EPIC Annual General Meeting 2024

DISCO Corporation
Benjamin Bernard

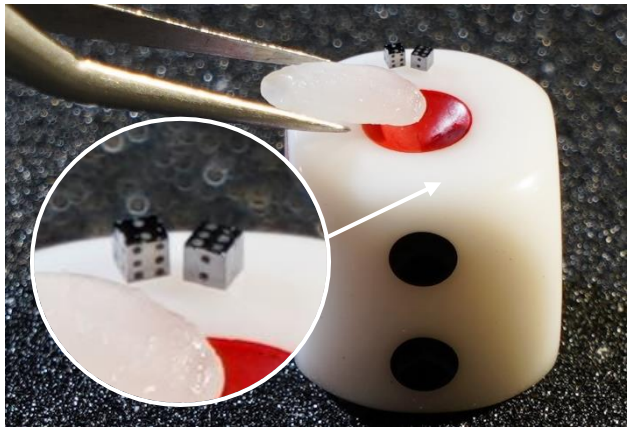
DISCO´s Mission

Bringing faraway science to comfortable living
through advanced Kiru, Kezuru, Migaku technologies

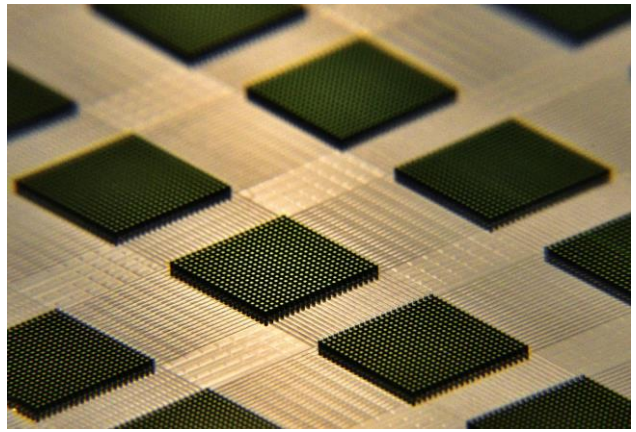
Universal Technologies

Kiru ・ Kezuru ・ Migaku

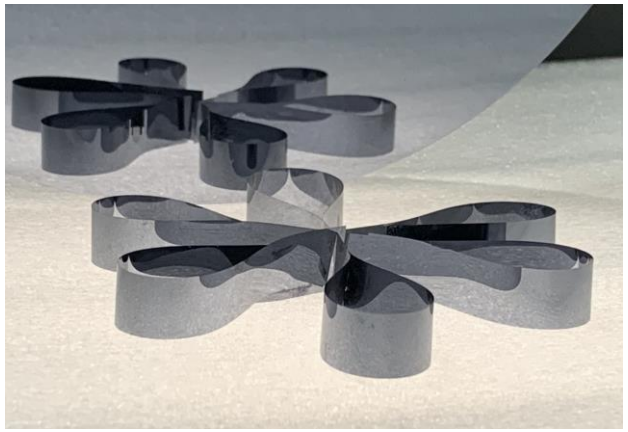
Cutting Grinding Polishing



The silicon dice with laser processing cut and drilled by DFL7560.



Tiny Silicon pillars produced by mechanical dicing saw. Each post has a slightly offset via with around 10um diameter.



Showing Bending Capabilities through Stealth Dicing Before Grinding, Si wafer, 30umt.

Office and Plants in Japan

Tokyo Head Office/ R&D Center(Tokyo)

Haneda R&D Center(Tokyo)

Kuwabata plant (Hiroshima)

Kure plant (Hiroshima)

Chino plant (Nagano)

DISCO's WORLDWIDE NETWORK

Cumulative sales

over 59,455 units

56 sites

Affiliate / Agent

As of Feb, 2022

5,916

Employees

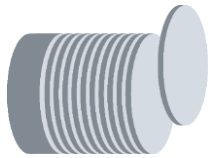
As of Sep, 2022

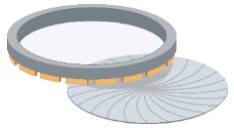
※ Includes permanent/contract employees only

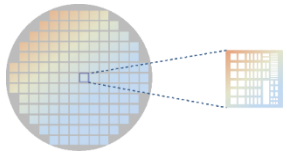
DISCO Technologies

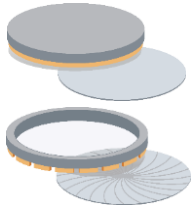
Wafer manufacturing process | Device manufacturing process (Front end) | Device manufacturing process (Back end)

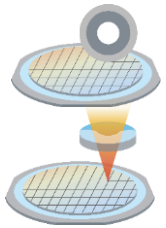
Slicing from ingot — Grinding — Patterning — Thinning/ Polishing — Wafer singulation — Assembly/ Packaging — Package singulation

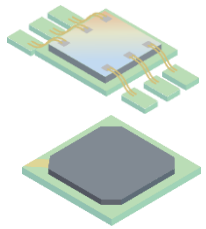


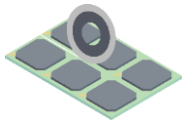












Kiru — **Kezuru** — **Migaku** — **Kezuru** — **Kiru** — **Kiru**

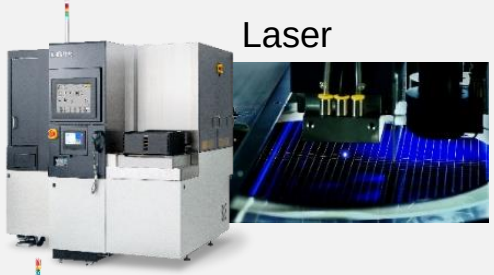
Splitter & Grinder

Grinder

Polisher

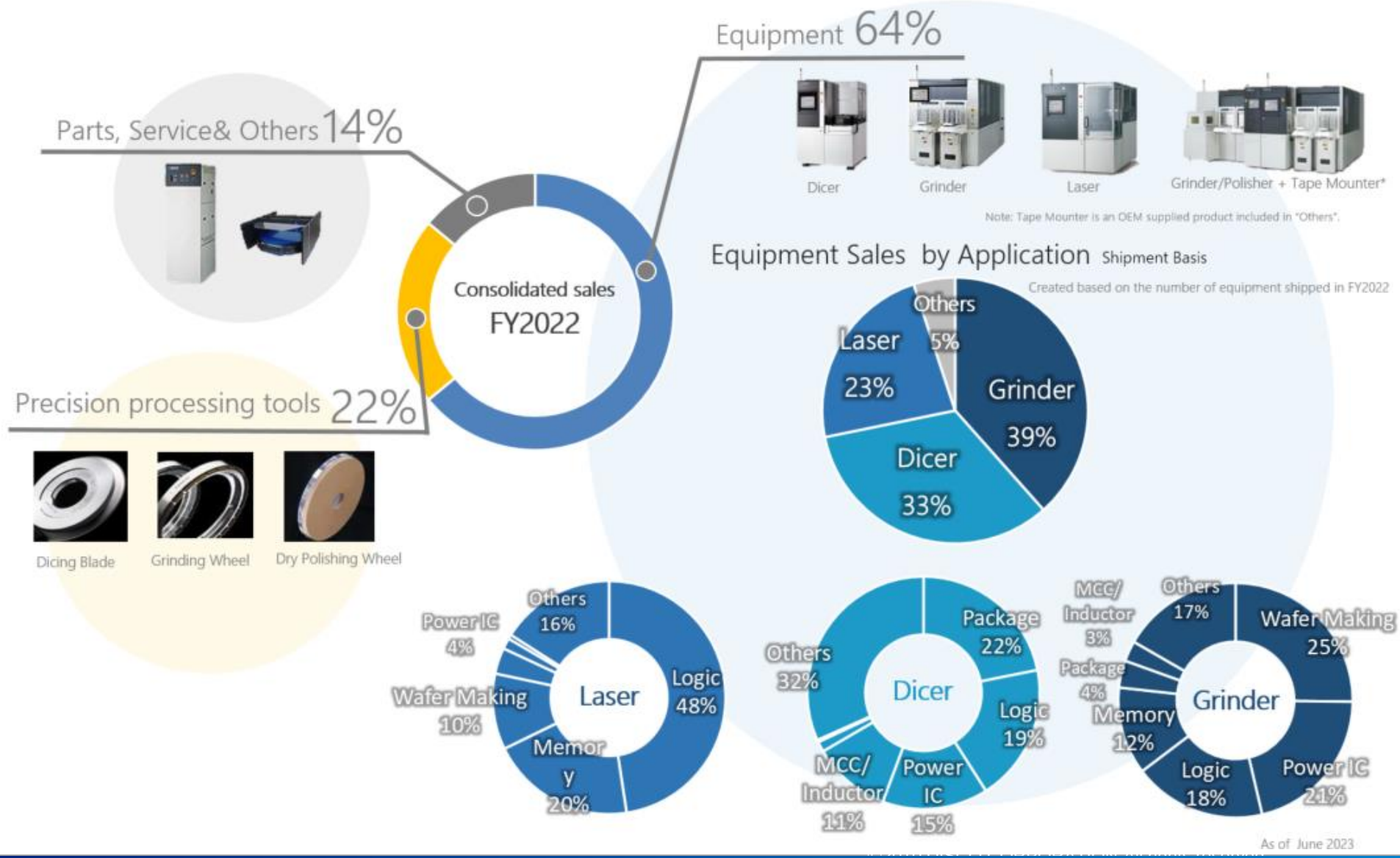
Grinder

Laser

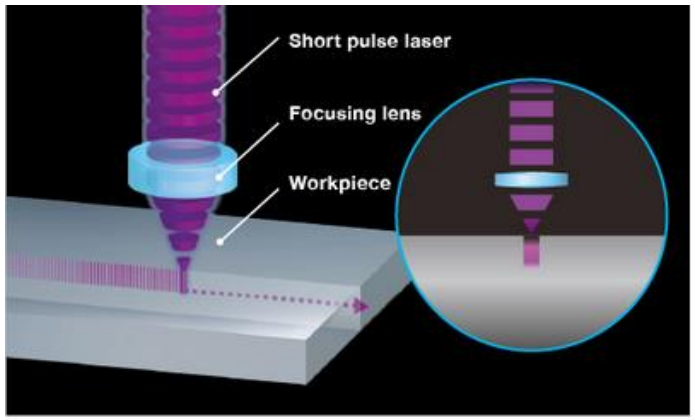


Dicer

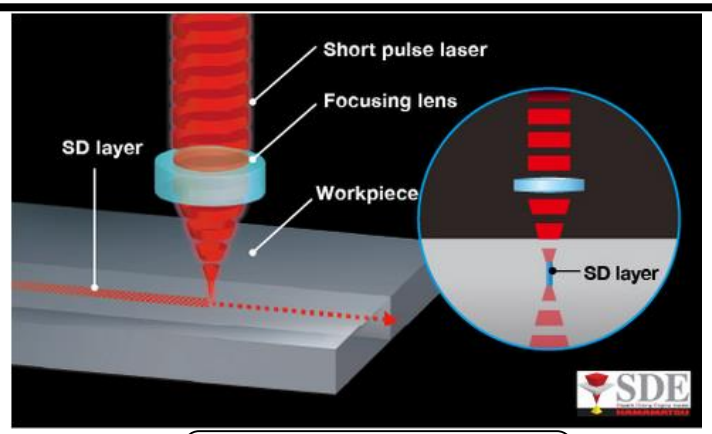
Sales Composition



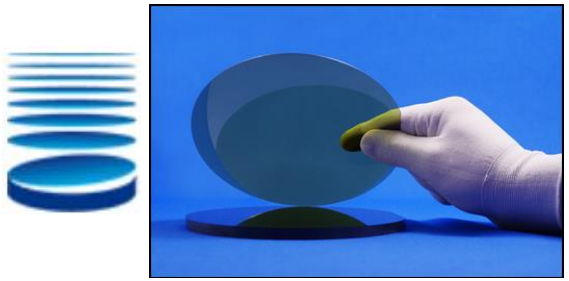
DISCO line-up for Laser Micromachining



Laser Grooving

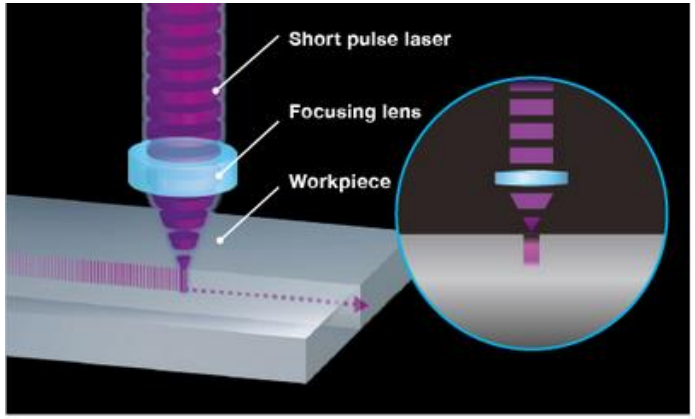


Stealth Dicing

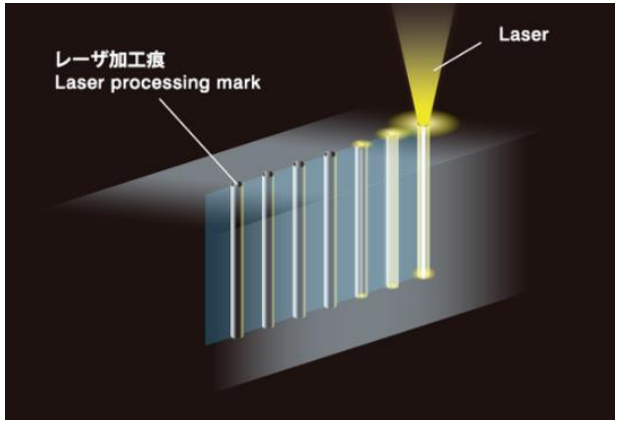


KABRA

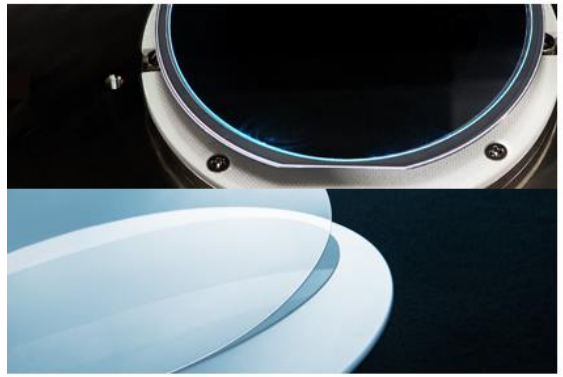
Laser Fullcut



LEAF

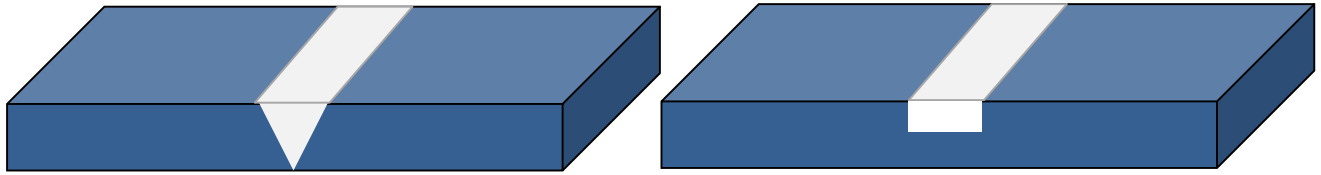


Laser Lift-off



Laser Processing: Ablative vs. Non-Ablative

Ablative Laser Processing

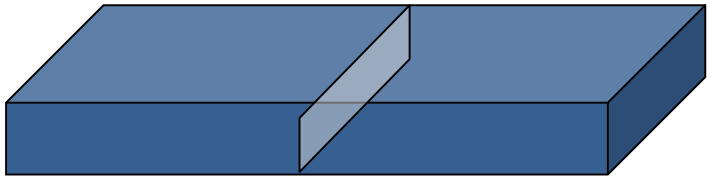


Laser Full Cut

Laser Grooving

- All materials
- NO additional separation process
- BUT: Thermal damage / HAZ

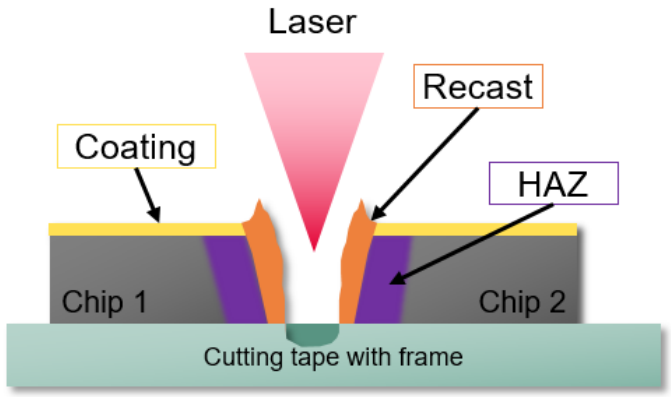
Non- Ablative Laser Processing



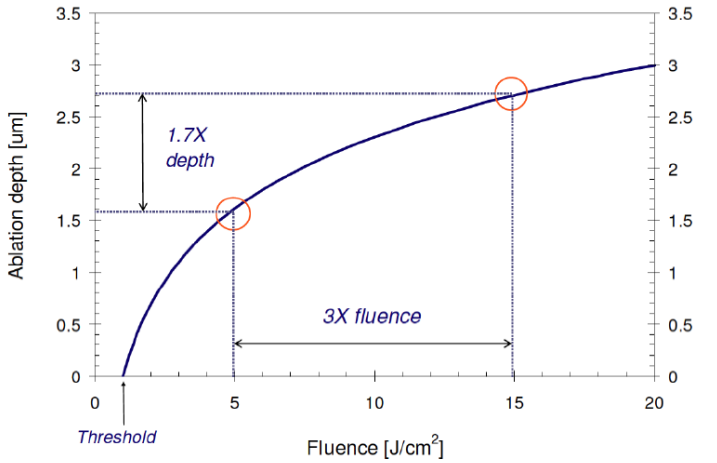
Stealth Dicing + LEAF

- Transparent Materials
- Internal modification
- Additonal Separation process
- Low HAZ

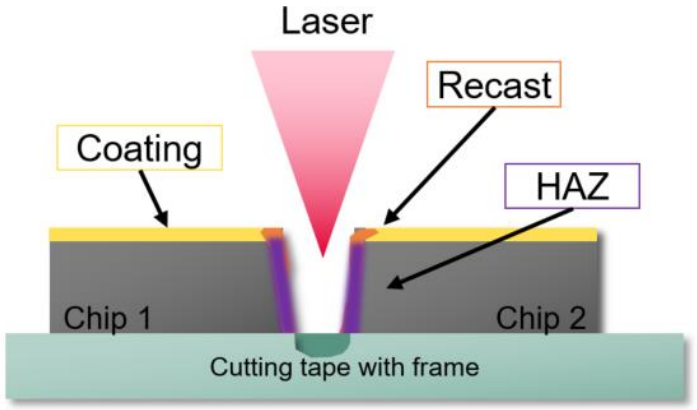
Laser Ablation– It´s all about heat management



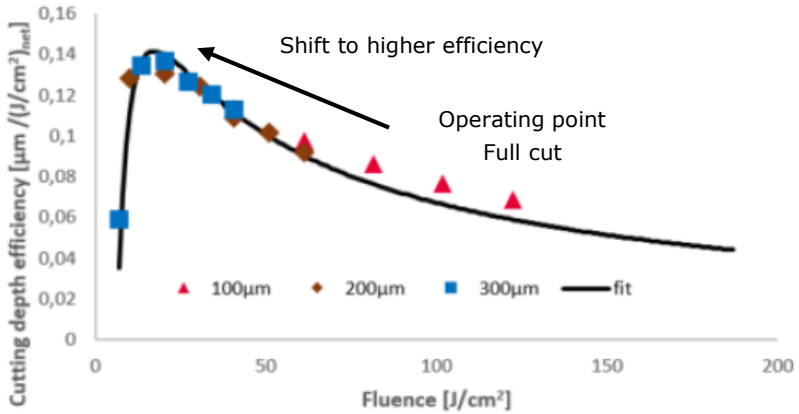
- Thermal driven process
- Heat Affected Zone (HAZ)
- Reduced mechanical stability



Highest-speed dicing of thin silicon wafers - James M. Bovatsek, Rajesh S. Patel



- Min. HAZ
- Shift to higher efficiency
- Higher mechanical stability



What kind of process can be done with Ablative Laser removal

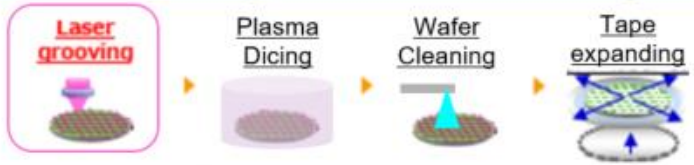
Laser Grooving + Blade Dicing

Laser Grooving + Dicing Before Grinding(DBG)

Laser Full Cut

Laser Grooving + SD Before Grinding(SDBG)

Laser Grooving + Plasma Dicing

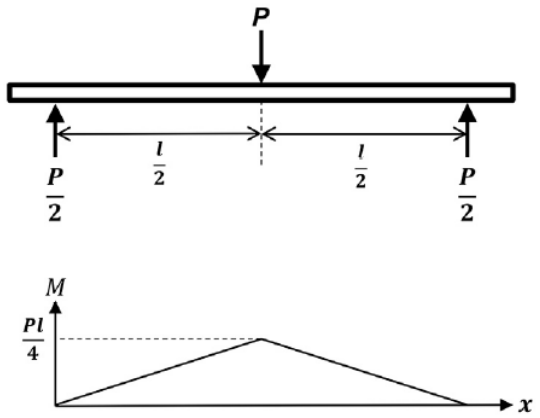


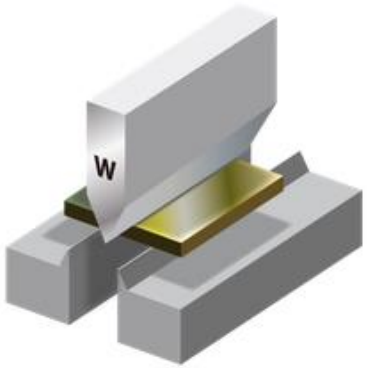
Mechanical Robustness – How to measure?

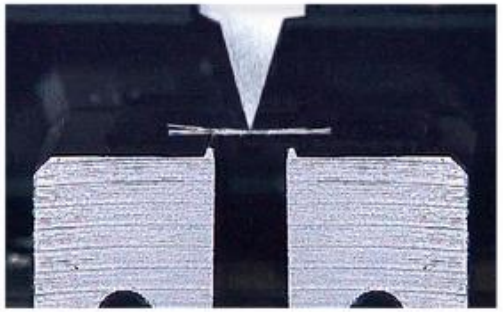
3-Point bending strength

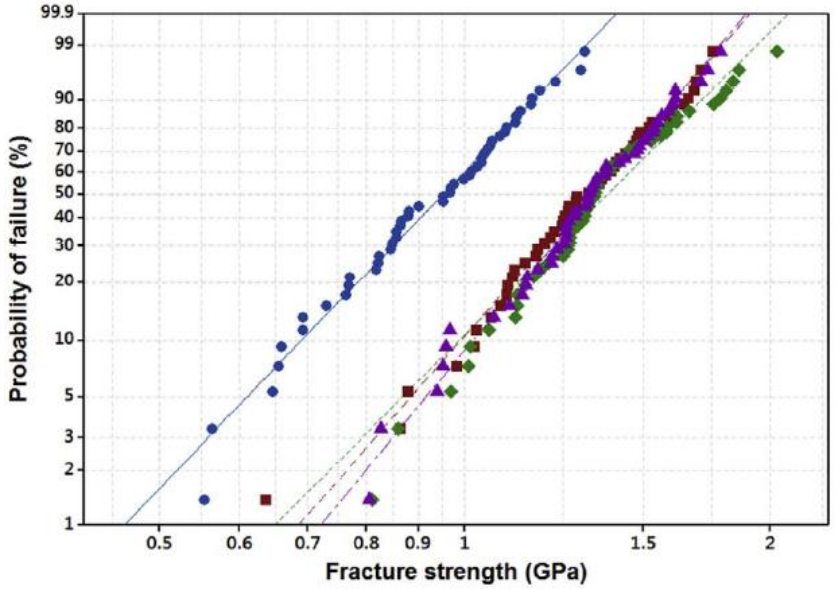
- Apply force until die breaks
- Recalculate into pressure (MPa)
- Active side down (FS) / up (BS)
- Boxplot / Weibull

$$\sigma = \frac{3}{2}\frac{FL}{wt^2}$$





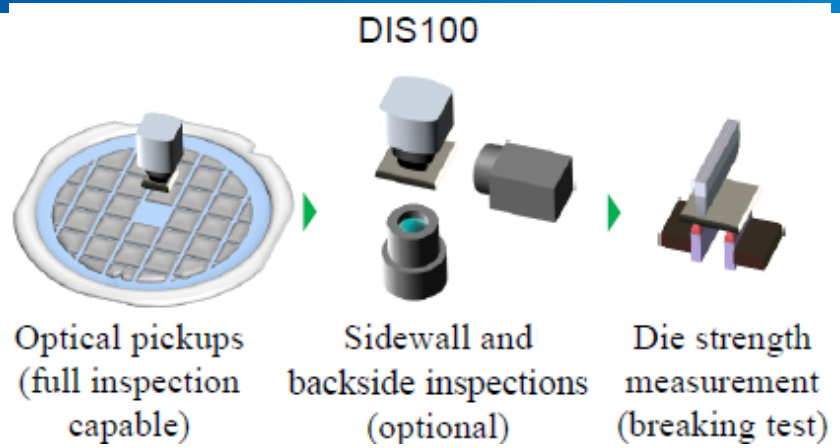


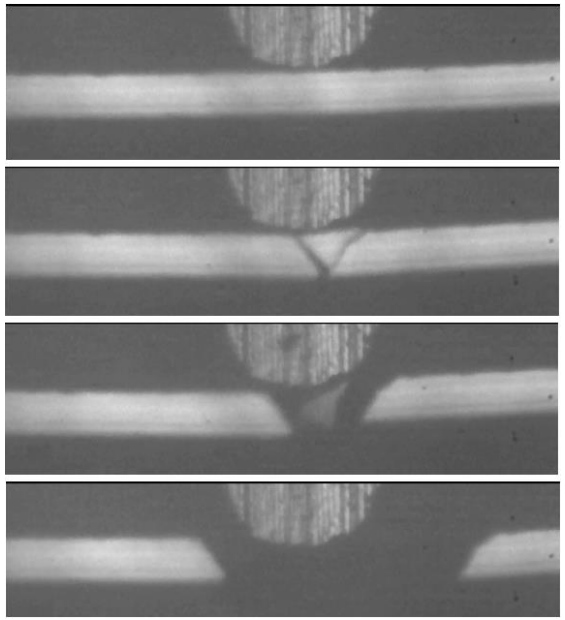


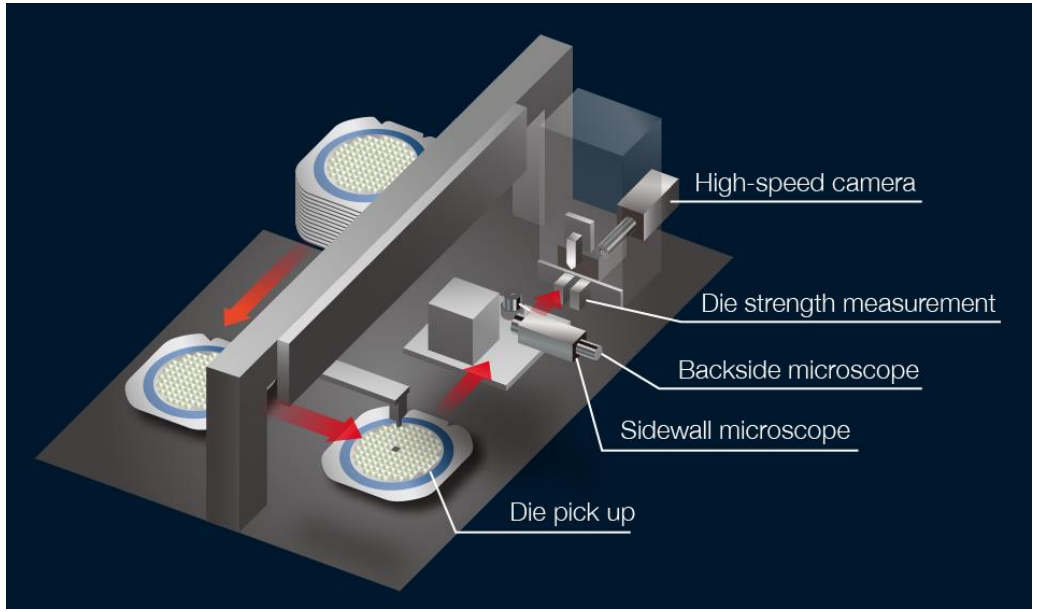
DISCO Inspection System DIS100

DISCO Inspection System DIS100

- Full automation from pickup to die strength measurement
- High statistical data from DEV to 24/7 mass production

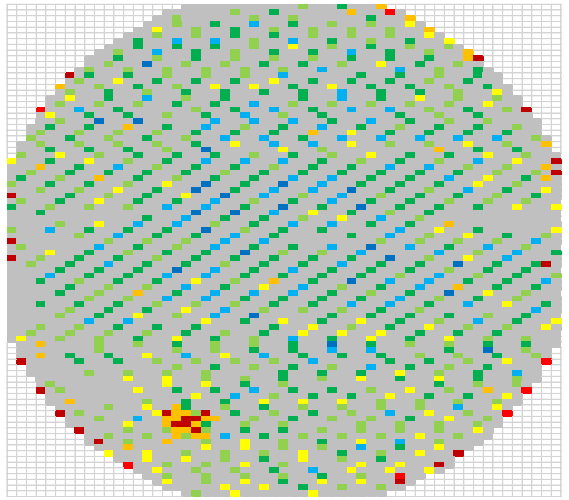






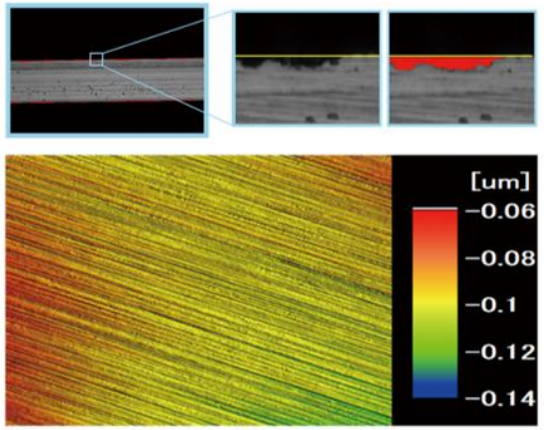
DISCO Inspection System DIS100

Creating a wafer map



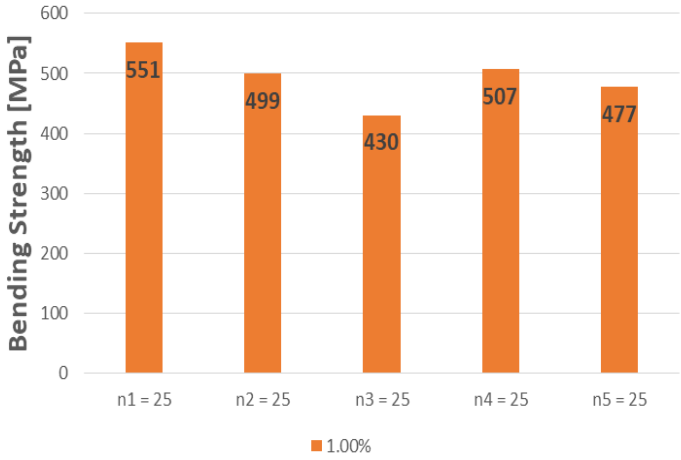
Wafer map of the pick-up sequence and color marking of the bending strength for individual dies. Two failure modes are visible, an wafer edge weakness and a localized single event effect

Chipping and roughness



Chipping analysis (upper images) and backside roughness measurement (lower image)

Statistic and die size



Fluctuation of the 1.00% values for 5 measurements with a sample size of 25 from the same wafer

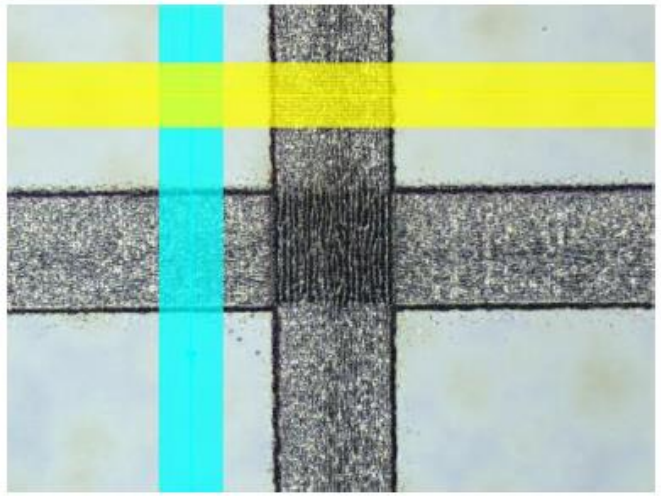
Width [mm]	2	2.5	3
Bending [MPa]	657	528	471
Force [N]	1.32	2.05	2.76

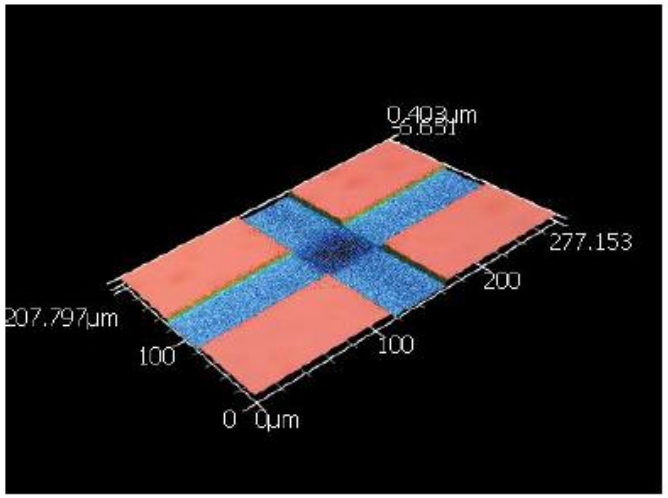
Influence of the die width on the bending strength result for a certain stack configuration

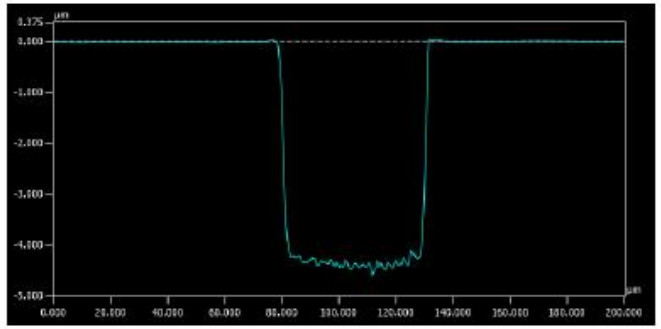
Example: GaN on Si Grooving

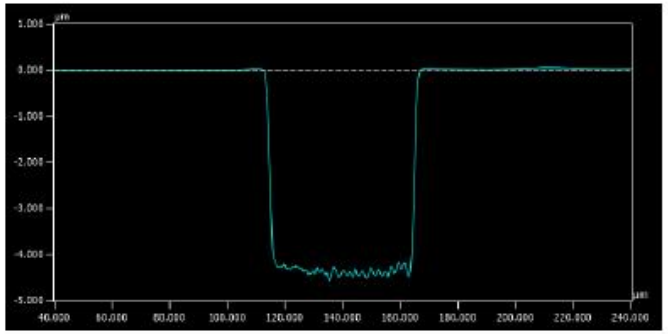
Motivation:

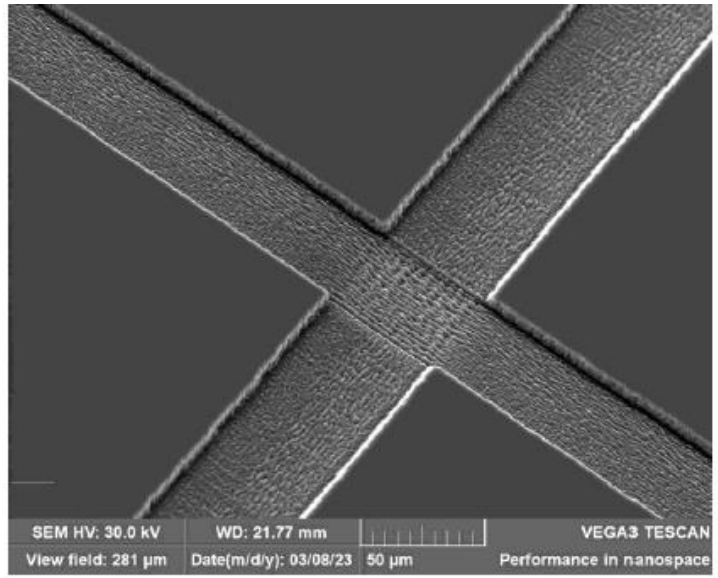
- Burr and debris free GaN grooving for wafer to wafer bonding applications

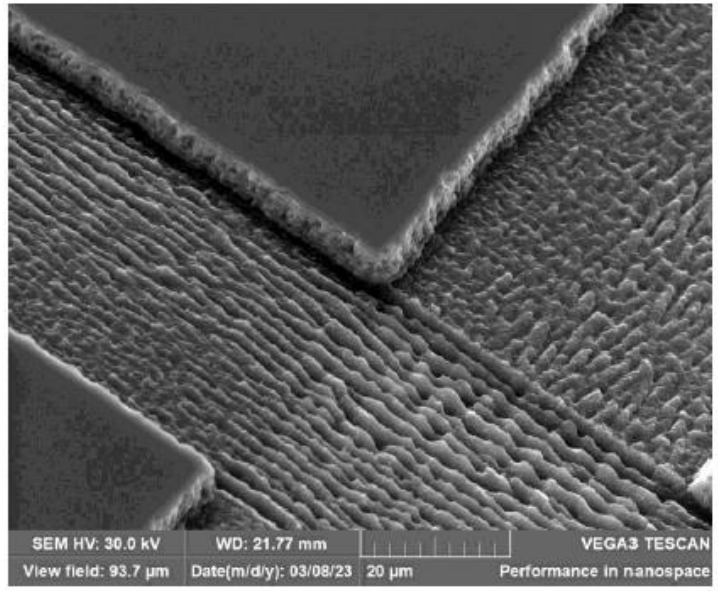










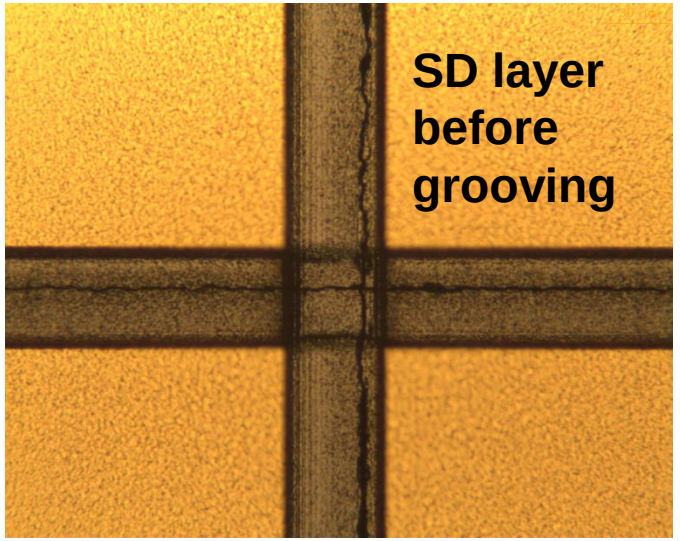


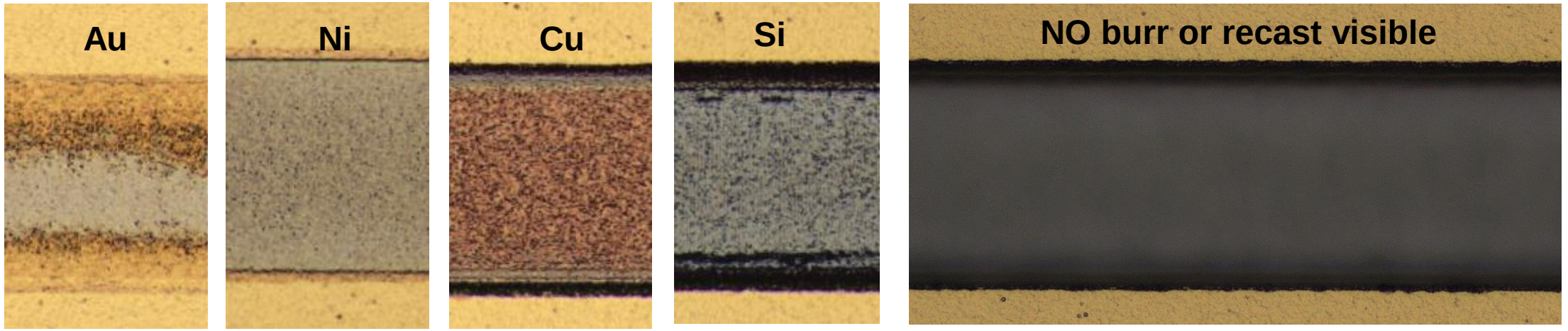
Laser Grooving of metals

Grooving of 500 nm Au + 2 µm Ni + 2 µm Cu

Motivation:

- Stealth Dicing Before Grinding
- Metal stack does not expand
  => USP Grooving needed

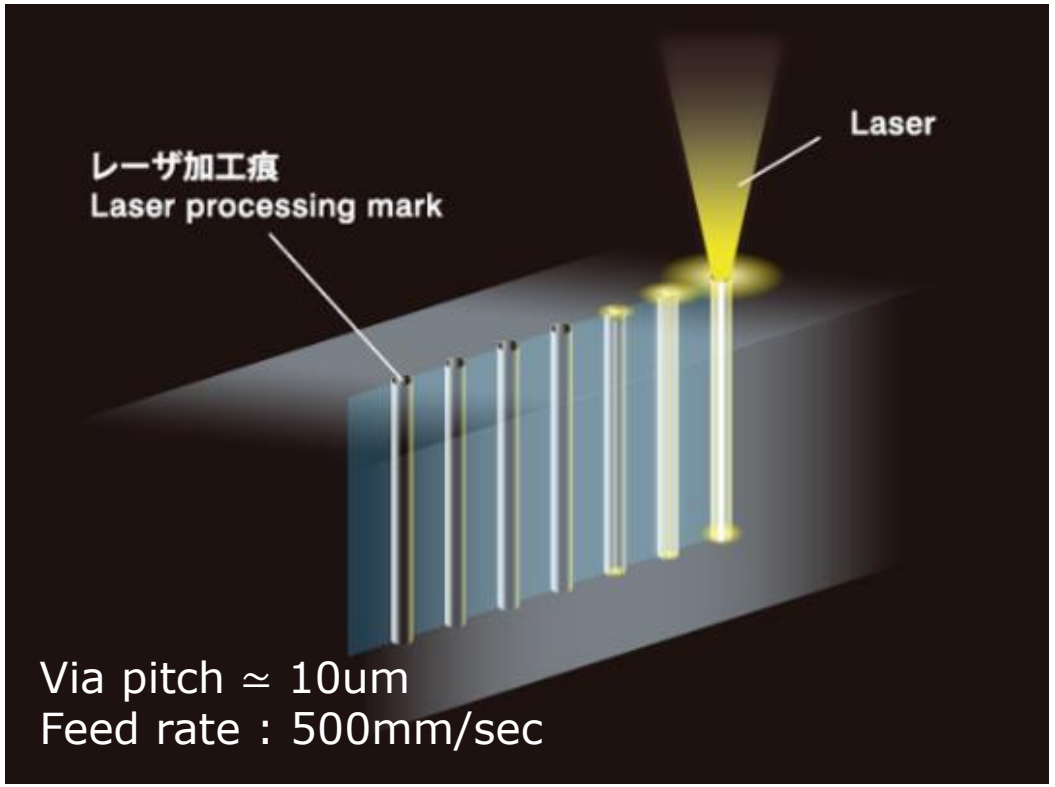




LEAF – Laser Enhanced Ablation Filling

- Singulation method using via drilling technology
- Separation method utilizing laser ablation
- Enables high-aspect ratio processing
- Ultra-narrow cutting margin

Applicable materials : Glass, Sapphire, SiC, LT/LN



No slant cut

Higher die strength

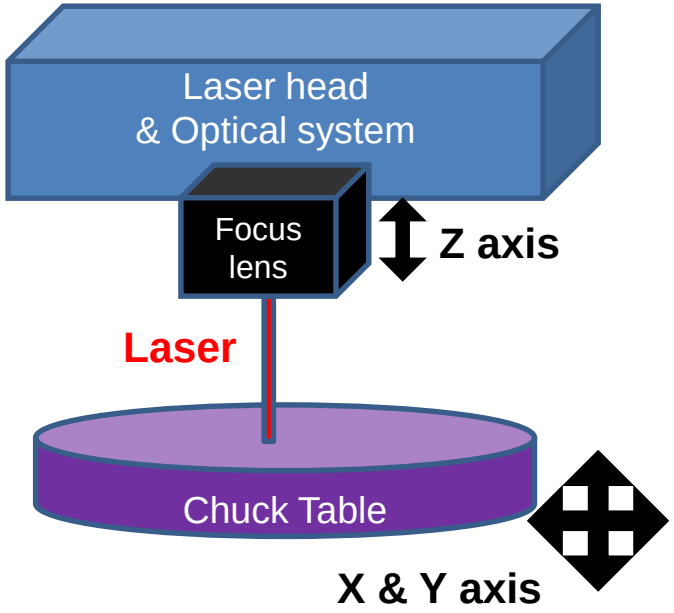
Easy separation
by tape expanding *

* <300umt

Free-Shape Laser Processing Equipment

- Realizes processing of intricate shapes
- Enables the free-shape processing by installing a motion controller which synchronizes the X- and Y-axis

Image of processing point structure

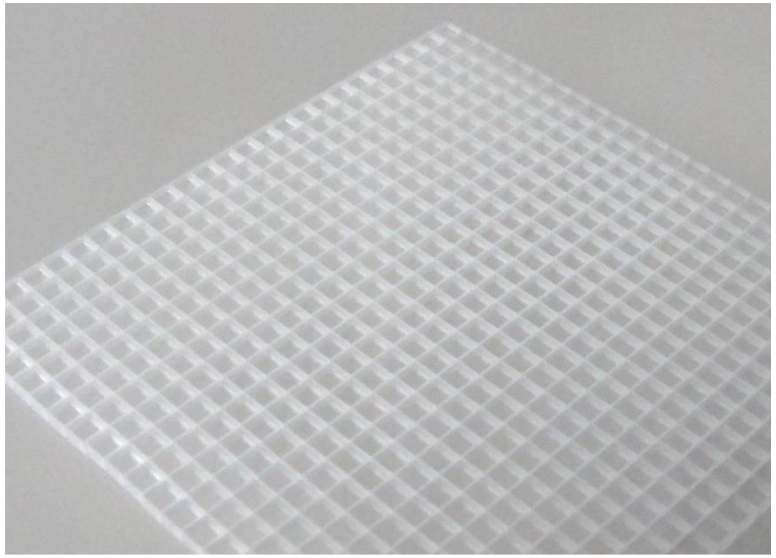


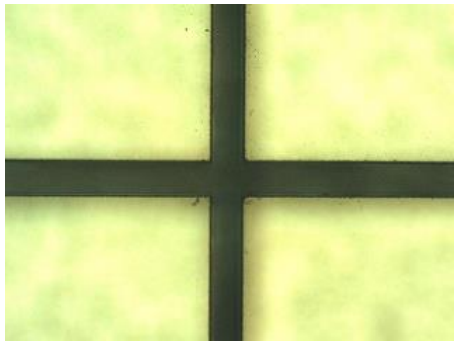
LEAF processing of Glass and Sapphire

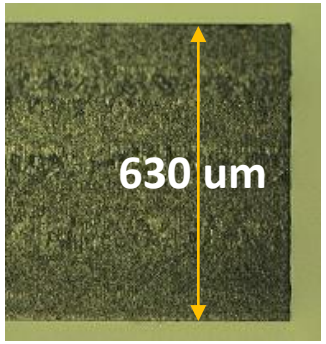
Non-alkali glass: Eagle 2000

- Thickness: 630 um
- Die size: 0.8mm

*For >300um thickness glass, some breaking method is required.

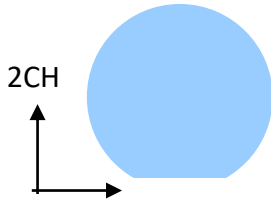


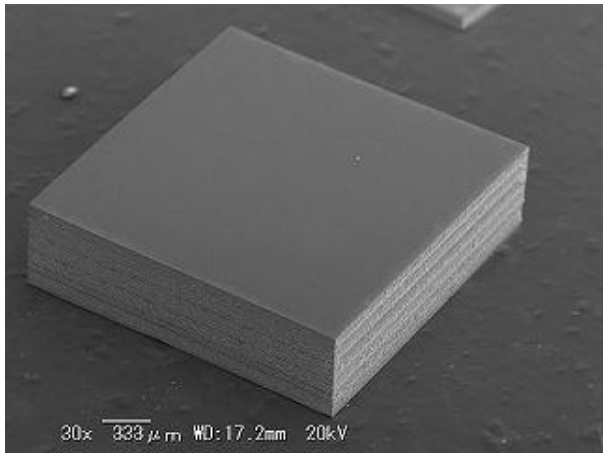


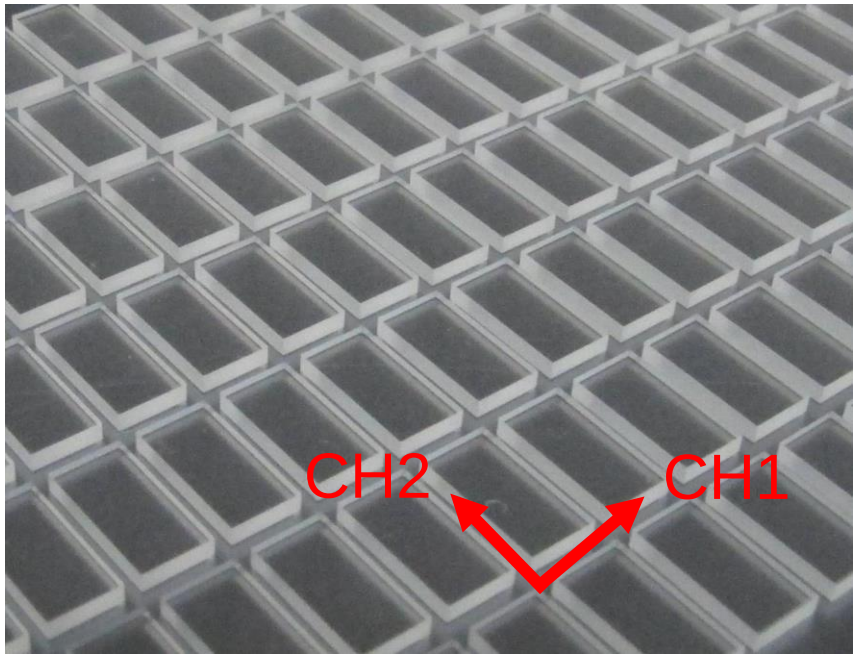


Sapphire

- Specification ：C
- Double side polished
- Thickness ：700 um



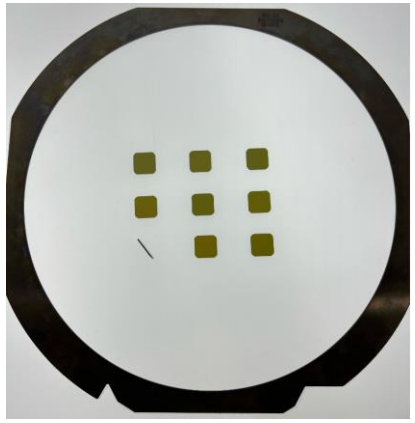


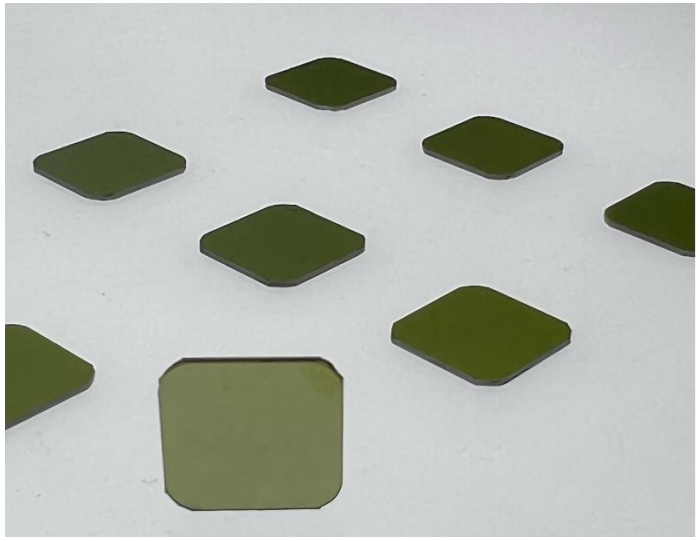


LEAF processing of doped and non-doped SiC

Doped SiC

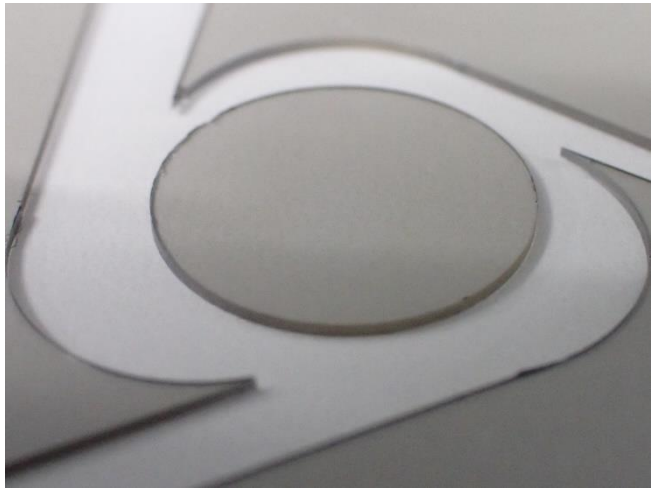
- 800um thickness
- 15x15mm Round corner

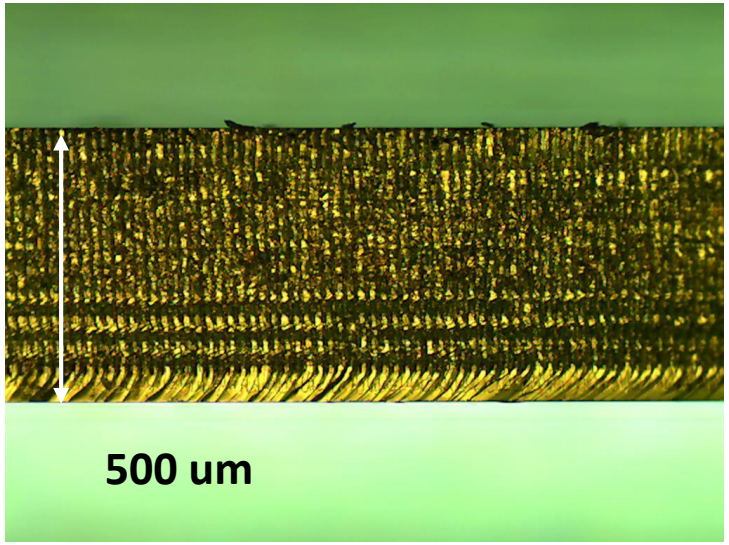




Non-Doped SiC

- 500um thickness
- Freeform Shape

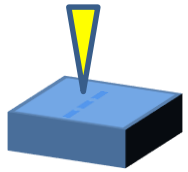




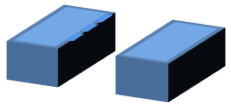
LEAF processing of diamond and via holes in glass

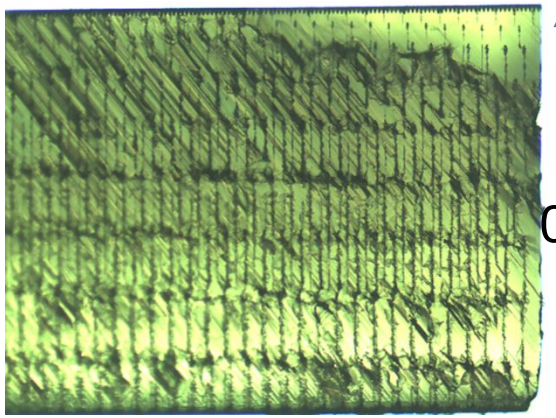
Diamond fullcut

- 500 µm thickness



LEAF

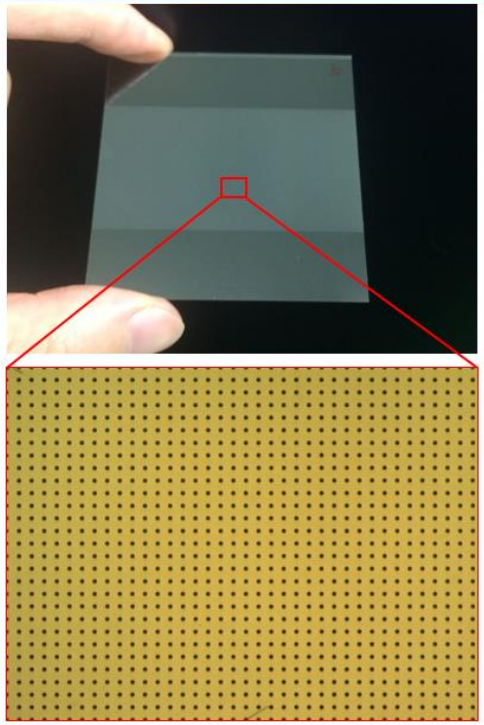




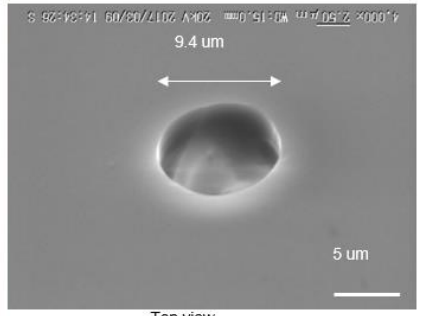
0.5mm

Micro via holes in glass

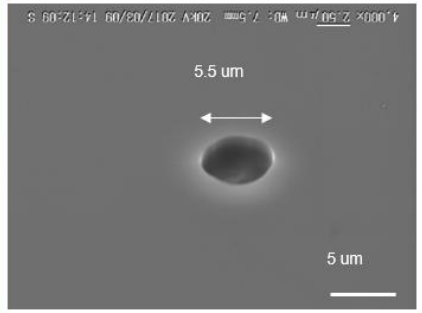
- 170 um thickness



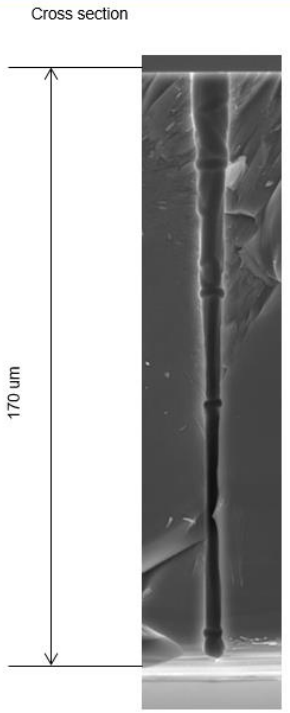
30 um pitch



Top view



Bottom view

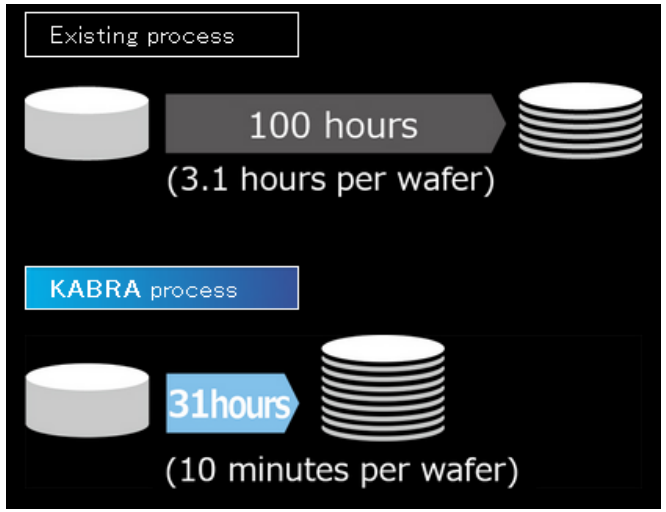


KABRA – The new technology of SiC wafer production

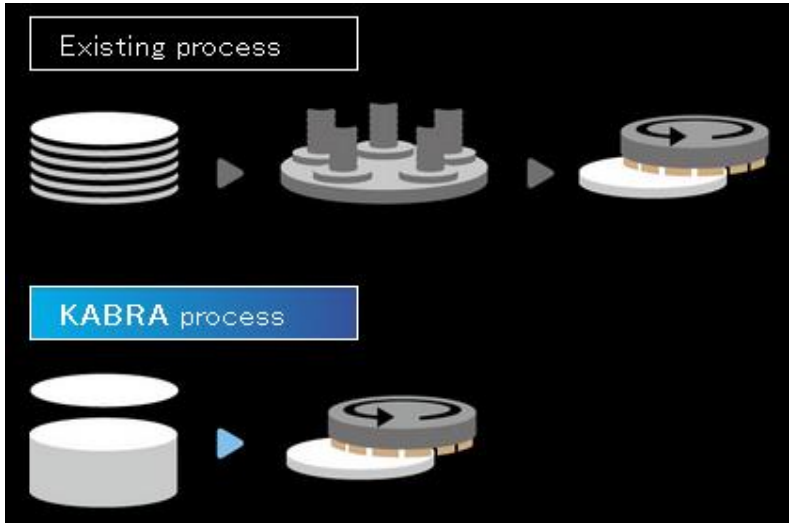
What is KABRA ?

This is an ingot slicing method where a separation layer (KABRA layer) is formed at a specified depth by continuously irradiating an ingot with a laser, producing wafers starting from the KABRA layer. In addition, this process can be applied to various types of SiC ingots, including single-crystal (4H, 6H, and semi-insulation) and multi-crystal ingots. This process can be also applied to monocrystal ingots, regardless of the off-angle of the crystal c-axis

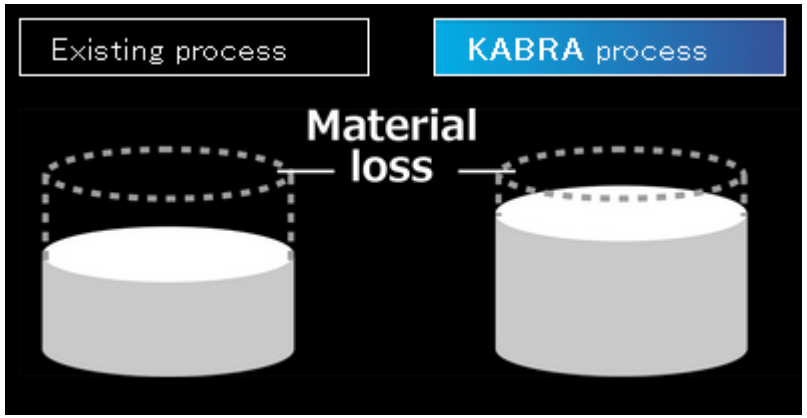
1. Processing time is greatly reduced



2. Lapping process is no longer required



3. Number of wafers produced increases 1.4 times



Thank you for your attention

DISCO

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