A Temporary Bonding and Debonding Technology for TSV Fabrication

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TSV Wafer Process - Via Middle Process -

	FEOL	TSV Etch/Liner/ Metal /CMP	Anneal CMP	BEOL	Temporary Bond	Thinning	Cu Reveal	RDL	Debond
Via Middle									

Thin wafer handling is key process for TSV

Temporary wafer bonder Synapse™ V

Mechanical wafer debonder Synapse™ Z Plus

Target Application

3D IC & TSV

2.5D Interposers

Temporary Bonder/Debonder - Key Process & Performance -

	Key Process / Key Performance	Bonding	Back Grinding	CVD	Litho	Etching	Debond Cleaning
Bond	Void	☑	☞ **Hole**	☞ **Burst**		☞ **Profile Error**	
	TTV	☑			☞ **DOF**	☞ **Profile Error**	
	Bonding Accuracy	☑	☞ **Chipping**		☞ **Notch Detect**		
	Edge Coverage	☑	☞ **Chipping**				
	Warpage	☑			☞ **Handling**	☞ **Handling**	
Glue	Modulus		**Burn**				
	Stick		**Unsticking**	**Unsticking**			
	Heat Resistance			**Unsticking**			
	Chemical Resistance				**Developing**		
	Debondability						**Debondability**
	Cleaning Properties						**Cleaning Properties**
De Bond	Debond Force						☑
	Cleaning Performance						

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Temporary Bonder / Debonder Trend

Thin wafer handling method is changed by application trends.
Mechanical debond method is selected for 3D TSV application

Market Needs

Debond Method		Feature
Solvent Release		Initial thin wafer handling method for **power device and MEMS** • Wafer warpage issue • Expensive Hole Glass Carrier • Low Throughput <2wph
Laser/UV Debond		Mainly **2.5D** application • Easy to remove carrier wafer • Expensive good TTV glass wafer • Wafer warpage issue
Mechanical Debond		Mainly **3D** application • Silicon carrier capable • Good wafer warpage < 100um

TEL support mechanical debond method!

TEL Thin Wafer Handling System Lineup

Key words: Productivity, Reliability, High Performance

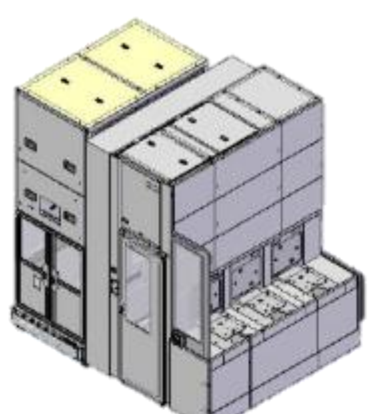
Temporary wafer bonder Synapse™ V

Mechanical wafer debonder Synapse™ Z Plus

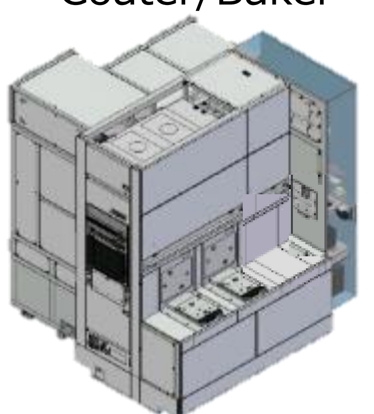
R&D

Key words: Low Cost, High Performance, Flexibility

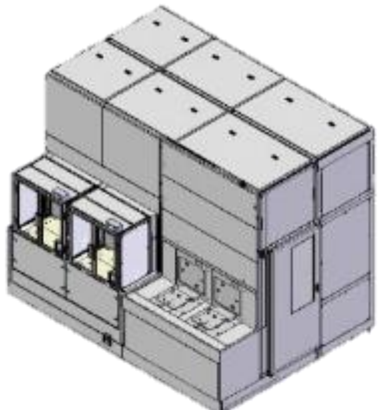
S/A wafer bonder



S/A Glue Coater/Baker



S/A Debonder/Cleaner



Temporary Bonding Process

Tri Layer
Wafer Bonding

Carrier Wafer

Glue Coat
Bake

Coater/Oven

Support Wafer
Support Layer
Release Layer
Protection Layer
Device Wafer

Bonding

Device Wafer

Protection Layer Coat
Bake

Coater/Oven

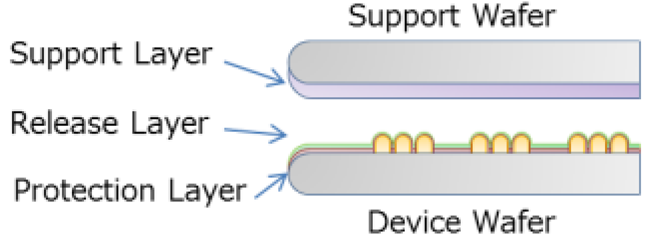
Release Layer Coat
Bake

Coater/Oven

Bonder

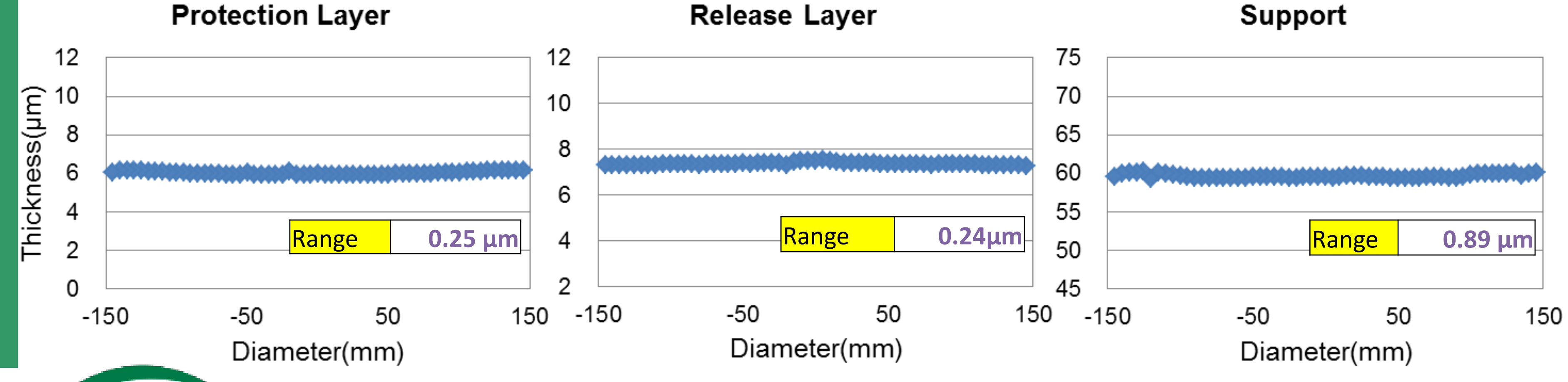
Synapse V | **Coater** | **Oven** | **Bonder**

Coating Film Thickness Uniformity



Protection Layer : Target Film Thickness : ～10um
Release Layer : Target Film Thickness : ～10um
Support Layer : Target Film Thickness : ～60um

Film Thickness and Range [μm] (E.E.=5mm)



Coating Film Thickness Variation

[After Coating]

Ave.	37.6	(um)
MAX	58.2	
MIN	29.2	
Range	28.96	

Film thickness (um)

Distance from center (mm)

A B C D E F G H I J K L

[After De-Bond]

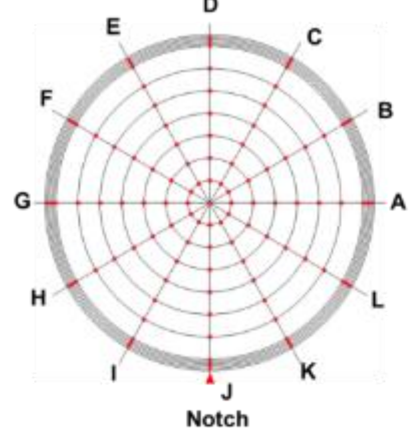
Ave.	33.7	(um)
MAX	35.7	
MIN	30.5	
Range	5.21	

Film thickness (um)

Distance from center (mm)

A B C D E F G H I J K L

Glue thickness varies significantly after bonding depending on the material

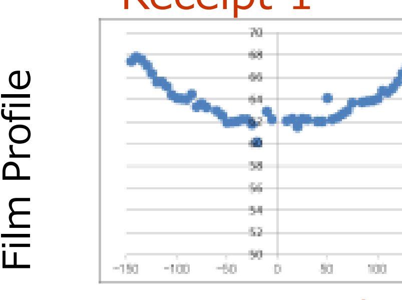


Coating Uniformity VS. TTV after Bonded

Coating Uniformity

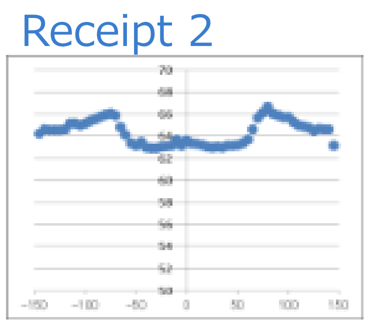
Film Profile

Receipt 1



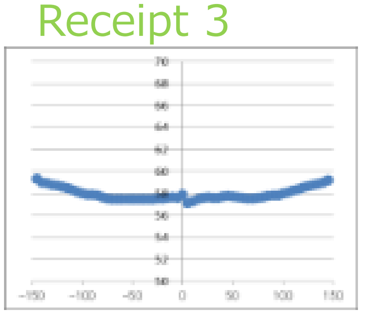
Range ≦ 7.0um

Receipt 2



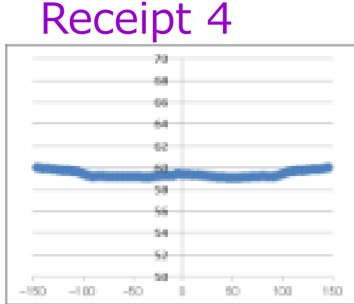
Range ≦ 4.0um

Receipt 3



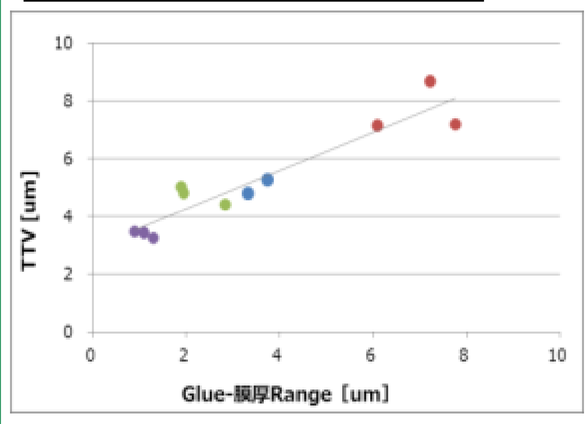
Range ≦ 2.0um

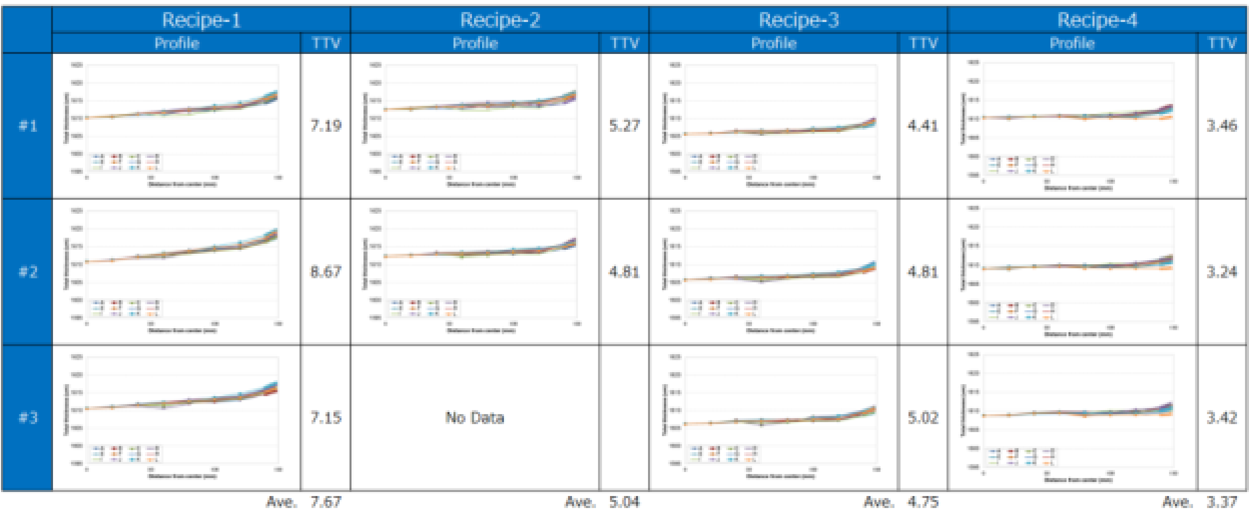
Receipt 4



Range ≦ 1.0um

TTV after Bonded





	Recipe-1		Recipe-2		Recipe-3		Recipe-4	
	Profile	TTV	Profile	TTV	Profile	TTV	Profile	TTV
#1		7.19		5.27		4.41		3.46
#2		8.67		4.81		4.81		3.24
#3		7.15	No Data			5.02		3.42
	Ave.	7.67	Ave.	5.04	Ave.	4.75	Ave.	3.37

TTV correlate with coating uniformity depending on the material

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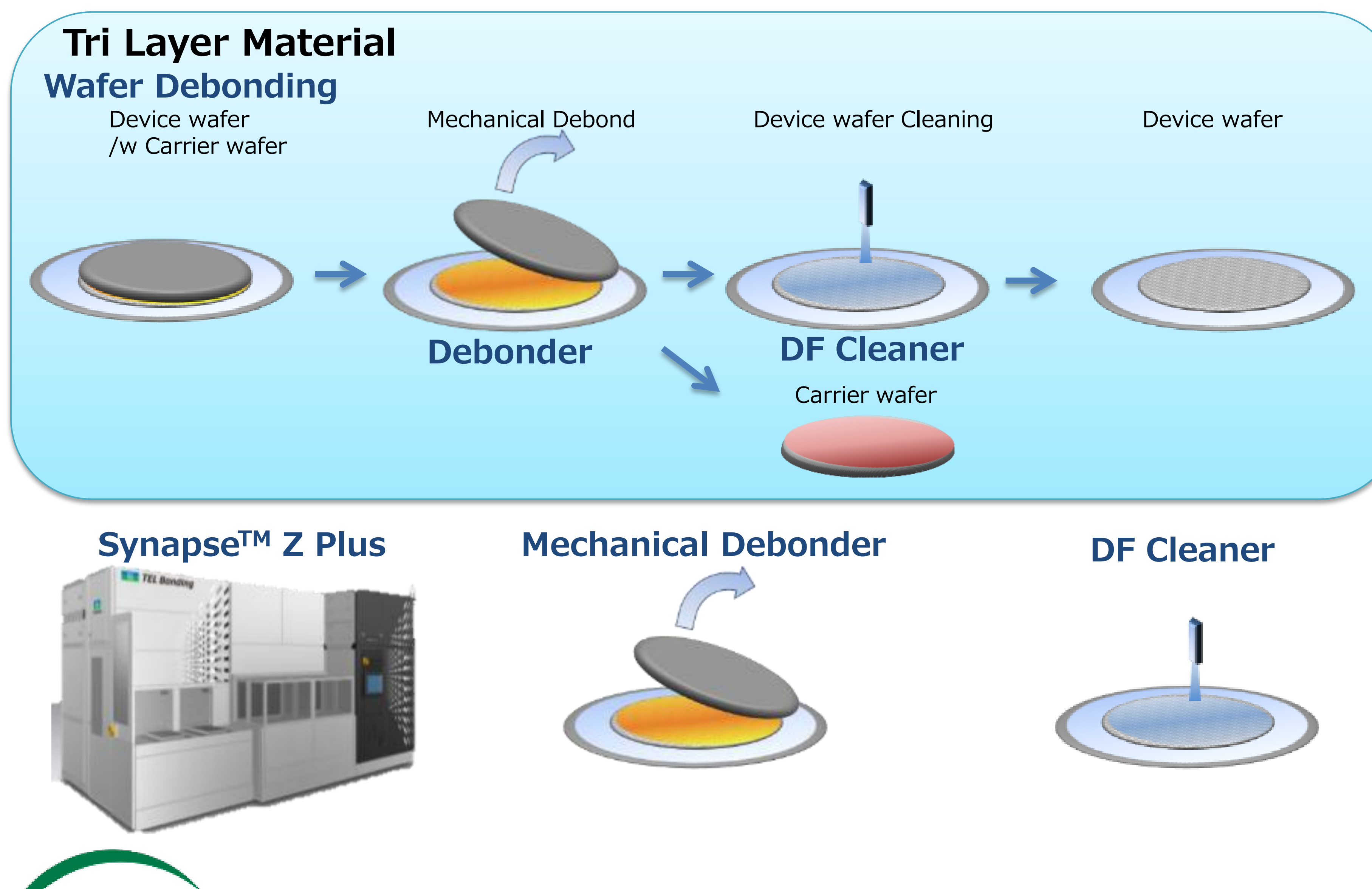
Void - CSAM -

No Void

Void

Prevent void by optimizing bonding conditions

Debonding Process



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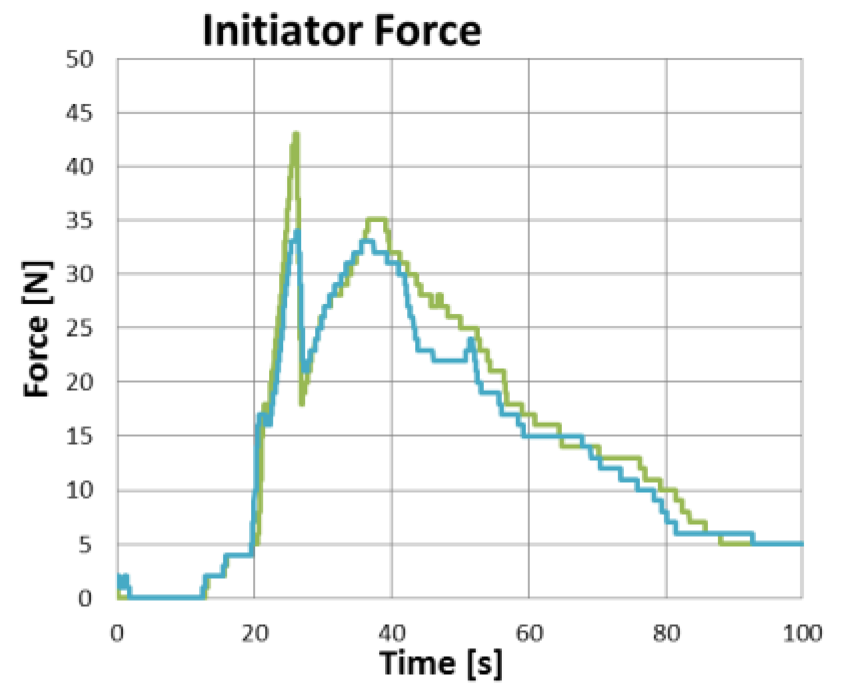
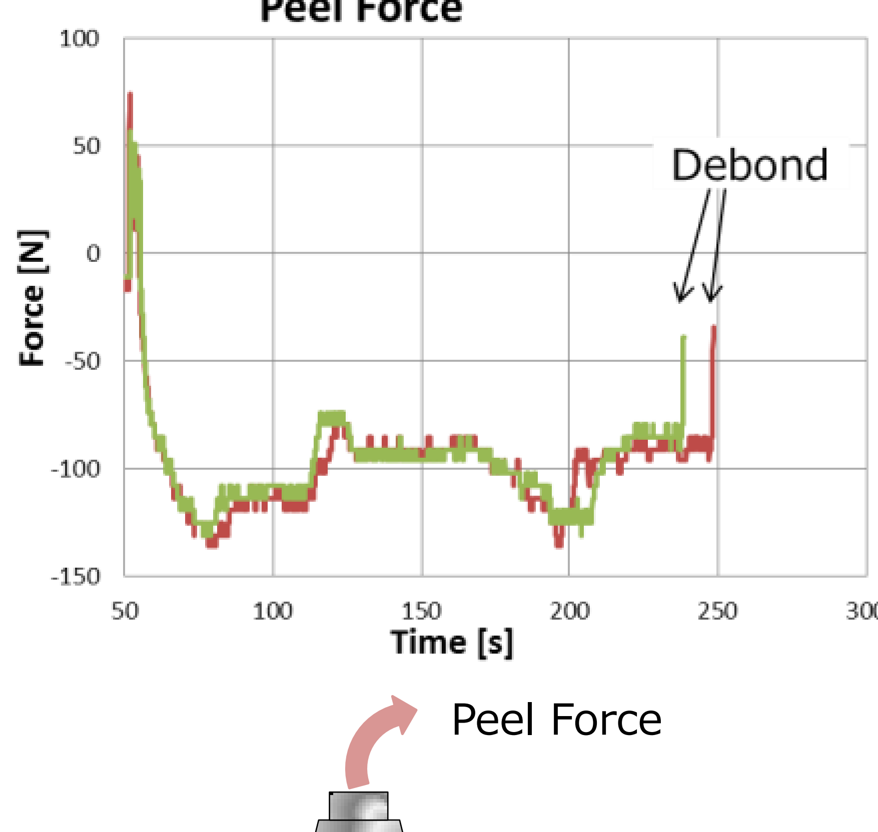
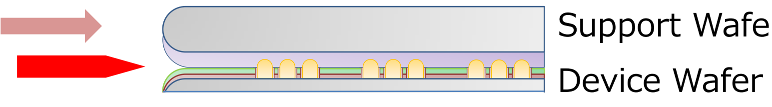
Debond Force Example





Peel Force <150N

Initiator Force



Initiator Force <100N

Room Temperature Temporary Bonder/Debonder

System Concept
- Genuine tool designed for high volume manufacturing
- Enough 300mm fab automation and software experience

Temporary Wafer Bonder System Feature
- Supports entire temporary wafer bonding process from material coat to wafer bond
- Open platform for glue material
- <5% TTV for glue thickness
- Void less bonding quality
- High alignment accuracy <+/-30um

Peel Off Wafer Debonder System Feature
- Supports entire wafer debonding process on tape from debonding to device wafer cleaning
- Open platform for room temperature debonding material
- Chipping less peel off debonding technology

Temporary Wafer Bonder
Synapse™ V

Peel Off Wafer Debonder
Synapse™ Z Plus

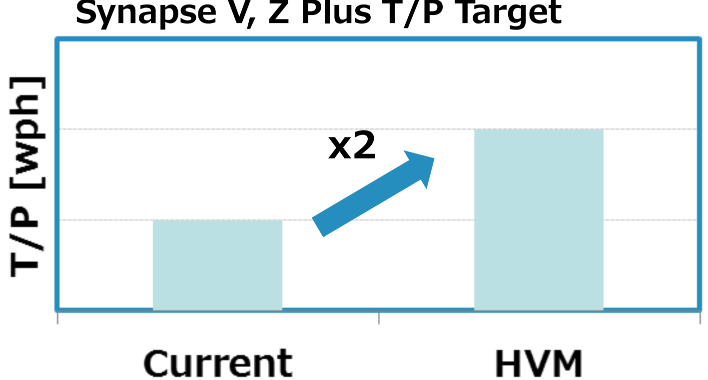
TEL Room Temp Temporary Bonder/Debonder

- Development Target
  - Expand adhesive choice for several application
  - Enhance productivity for TSV HVM

Optimize Throughput

Double system T/P from current

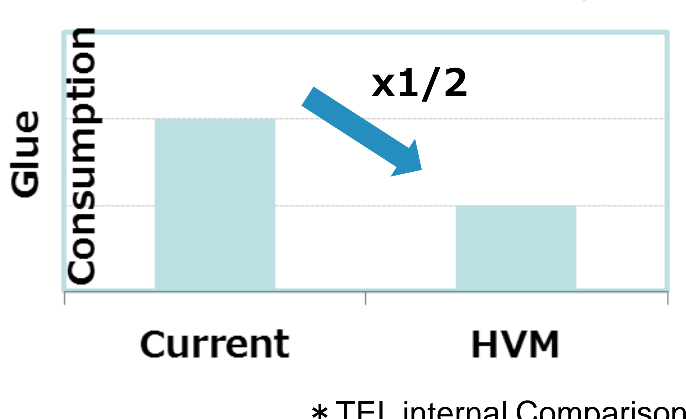
- Optimize tool configuration
- Minimize tool overhead time
- Mature coating process and glue character



Reduce Glue Consumption

Half glue consumption

- Optimize coating recipe
- Design new coating nozzle



＊TEL internal Comparison

Summary

- In order to successfully handle TSV thin wafers during before dicing, temporary bonder and debonder are one of key process.
  TEL focus on mechanical debond method.
- In temporary bonding process, optimization of both material coating and bonding are important.
- In mechanical debonding process, control of debonding force is important.
- TEL can provide the best solution for HVM.