

The Application of Laser in WLCSP Process

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CONNECT

What is WLCSP & Why is WLCSP

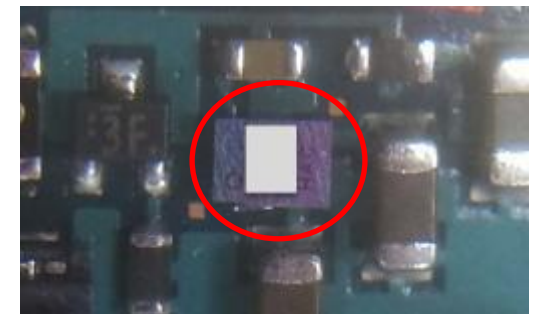
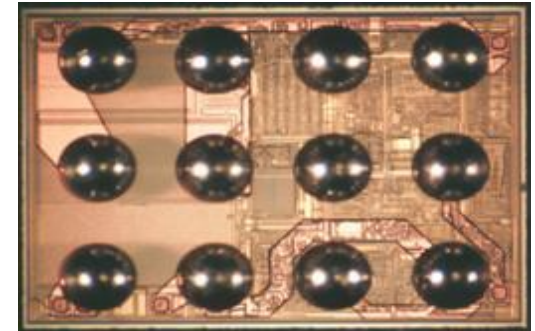
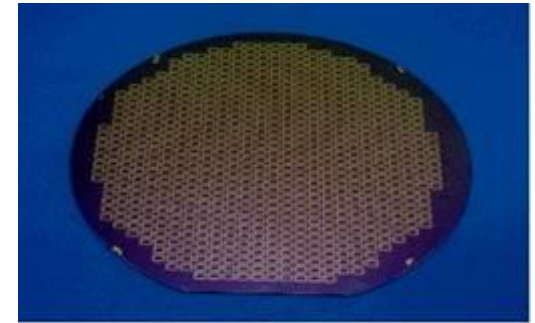
What is WLCSP & Why is WLCSP

Wafer Level Chip Scale Package defined

- All the IC packaging is conducted in wafer form
 - The final "package" is manufactured and tested on the wafer, prior to singulation
- True chip-size package
 - When mounted onto a printed circuit board, the area occupied by the WLCSP **equals the size of the die**






Market drivers

- Size
- Weight
- Cost
- Performance

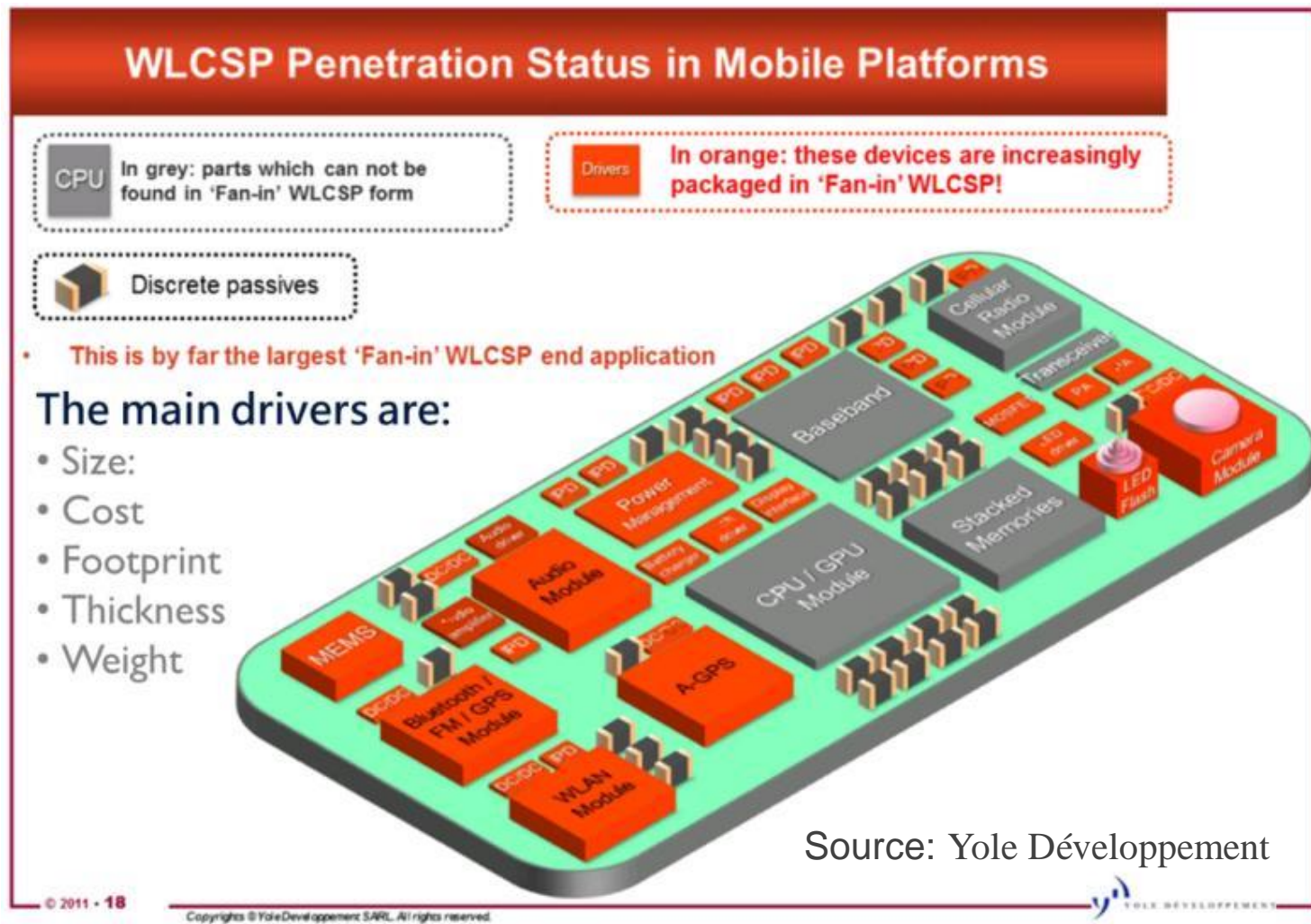


What is WLCSP & Why is WLCSP

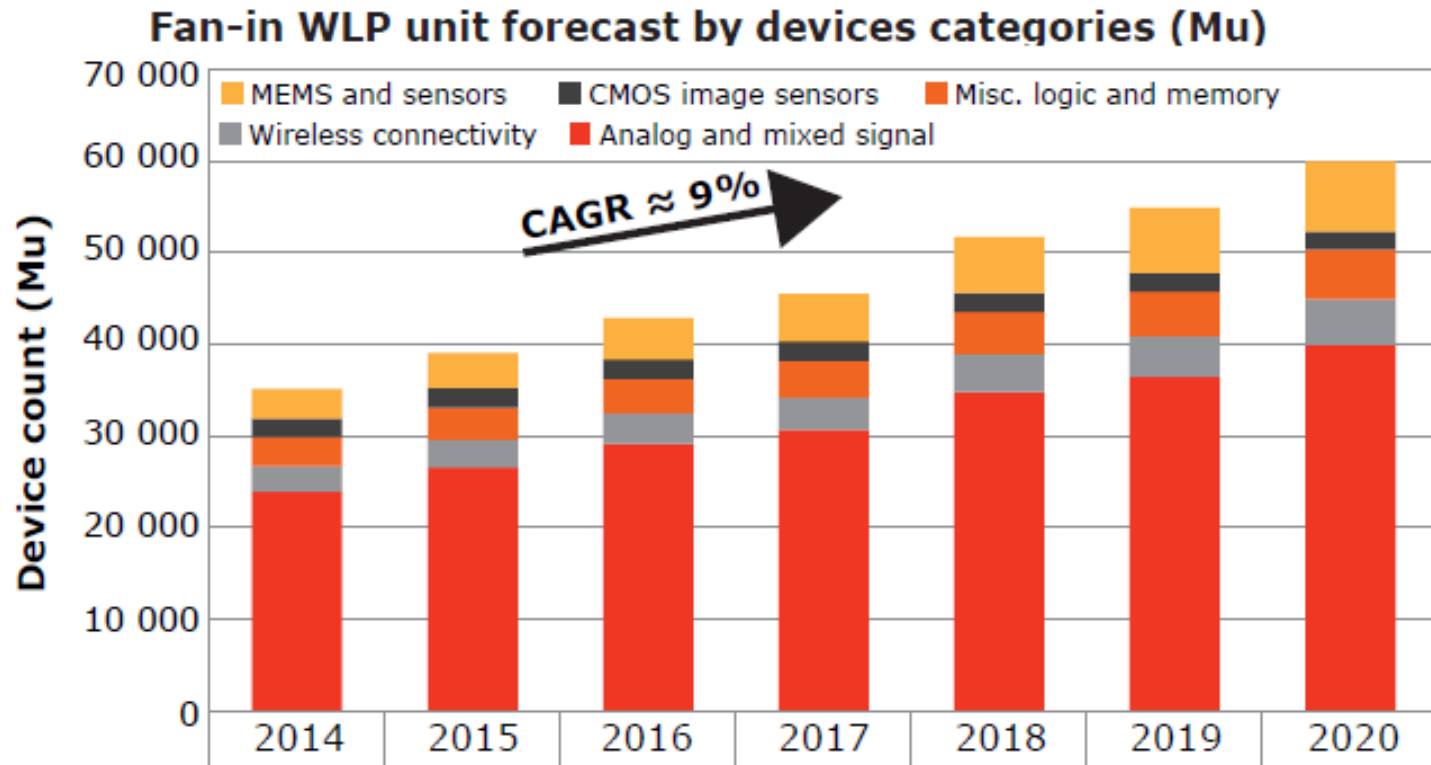
Real Estate Saving of 7.6 x 7.6 mm Die with 28 I/O

Package Type	Pitch	Max Package Dimensions	Area	Example
PQFP	0.5 mm	31 mm	100%	
PBGA	1.27 mm	23 mm	55%	
COB	0.23 mm	19 mm	38%	
CSP	0.5 mm	8 mm	7%	
WLCSP	0.5 mm	7 mm	6.3%	

What is WLCSP & Why is WLCSP



What is WLCSP & Why is WLCSP



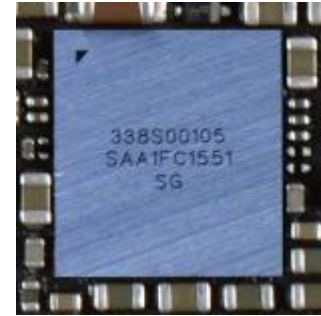
(Yole Développement, June 2015)

Fig 2

Laser Applications in WLCSP

Laser Applications in WLCSP

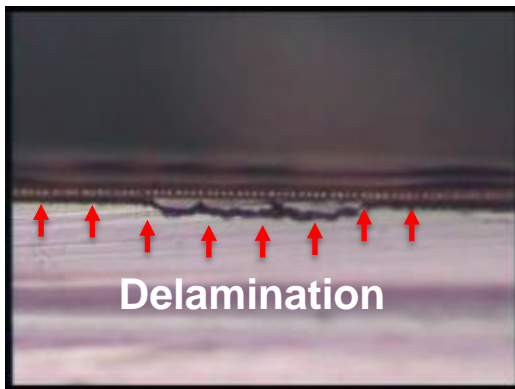
- The application in WLCSP is
 - Laser marking
 - Scribe product info on die backside for traceability
 - Laser dicing
 - Separate product from wafer form to die form for
 - Advanced process node low-k wafer (90 nm and below)
 - Saw street design weakness (non low-k wafer)
 - Saw street width shrink
 - Tighten external visual criteria (chipping)



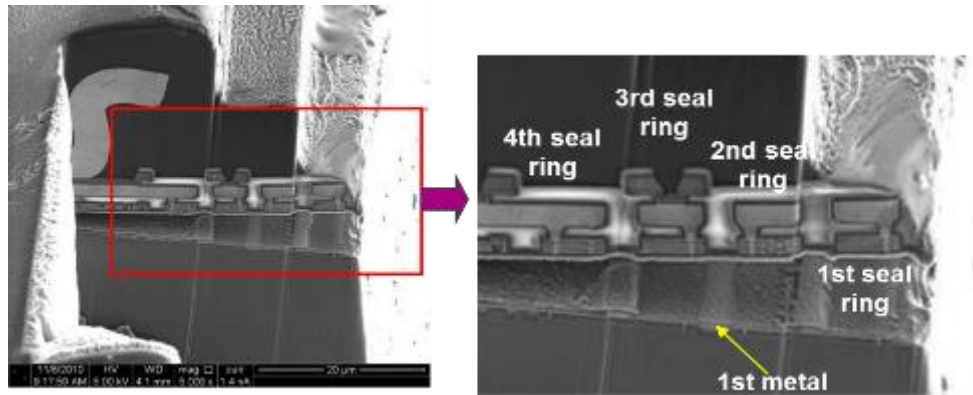
Source: Chipworks

Laser Dicing

- Advanced process node low-k wafer (90 nm and below)
 - Delamination can be easily observed by blade saw due to low-k material being more brittle



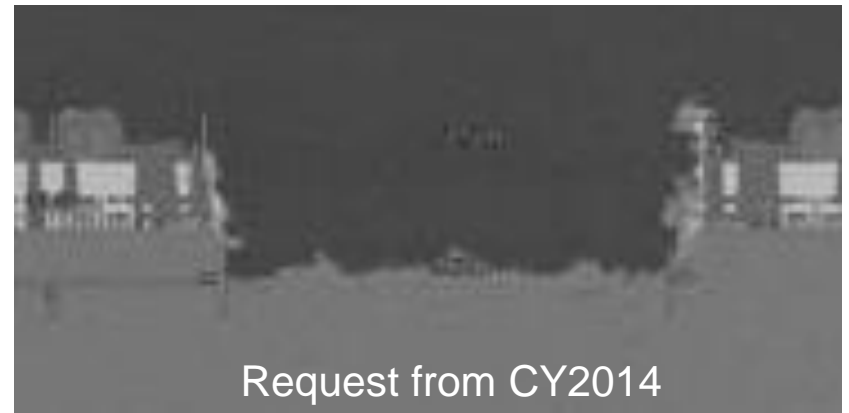
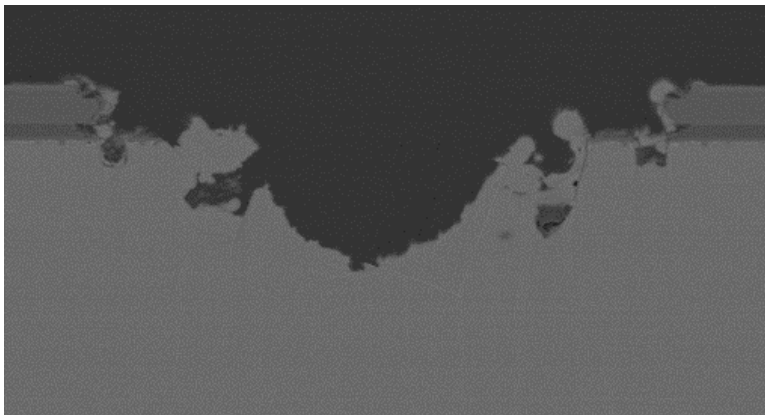
OM photo: Blade saw



Delamination is observed with blade saw process even 4x seal ring applied

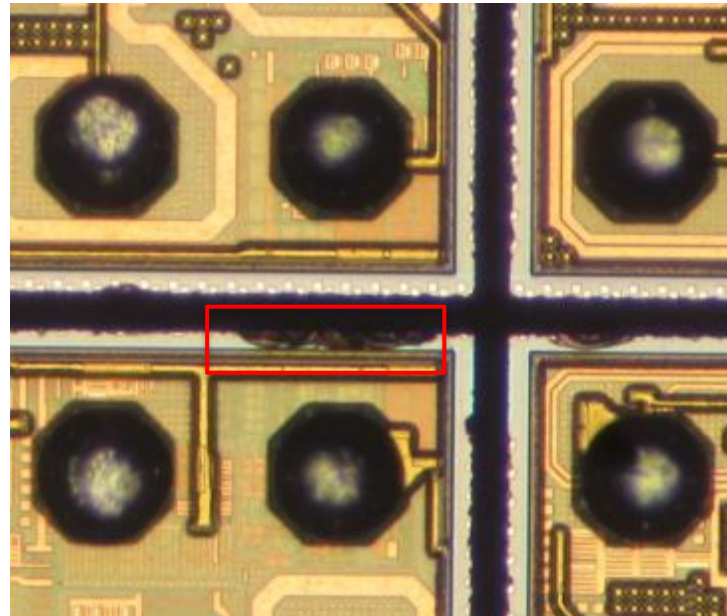
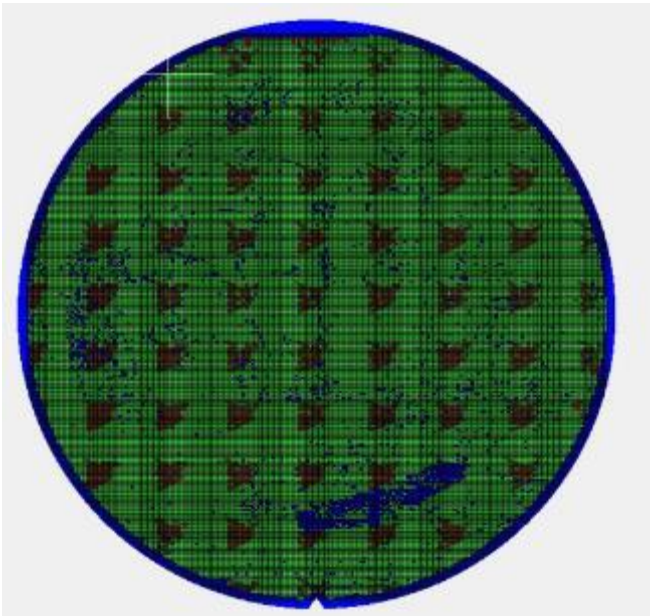
Laser Dicing

- Advanced process node low-k wafer (90 nm and below)
 - Laser groove is applied to remove metal, following with blade saw to solve delamination issue
 - “U” profile is driven from CY2014 for more robust process control.



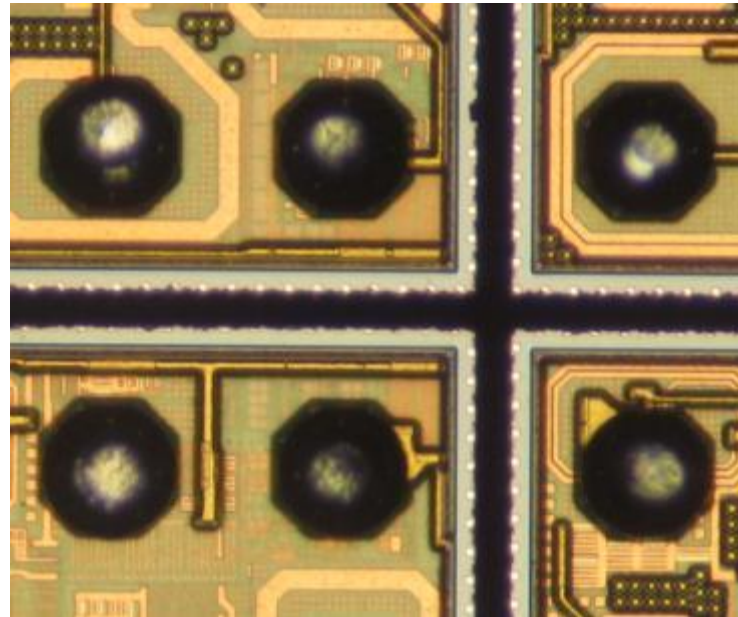
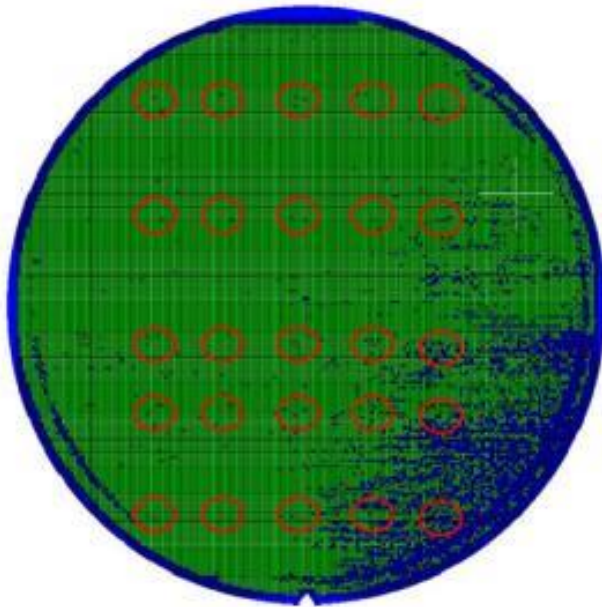
Laser Dicing

- Saw street design weakness (non low-k wafer)
 - Improper saw street design can induce topside chipping, peeling, repetitive as the same as reticle size



Laser Dicing

- Saw street design weakness (non low-k wafer)
 - Laser groove is applied to accommodate this weakness



Laser Dicing

- Saw street width shrink
 - By shrinking saw street width, gross die per wafer would be increased which can reduce unit cost, ex. RF switch, LNA products

Die Size (mm)	Saw Street Width				
	80 μm	50 μm	40 μm	30 μm	20 μm
1.0 * 1.0	–	5.8%	7.8%	9.9%	12.1%
0.9 * 0.7	–	7.3%	9.9%	12.6%	15.4%

Increased die qty

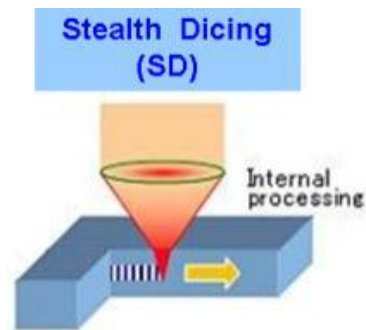
Laser Dicing

- Saw street width shrink
 - Blade saw constraint
 - Usually step cut is applied for blade saw, and its min. saw street width is ~ 50 μm

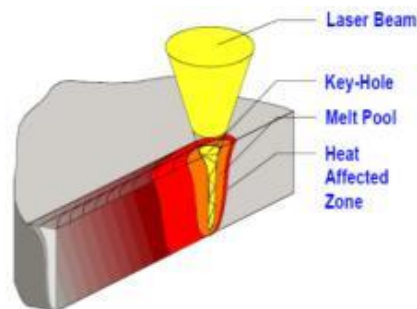


Laser Dicing

- Saw street width shrink
 - Two kinds of laser cut can support saw street width down to 20 μm
 - Stealth dicing (SD)

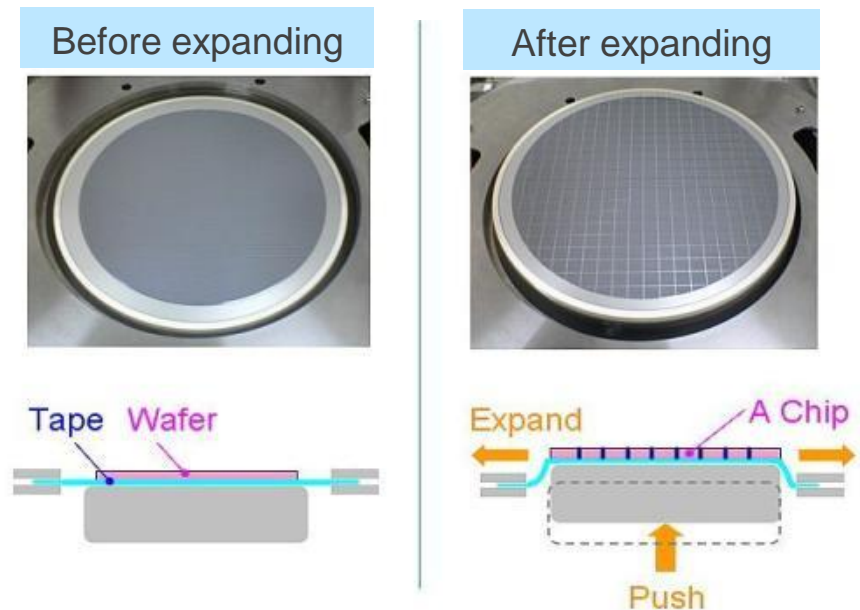
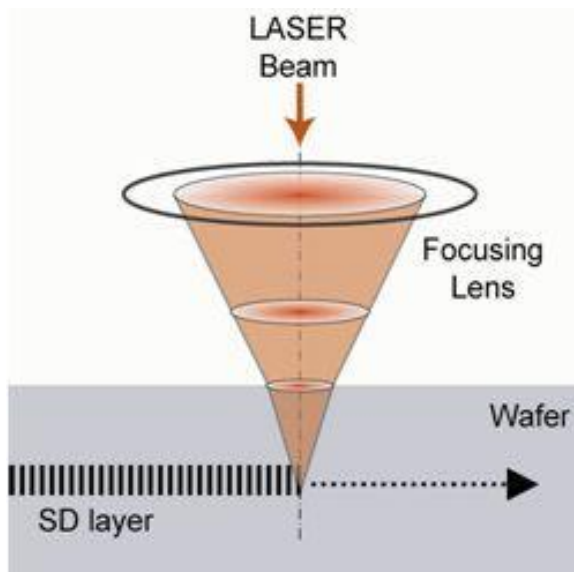
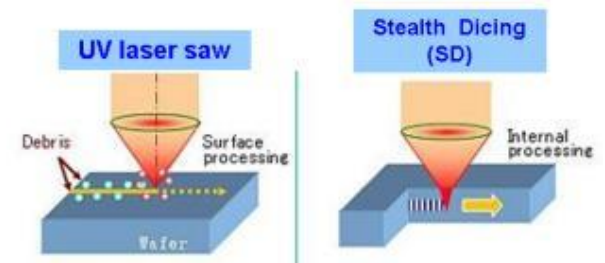


- Laser full cut



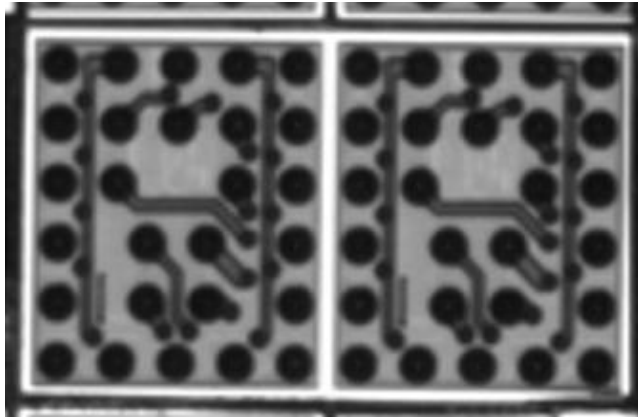
What is Stealth Dicing

- Process mechanism of SD
 - 1) Laser source: IR laser
 - Laser grooving: removing surface material
 - Stealth dicing: Si modification
 - 2) Expanding dicing tape to separate die



What is Stealth Dicing

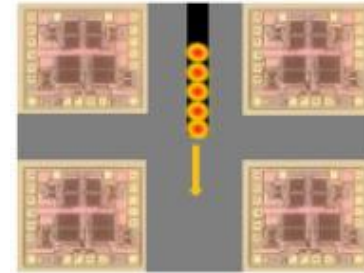
- Limitation of SD
 - Uncut can be observed on die size smaller than 2 x 2 mm



- High die touching risk in PnP due to narrow die to die space

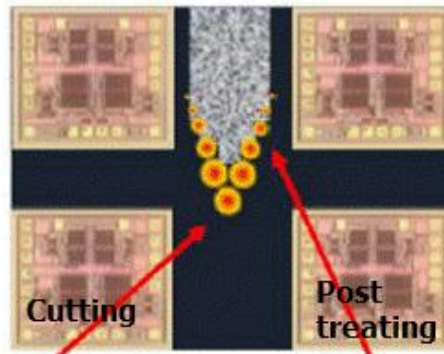
What is Laser Full Cut

- Process mechanism of laser full cut
 - 1) Laser source: UV laser
 - Apply multi-beams laser to cut thru Si.



Source: ASM

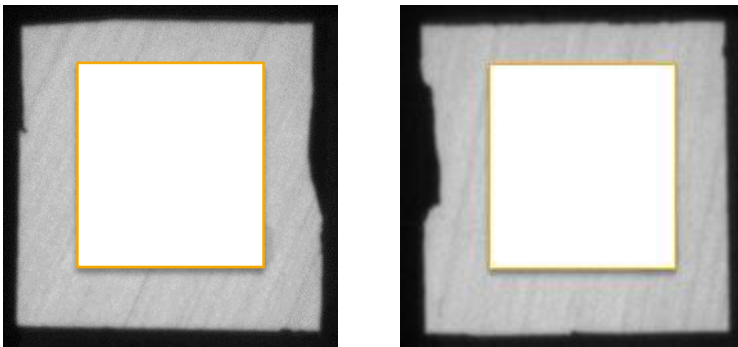
- HAZ minimization (post treatment)
 - Less heat → Less recasting → Improve die breakage strength
 - Inner beams for cutting & outer beams for recasting removal



Source: ASM

Laser Dicing

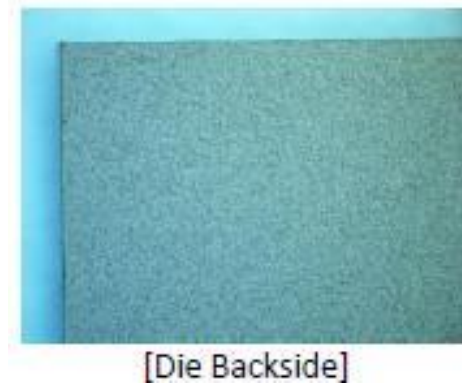
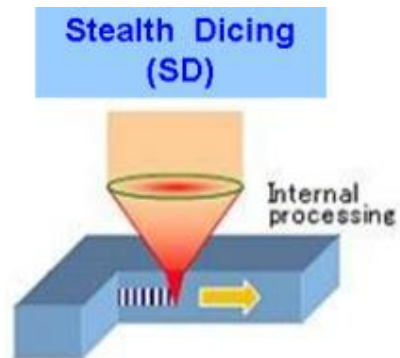
- Tightened external visual criteria (chipping)
 - Chipping is unavoidable in blade saw process



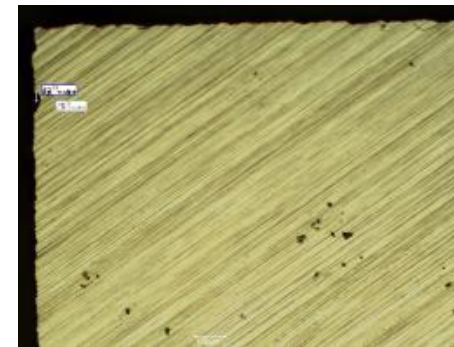
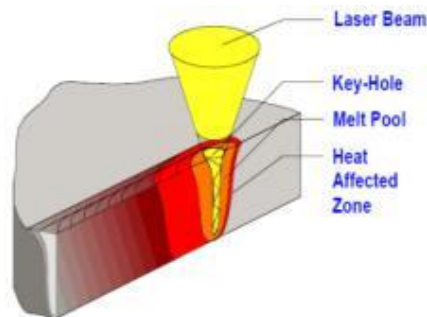
- Today, tightened chipping size is driven by end customer

Laser Dicing

- Tightened external visual criteria (chipping)
 - To meet tightened criteria with productivities by applying
 - Stealth dicing



- Laser full cut



Summary

- Main application is used as dicing process for laser in WLCSP
- Minimize HAZ (Heat Affect Zone) → less recasting → stronger die strength → good quality

Thank you

