>DFL7560L</td>
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**Ablation** is a method that sublimes and vaporizes a narrow gap in a workpiece by irradiating it with a very strong laser for a short period of time.

- Little or no heat damage to the workpiece
- Non-contact processing with a low impact and load
- Ideal for hard workpieces that are very difficult to process
- Able to process fine streets less than 10 µm in width (depending on workpiece conditions)

**Application Examples**

**Low-k Film Grooving**
- Inhibits delamination (film peeling)

**Sapphire Scribing**
- Improves CoO with a shape recognition function for broken wafers and with multiple-mounted wafer processing
- Realizes stable processing while restraining sapphire brightness deterioration

**Laser Full Cut**
- Increases the number of die per wafer by street reduction
- Improves the feed speed (compared to blade dicing)

**Si-DAF cut**
- High quality cutting of DAF (Die Attach Film)
Stealth dicing, a new Kiru technology, provides high-quality, high-speed wafer processing of MEMS devices and thin wafers.

**What is stealth dicing?**

Stealth dicing is a processing method that forms a modified layer in the workpiece by focusing a laser inside the workpiece, and then separates the die using a tape expander.

- Able to control processing waste because it modifies the internal part of the workpiece, making it suitable for workpieces that are vulnerable to contamination
- A dry process that does not require cleaning, making it suitable for processes that are vulnerable to loading (e.g., MEMS)
- Greatly contributes to street reduction because the kerf width can be made extremely thin

**DISCO’s stealth dicing laser saws incorporate an SD engine which has a modularized laser and dedicated optical system. The SD engine was developed for DISCO by HAMAMATSU Photonics K.K.**

### Application Examples

**Silicon wafer**
- [Cross-section photograph]
- SEM x50
- Feed speed: 30 mm/s, 1 pass
- Wafer thickness: 100 µm

**Sapphire**
- [Cross-section photograph]
- 5X4 x200
- Wafer thickness: 90 µm

**GaAs**
- [Top view photograph]
- 5X4 x100
- Wafer thickness: 100 µm

**MEMS**
- [MEMS die] (image)

**Glass**
- [Cross-section photograph]
- SEM x50
- 700 µm thickness

**LiTaO3**
- [Cross-section photograph]
- SEM x100
- 350 µm thickness
Delamination (film peeling) can be a problem when blade dicing of wafers with low-\(k\) film. Laser grooving, which has no mechanical load, can be used to achieve high-quality processing with minimal delamination, thereby contributing to higher productivity. DISCO laser grooving is also used in applications where the metal layer (TEG, wiring, circuits, etc.) is removed along the dicing street.

**Low-k Film & Metal Layer Grooving**

Delamination (film peeling) can be a problem when blade dicing of wafers with low-\(k\) film. Laser grooving, which has no mechanical load, can be used to achieve high-quality processing with minimal delamination, thereby contributing to higher productivity. DISCO laser grooving is also used in applications where the metal layer (TEG, wiring, circuits, etc.) is removed along the dicing street.

**Low-k Film Grooving Examples**

Performing laser grooving prior to blade dicing enhances the quality and throughput when processing low-\(k\) film wafers.

Combining laser grooving and stealth dicing achieves significant street reduction.

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**Laser Grooving**

A processing method that forms a narrow groove in the cut street using a laser.

Laser grooving is suitable for wafers with low-\(k\) film (low dielectric constant) commonly used for the miniaturization of semiconductor devices. After forming a narrow groove with a laser in these difficult-to-cut materials, the die are separated using a blade or laser dicing.

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**Scribing on Hard-to-Cut Materials + Breaking**

The materials below, which are difficult to cut with a blade, can now be made into die by laser scribing followed by breaking.

- Aluminum nitride used in heat sink materials
- Gallium nitride used in laser diode materials
- Alumina ceramics, SiC, etc.

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**Laser Full Cut**

A method that completely cuts the workpiece only with a laser process.

A laser full cut is effective for thin silicon, compound semiconductors, wafers with backside metal film, and metals (Cu, molybdenum), and normally cuts into the tape by irradiating a laser for one to several passes on the patterned surface. This method realizes high-speed, high-quality processing and significant street reduction by focusing the laser beam on a spot less than 10 \(\mu\)m in diameter. This laser process also enables a Si + DAF (Die Attach Film) full cut.

**Thin Silicon Wafer Full Cut**

This process realizes high quality, high-speed full cutting with a laser on thin silicon wafers that are very difficult to process.

**Compound Device Full Cut**

Previously, when processing compound semiconductors such as GaAs and SiC, high productivity could not be achieved since it was difficult to increase the feed speed in the existing blade dicing. The non-contact and low-load laser process enables high-speed, high-quality processing.

**Si + DAF Full Cut**

Uncut DAF (whiskers) tends to occur when dicing DAF with a blade. Laser cutting can significantly reduce this.

**Metal Full Cut**

The laser enables high-quality and high-speed full cuts of metals such as Cu and molybdenum used in high-brightness LED substrates and heat sink. The kerf loss can also be reduced.
What is a Hasen cut?

A processing method involving laser irradiation in a broken (dotted) line.

In a Hasen cut, the laser can be turned on and off at any point to process workpieces with different die sizes and polygonal-shaped workpieces, supporting a wide range of applications.

Processing Polygonal-Shaped Die

Linear processing can be combined to enable processing of hexagonal, octagonal, and other polygonal shapes.

Continuous polygonal-shaped die are processed by combinations of linear processing.

Multi-project Wafer (MPW) Processing

Processing is also possible for sample wafers, evaluation wafers, and other wafers with varying sized die. Processing is even possible for wafers where the die are offset in order to increase the yield of long or other irregular-sized die.

Synergetic Effect by Combining Stealth Dicing and the Hasen Cut

Processing is possible for sample wafers, evaluation wafers, and other wafers with varying sized die. Processing is even possible for wafers with long or other irregular-sized die where the die are offset in order to increase the yield.

DBG + DAF Laser Cut

What is a DBG + DAF laser cut?

A process that cuts the DAF with a laser after the DBG process.

The DBG (Dicing Before Grinding) process, which separates die during backgrinding after half-cut dicing, lowers backside chipping, improves die strength, and is expected to lower the risk of damage in thin wafers. The DBG + DAF cut process attaches DAF to the backside of a wafer for which the die were separated in the DBG process, and then cuts only the DAF. Laser DAF cutting is effective because it can process shifted die and improves processing quality. When DAF is applied to the DBG process, it is possible to use DBG in the production of the ultra-thin die used in SiP.
A water-soluble protective film that prevents thermal adhesion of the protective film and contributes to increased yield.

Laser processing particles (debris) generated during the ablation process cannot be removed by deionized water cleaning once attached to the wafer surface. Debris causes device defects such as bonding defects and increased current leaks. HogoMax, an original water-soluble protective film developed by DISCO, contributes to the improved reliability of devices when applied to the processing surface before laser processing by greatly reducing the adhesion of debris. Moreover, HogoMax003 can be applied evenly and prevents thermal adhesion of the protective film, contributing to a boost in yield.

Prevents Debris Adhesion on the Wafer Surface

- Coating the laser processing surface with HogoMax prevents adhesion of debris during processing.
- Due to the superior processability by UV laser, the protective film surrounding the processing point does not peel.
- The film can be removed after laser processing just by cleaning with deionized water.

Best Suited for Laser-Processing on a Concave/Convex Wafer

- With conventional products, the protective film between bumps becomes thin due to surface tension, causing coating irregularities. Thermal adhesion occurring at thin areas of the protective film during processing and causing stains is also an issue.
- HogoMax003 eliminates coating irregularities between bumps and prevents thermal adhesion.

Full-Auto Processing From Coating to Cleaning

- HogoMax makes it possible to process fully automatically from HogoMax coating to laser processing and deionized cleaning. (Applicable models: DFL7161, DFL7160)

Laser Lift-Off

A method that detaches the material layer from the substrate by irradiating a laser on the material layer formed on the substrate.

Laser lift-off is a process for peeling substrates made of sapphire or glass. It is used for peeling off the sapphire substrate from the crystal layer of GaN (gallium nitride) compound materials, which are primarily used for making vertical structured blue LEDs.

High-Yield and Low-Running-Cost Manufacturing

- Employs a solid-state laser to save a significant amount of maintenance time (reducing the frequency of replacing consumable products and adjusting the optical axis), achieves stable processing quality, and improves productivity.
- Employs DISCO’s original optics system to process at an extensive focal range with optimal power. This suppresses wafer damage and minimizes detachment failures. In addition, the surface roughness after detachment becomes one-third of the current value.

Example of Applicable Processes: Sapphire Substrate Detachment for vertical structured-LED

- The light emitting layer is remounted on a highly exoergic conductive substrate for the purpose of improving brightness and better heat sink. Laser Lift-Off is used in this sapphire substrate detachment process.
## 7000 Series Specifications

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<thead>
<tr>
<th>Processing method</th>
<th>DFL7161</th>
<th>DFL7160</th>
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</thead>
<tbody>
<tr>
<td>Workpiece size</td>
<td>mm</td>
<td>φ 300</td>
</tr>
<tr>
<td>X-axis (Chuck table)</td>
<td>Processing range mm</td>
<td>310</td>
</tr>
<tr>
<td>Max. processing speed mm/sec</td>
<td>1 - 1,000</td>
<td>0.1 - 600</td>
</tr>
<tr>
<td>Y-axis (Chuck table)</td>
<td>Processing range mm</td>
<td>310</td>
</tr>
<tr>
<td>Index step mm</td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td>Positioning accuracy mm</td>
<td>0.003/310 (Single error)0.002/5</td>
<td>0.003/310 (Single error)0.002/5</td>
</tr>
<tr>
<td>Z-axis</td>
<td>Moving resolution mm</td>
<td>0.000015</td>
</tr>
<tr>
<td>Repeatability accuracy mm</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>θ-axis (Chuck table)</td>
<td>Max. rotating angle deg</td>
<td>330 (standard)</td>
</tr>
</tbody>
</table>

**Processing method:** Ablation

**Fully automatic**

| Machine dimensions (W×D×H) mm | 1,560 × 1,550 × 1,800 | 1,200 × 1,550 × 1,800 |
| Machine weight kg | Approx. 2,300 | Approx. 1,750 |

### Environment Conditions
- Use clean, oil-free air at a dew point of -15°C or less, and residual oil content 0.1 mg/m³ or less, and filtration rating 0.01 μm/99.5% or more.
- Keep room temperature fluctuations within ±1°C of the set value (between 20 and 25°C).
- The equipment should be used in an environment free from external vibration. Do not install equipment near a ventilation opening, heat-generating equipment, or oil mist generators.
*The above specifications may change due to technical modifications. Please confirm when placing your order.*
*All pressures are described using gauge pressure.*

### Safety Precautions
- This product uses invisible laser. Please handle with extreme care.
- Avoid eye or skin exposure to direct or scattered laser light.
- Do not place reflective objects such as metals in the laser path.
- This product includes a built-in oscillator considered a Class 4 laser product under JISC 6802 “laser product safety standards” but meets safety standards such that it can be used as a Class 1 laser product.
- Before using the equipment, thoroughly read and follow the instructions set forth in the manual.
- Never attempt to modify or repair the equipment in a manner not designated in the manual.