Panasonic CONNECT

Plasma Dicing

Technology and total process

Plasma dicing is becoming increasingly attractive in the semiconductor market. Dies are becoming smaller and thinner and manufacturers are facing difficulties such as increasing material loss due to the width of the dicing line, mechanical damage to the dies from chipping and increasingly longer processing times due to line-by-line mechanical dicing.

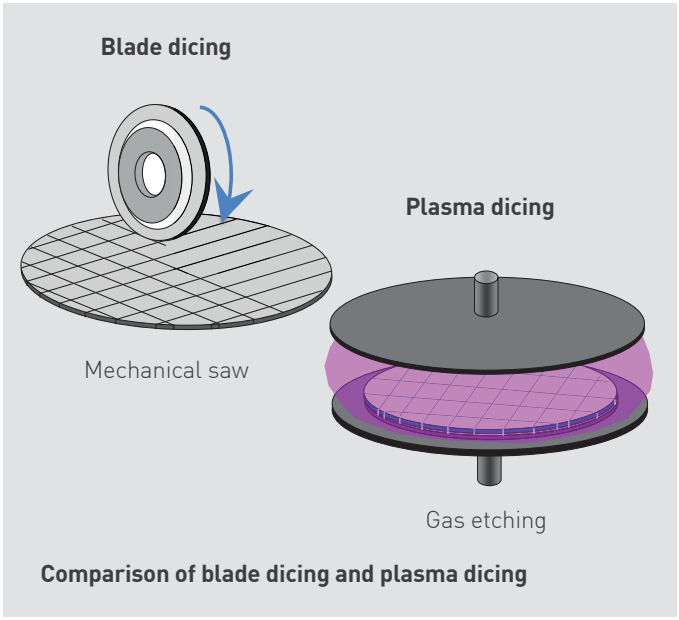
Panasonic's APX300 Plasma Dicer solves these challenges and simultaneously provides a higher quality product with a lower cost of production.

APX300 Plasma Dicer

Features of plasma dicing

The plasma dicing process

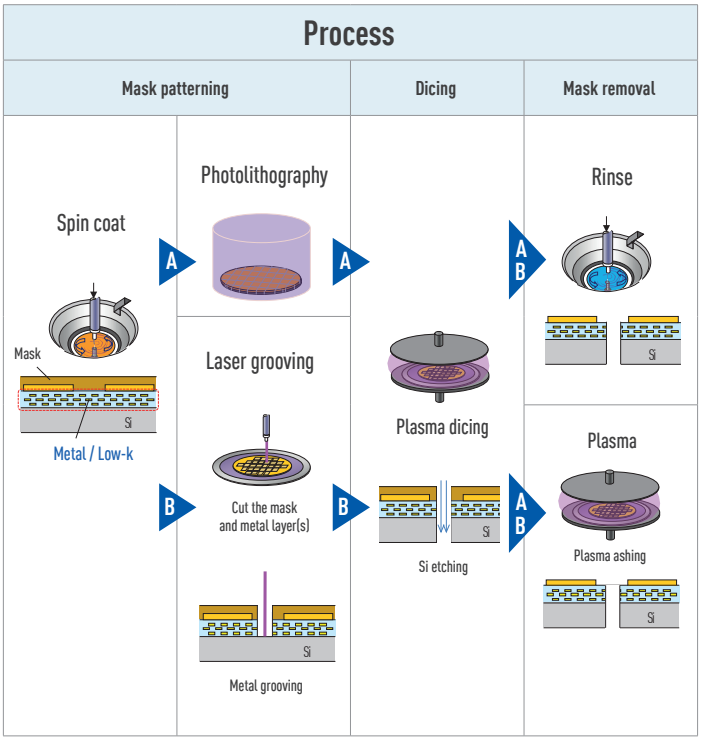
Plasma dicing requires a dicing street mask. After the mask is applied to the surface of the wafer and the dicing streets are exposed, the plasma process etches the exposed streets by a chemical reaction.



Comparison of blade dicing and plasma dicing

By using a chemical etching process, a chipping-free and particle-free process is achieved. Thanks to the use of mask patterning, narrower street widths are possible – allowing more chips to be designed into the wafer. Furthermore, the mask patterning allows complete flexibility in chip size, shape and position.

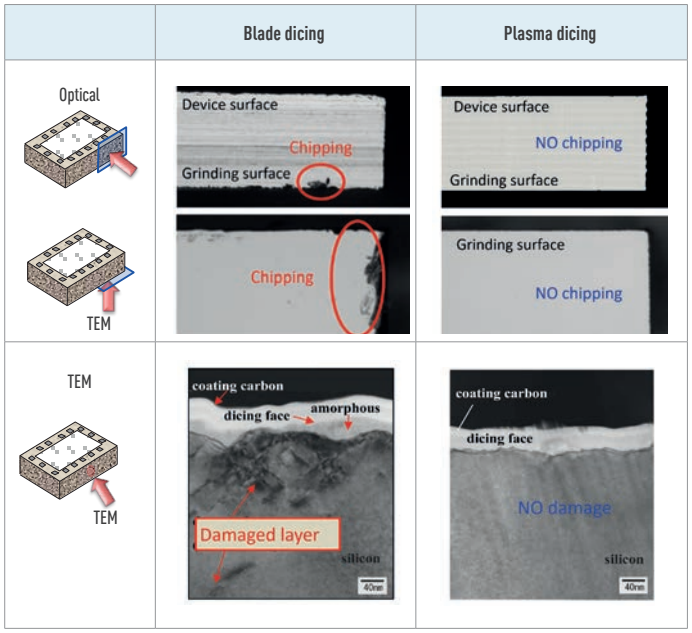
Panasonic plasma dicing can be achieved using either a photolithography mask or laser patterning mask method. The appropriate process flow should be selected to fit the wafer design.



Panasonic plasma dicing process

Particle-free and damage-free process

Blade dicing causes mechanical damage such as chipping and affected layers.



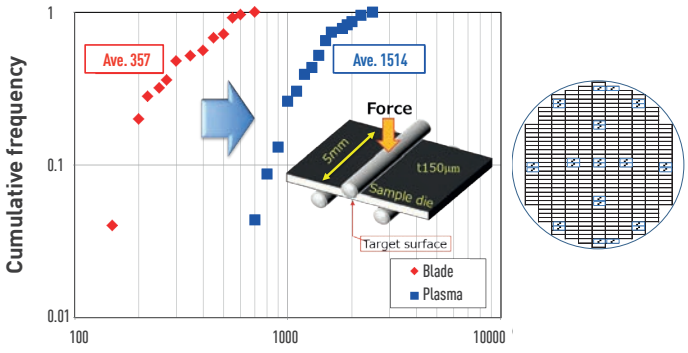
Damage inspection

Higher chip strength

Chip strength is measured by chip breakage tests. Typical values of fracture strength for Si chips are in the range of 100 MPa to 3000 MPa.

To perform a chip strength measurement, chips at several positions on a wafer are evaluated and a Weibull Plot is used to compare these statistical data. Panasonic has verified the chip strength of plasma-diced samples from a 150 µm thick wafer.

The data presented show that plasma dicing achieves about 5 times higher chip strength than blade dicing samples. Blade-diced samples all broke after 600 MPa of applied stress. Plasma-diced samples did not break.

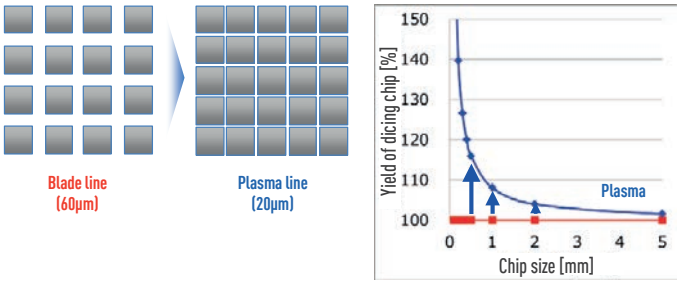


Deflecting strength [MPa]

Yield increase

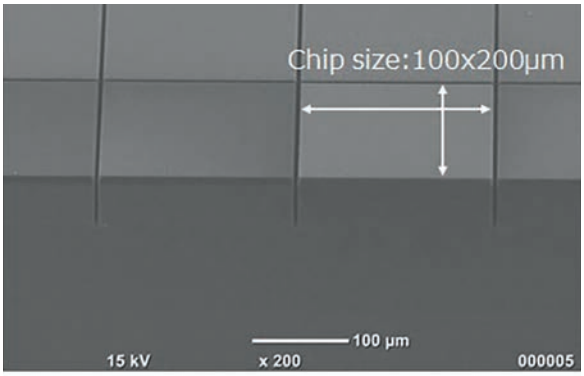
Plasma dicing processing time and throughput are not affected by the number of dicing lines because etching is performed on the whole wafer in one complete process. Compared to blade dicing, plasma dicing allows much narrower dicing streets.

To demonstrate the value of this, if the chip target size is 0,5 mm x 0,5 mm, and a street width reduction from 60 µm to 20 µm is achieved, the yield per wafer will be increased by more than +15% when using plasma dicing.

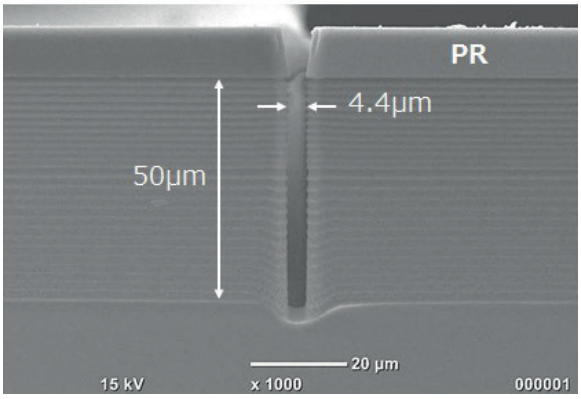


Increased productivity

The images below demonstrate the result of small chip dicing with dicing streets narrower than 5 µm.

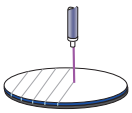
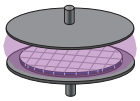


Diced wafer appearance



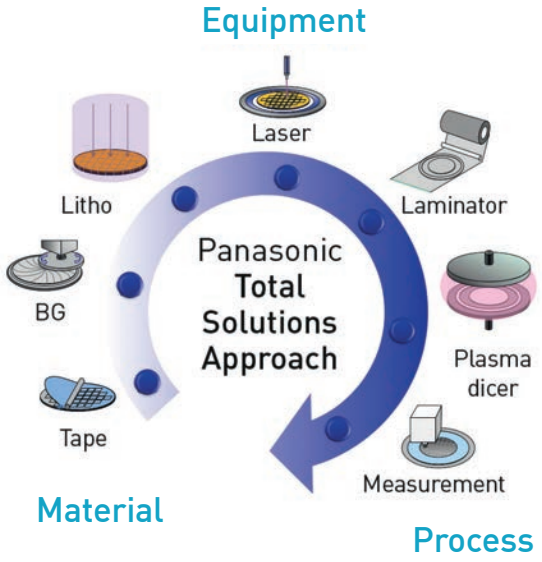
Narrow dicing street

Advantages of plasma dicing

	Blade	Laser	Plasma
Dicing method			
Processing time (8"wafer, t100mm, □1mm)	✗ (32min / wafer)	✔ 13min / wafer)	✔ Shortest (7min / wafer)
Chip strength	✗ (Mechanical damage)	✔ (Mechanical damage)	✔ Highest (Damage-free)
Low-k etching	✗ (Wet process)	✔ (Dry process)	✔ (Dry process)

Total Solutions Approach

In addition to supplying the APX300 Plasma Dicer, Panasonic is in close contact with vendors globally to assist our customers with the integration and selection of appropriate equipment and material, and implementation of decades of process know-how.



Upgrade to the Cutting-Edge

The information and data presented here have all been verified in the Panasonic Plasma Dicing Demo Center at Panasonic Smart Factory Solutions Co. Ltd, in Osaka, Japan. The Panasonic Plasma Dicer APX300 was used for of all these evaluations.

Panasonic is continuing to develop the plasma dicing process by applying this technology to not only Si wafers, but also SiC, GaAs and so on, to meet the industry's latest demands.

Panasonic can provide a plasma dicing total solution to achieve a damage-free, particle-free, higher throughput and lower overall cost of production.

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