

SILICON PROCESSING TOOLS for SEMICONDUCTORS

SEMICONDUCTOR

Asahi Diamond makes a social foundation.

We see electronics and semiconductor products used in various ways in our surroundings. For example, electronics and semiconductor products are incorporated into televisions, smartphones, personal computers and domestic electrical appliances familiar to us. That material is silicon.

This catalog introduces our company's diamond tool used in the pre-process (manufacturing process for wafers) and the post-process (manufacturing process for devices) based on the manufacturing process of silicon semiconductor.



Semiconductor Manufacturing Solution

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Diamond Band Saws

Cropping

Diamond band saws are used in the process of cropping silicon ingots. In addition to this, they are also put to various other uses, such as cutting carbon and fused silica glass.

Electroplated band saws

By selecting the blade edge electroplate pattern best suited for the material to be grinded or the condition of use, it is possible to achieve high-precision cutting with high efficiency.

■ The table of sizes

Entire length (mm)	Width of core metal (mm)	Thickness of core metal (mm)
2,500~10,000	26~125	0.15~1.33

*Please contact our sales representatives for details on the sizes we manufacture.



■ Shape of the blade edge



Segmented Type

- ◆ Suited for processing rigid and fragile materials, with superior grinding performance and a long life.
- ◆ Especially well suited for high-precision and high-efficiency cutting of monocrystalline silicon.
- ◆ We also manufacture customized products that prioritize the sharpness of cutting, by changing the electroplating pattern (size and pitch) according to the required performance.



Serrated Type

- ◆ Can be used for a wide variety of products.
- ◆ Superior sharpness even for hard-to-grind materials.
- ◆ Perfect for cutting materials that tend to clog the blade edge when grinded.



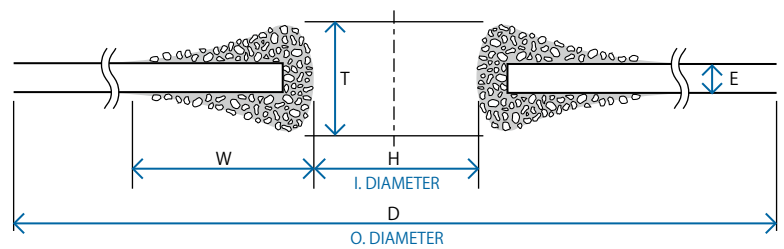
Continuous Type

- ◆ A wide variety of uses, from narrow to wide widths.
- ◆ The continuous electroplated surface reduces saw marks on the cut surface of the grinded material.

■ Use case

Cutting speed (mm/min)	Peripheral speed (m/min)	Tension (N/mm ²)
20~100	1,000~1,200	100~200

The ID blade is a blade with a high tensile strength stainless-steel core and diamonds fixed onto the thin, nickel-electroplated inner circumference. It is mainly used for cropping and slicing monocrystal line silicon ingots. The thin blade requires less cutting margin and achieves a high cutting efficiency. In addition, it produces high-precision and highly-flat cutting surface.



■ Main specifications

Process	Size	Workpieces size	Outer diameter	Inner diameter	Core metal thickness	Blade width	Blade thickness	Grit size
		Inches	D: mm	H: mm	E: mm	W: mm	T: μm	
Cropping	AGI-27	4~6	690	240	0.15, 0.18	3.0	0.4~0.5	#170, #200, #230
	AGI-34	8	860	305				
Slicing	AGI-23	4~5	597	204	0.1, 0.12, 0.13	2.0, 3.0	260~300	30~50, 40~60 μm
	AGI-27	5~6	690	240	0.1, 0.12, 0.13	2.0, 3.0	260~300	30~50, 40~60 μm
	AGI-34	8	860	305	0.15	3.0	330~350	45~65 μm

* These represent our standard specifications. We also provide products customized to other specifications (please inquire).

■ Use case

Process	Workpieces size (inches)	Cutting speed (mm/min)	Rotating speed (min ⁻¹)	Coolant
Cropping	4~8	20~50	1,000~1,500	Water-soluble
Slicing		40~50	Approx. 1,500	

Grinding Wheels for Silicon Ingots

Peripheral Grinding
Orientation Flat Processing

Peripheral grinding, orientation flat processing, notch grooving

Metal bond wheels are used for the peripheral grinding of silicon ingots, or processing orientation flats to show the crystal orientation and processing notches.

Based on our past experience in various field, we provide wheels that fulfill the needs of our clients and fit the machines they are using.



Main specifications for peripheral grinding and orientation flat processing

Metal bond	Grit size		Outer diameter
	Rough grinding	Fine grinding	
MHX	#60~80	#140~200	$\phi 78 \sim \phi 120$
MK10			

* These represent standard specifications for silicon ingot.
We also provide products customized to other specifications (please inquire).

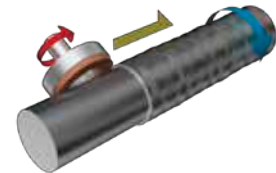
New bond MK10

The new bond in the MK10 gives it the superior ability to stay sharp, making it possible to extend the dress intervals and reduce the frequency of dressing.

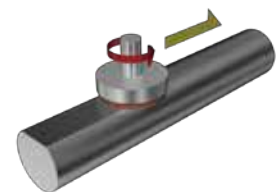
Main specifications for V-groove notches

Metal bond	Grit size	Outer diameter	Angle	Point R
MHX	#120~#200	$\phi 80 \sim \phi 120$	Around 90 degrees	0.9~1.0

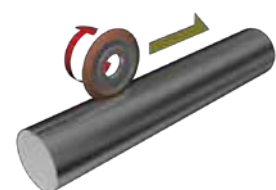
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Peripheral grinding



Orientation flat grinding



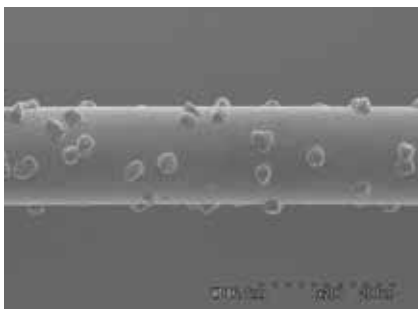
Notch grooving

Diamond Electroplated Wire (EcoMEP)

Eco MEP

Ingot Slicing

EcoMEP diamond wire is a thin elongated wire with diamond abrasives electroplated onto high tensile wire using special technology. Compared to the conventional loose-abrasive method, the slicing (processing) time of rigid and fragile materials such as silicon and sapphire can be shortened. It is also possible to reduce cutting margins and processing strains, so improvement of yield can be expected. Because water-soluble coolant can be used, dust can be collected and recycled, making this an eco-friendly product that also reduces overall costs. Clients can try out our cutting machines at our testing laboratory, which enables us to offer machines and cutting conditions that are best-suited to the materials our clients need to cut.



Surface enlargement of EcoMEP



□ Main specifications

Strand diameter mm—Nominal grit size μm (Finished diameter mm)	Supplied length
$\phi 0.12$ 10~20 ($\phi 0.145$)	10~50km/reel

* Please contact our company for other specifications we offer.

□ Advantages (over loose-abrasive), performance

1. Reduced total cost

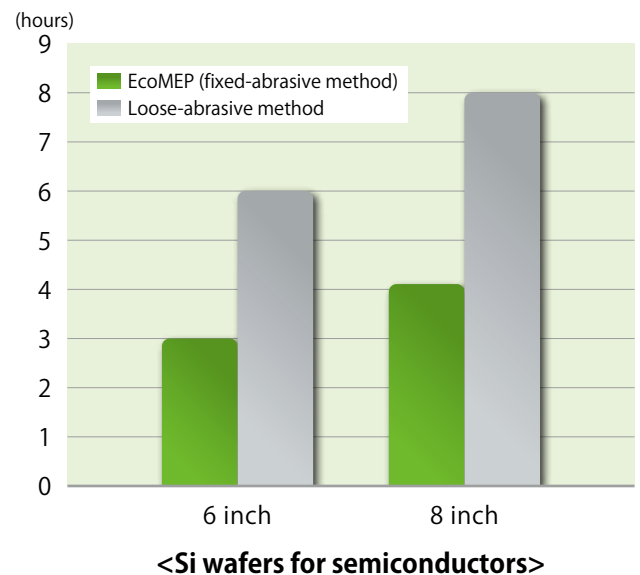
- ◆ Shortened cutting time
- ◆ Improved wafer yield \Rightarrow Thinner wafers, thinner wires

2. Improved quality

- ◆ Reduced wafer damage
- ◆ More balanced thickness

3. Reduced environmental burden

- ◆ Improved working environment \Rightarrow Use of water soluble coolant \Rightarrow Slurry unnecessary
- ◆ Recyclable coolant and cut dust



Edge Grinding Wheels

Edge Grinding

Metal bond wheels and resin bond wheels are used in edge grinding on the outer circumference of silicon wafers, which requires uniform sharpness in addition to precision accuracy in the shape of the wheel and abrasion resistance. We are able to provide a wide variety of specifications, including single grooved wheels, multi-grooved wheels, and wheels for both rough and finish grinding.



■ The table of sizes

Process		Grit size	Outer diameter of the wheel	Depth of diamond layer	No. of grooves
Edge grinding	Rough and finishing (metal)	#400~#3000	φ 102, φ 202	2.5~3.7 mm	~10 grooves
Edge grinding (low-strain processing)	Rough (metal)	#800 (for truer groove, #600)	φ 202	2.5~3.7 mm	~10 grooves
	Finishing (resin)	#1500, #2000, #3000	φ 50	—	2~3 grooves

* Please contact our sales representatives for details on the sizes we manufacture.

■ Use case

Process		Peripheral Speed (m/min)	Feed speed (mm/sec)	Accuracy of workpieces (μm)
Edge grinding	Rough (metal)	1,800~3,000	10~30	0.3Ra (#800)
	Finishing (metal)			0.15Ra (#1500)
Edge grinding (low-strain processing)	Rough (metal)	5,000	30~45	—
	Finishing (resin)	5,000	8~24	0.05~0.06Ra (#1500)
				0.01~0.02Ra (#3000)

■ Shape of the diamond layer

Please refer to the figures on the right.

Notch Grinding Wheels

Small-diameter formed wheels are used to finish the notches of large-diameter wafers. Our notch grinding wheels maintain the run out accuracy of diamonds to the shank, and realize a favorable wafer circumference. As with our edge grinding wheels, we are able to provide a wide variety of specifications, including single-grooved wheels, multi-grooved wheels, and wheels for both rough and finish grinding.



■ The table of sizes

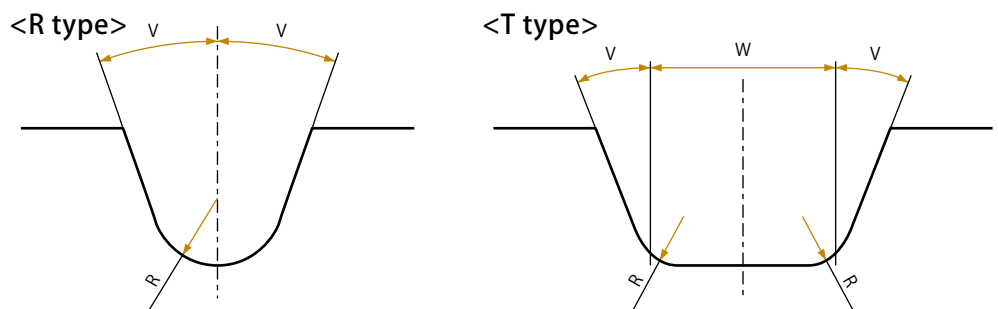
		Metal bond grit size	POLYX grit size	Outer diameter of the wheel	No. of grooves
Edge grinding		#800~#2000		$\phi 3.3\sim 4.2$	~6 grooves
Edge grinding (low-strain processing)	1st	#800	—	$\phi 3.8\sim 4.2$	~6 grooves
	2nd	#1500~#2000	#1500, #2000, #3000	$\phi 3.8\sim 4.2$	~6 grooves

* Please contact our sales representatives for details on the sizes we manufacture.

■ Use case

	Bond	Rotating speed (min ⁻¹)	Feed speed (mm/sec)	Accuracy of workpieces (μm)
Edge grinding	Metal	30,000~60,000	0.4~0.8	0.5Ra (#800 metal)
Edge grinding (low-strain processing)	Metal	1st 80,000 2nd 150,000	0.1~0.6	0.5Ra or less (#800 metal)
	POLYX	150,000	0.2~0.5	0.08~0.11Ra (#1500)
				0.06~0.08Ra (#3000)

■ Shape of the diamond layer



Chemical Mechanical Polishing Conditioner

CMP

The CMP (chemical mechanical polishing) process has been introduced into the smoothing technology used for LSI manufacturing. Elements are becoming increasingly miniaturized and wiring is becoming multilayered in order to improve the function and speed of semiconductor devices.

Conditioners for getting the pad surface back into optimal condition are considered an important consumable component, together with pads and slurry.

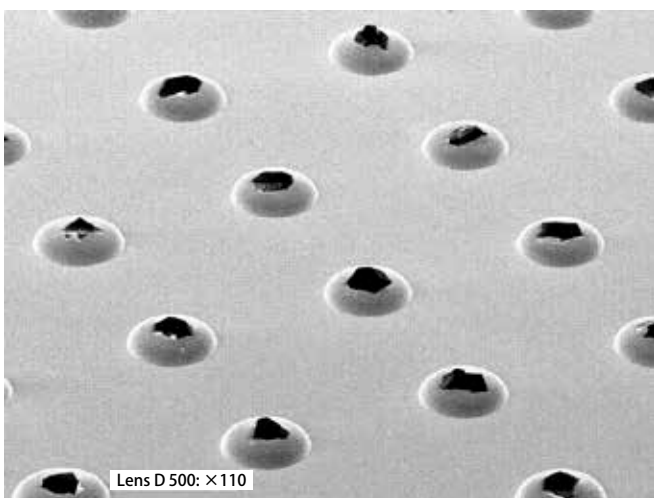
■ Main technical developments

- Improved polishing rate → Review of the selection and positioning of abrasives
- Scratch control → Control in the falling of abrasives
- Cost reduction → Extension of the life of conditioners

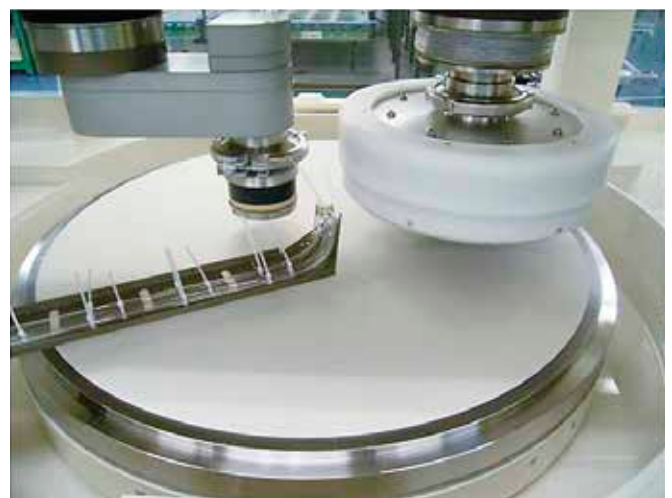
■ Standard specifications

Type	Grit size	
	#60	#100
Pellet (φ20)	○	○
4-inch Scan	○	
Ring type (φ250~360)		○

*Please contact our sales representatives for details on the specifications we manufacture.



Surface enlargement



Grinding Wheels for Silicon Wafers

Double Disc Grinding
Surface grinding
Back grinding

Grinding wheels for silicon wafers are used to process silicon wafers (including compound semiconductors) to be thin and flat.

Diamond wheels for back grinding are used to grind the back side of silicon wafers in order to improve the quality of the processing and reduce grinding damage. It also makes it possible to shorten the processing time because it lightens the polishing process.



Main specifications

	Grit size	Bond type	Bond specification
For rough grinding	#325~#500	Resin, vitrified	DK Series
For finish grinding	#1200~ #4200	Resin	DK Series
	#5000~ #30000	Vitrified	SILKY STAR (VF Series)

*Grit size over #30000 are also available (please inquire).

For rough grinding

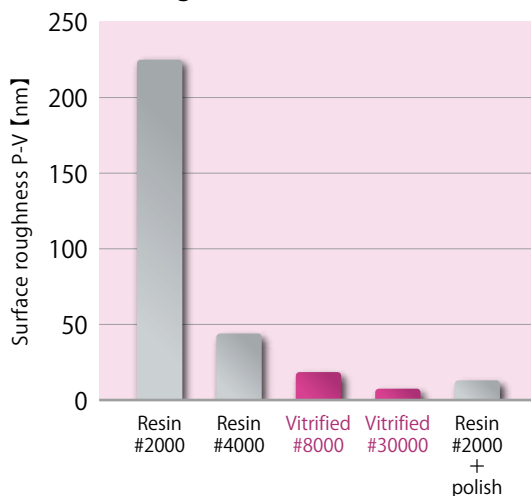
We offer two types of bond that provide cutting sharpness and improved processing quality: a vitrified bond with high rigidity and a resin bond that causes less grinding damage to work, and clients can choose the one that best fits their needs.

For finish grinding

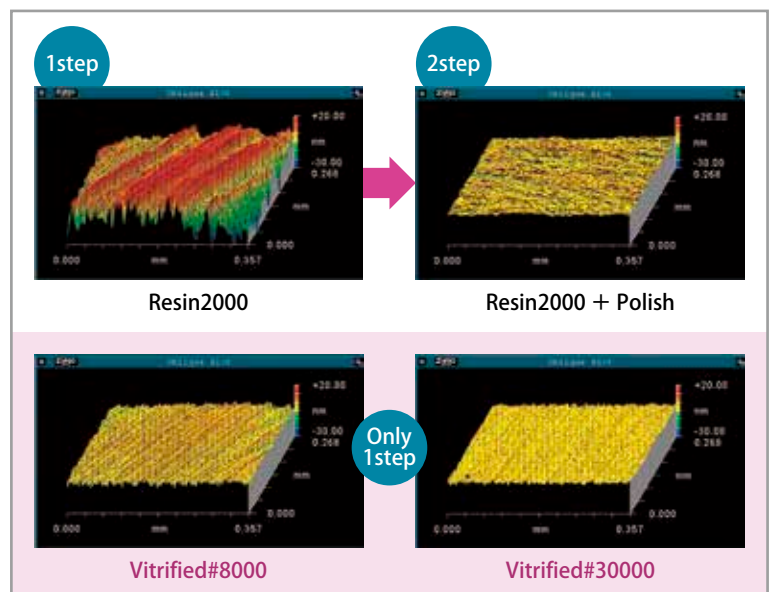
By using **SILKY STAR**, a vitrified bond wheel with ultrafine diamond abrasives, wafers can be thinned very easily. It also reduces the roughness of the finish surface of the wafer and damage from grinding. We provide the bond specifications best suited to the machines used, the conditions of processing, and the level of precision required.

Examples of semiconductor device manufacturers

<Surface roughness>



<Grinded surface>



※by ZYGO

Hub-type electroformed blades are used for dicing patterned wafers. Because they have aluminum alloy hubs, they can be used more easily than ring-type blades. Not only can the specifications for our dicing blades be set according to the client's needs, but the blades can also handle materials that are difficult to grind, such as ultra-thin wafers and wafers with metallic film, by using specially-treated blade edges.



Examples of main specifications

Sample specifications: : H 25 5 R M — T4 — 030 060

Shape	Grit size	Concentration	Hardness of bond	Manufacturing process	Steel core shape	Blade thickness (μm)	Blade edge protrusion (x10μm)
H: Standard	25: #2500 ~ 40: #4000	3: Low 5: Standard 7: High	J: Soft N: Standard R: Hard	M N S P V	T4	015 ~ 050 <small>* Depends on grit size</small>	030 ~ 130 <small>* Depends on blade thickness</small>

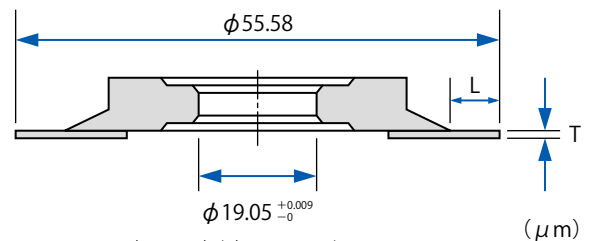
* These represent standard specifications. We also provide products customized to other specifications or processed materials (please inquire).

Size

Outer diameter (mm)	Inner diameter (mm)
55.58	19.05

Performance during normal use

Main shaft rotating speed (min ⁻¹)	Feed speed (mm/sec)
30,000~ 50,000	up to 100



The HD Blade for shortening precut times (grit size: from #3000)

Because of the special manufacturing method used for the blade edge, precut times are drastically shortened. It is especially well suited for processing ultra-thin wafers.

Bonding tools

In reaction to the market needs of increased thinness and number of pins due to recent developments in semiconductor mounting technology, we provide various tools for mounting including TAB (tape automated bonding), FC (flip chip), COF (chip on film), and COG (chip on glass).

Our use of diamonds and CBN materials with superior abrasion resistance, heat resistance and heat conductivity that perform stably in high temperature environments, and our adoption of original processing technology allow us to provide high-precision, quality Asahi Diamond bonding tools and bonding stages.



Cutting Wheels for Packages

Package cutting

Precision cutting wheels are used to cut packaged electronic parts.

Specifications for our cutting wheels can be set according to the client's needs and the type of and materials used for their packages.

Our cutting wheels are also used for processing a wide range of materials other than packaged parts, such as magnetic materials, laminated ceramics and glass materials (including combined materials).

Representative specifications

	Grit size	Bond
Resin	#325~#400	BSAT BG2
Metal	#400~#600	MRST SUN NOVEL TCR Series
Electroforming	#325~#600	PS PW SUN MIGHTY (with steel core)

* These represent standard specifications and sizes for package cutting.
We also provide products customized to other specifications (please inquire).

Size

Outer diameter (mm)	Blade thickness (mm)	Inner diameter (mm)
$\phi 49 \sim \phi 58$	0.25~0.35 * Depends on grit size	40

* These represent standard specifications and sizes for package cutting.
We also provide products customized to other specifications (please inquire).

Performance under normal use

Blade	Main shaft rotating speed (min ⁻¹)	Feed speed (mm/sec)
For an outer diameter of $\phi 56$	20,000~30,000	30~100

* These may differ according to the type, materials and size of the package.



Special cutting wheels

Highly elastic metal bond cutting wheels **SUN NOVEL**

The SUN NOVEL is a cutting wheel with the durability of metal bond and the cutting performance of resin bond.

TCR Series highly rigid metal bond cutting wheels

The TCR is a metal bond cutting wheel with a rigidity that is even equal to electroforming cutting wheels.

SUN MIGHTY electroforming cutting wheels with steel core

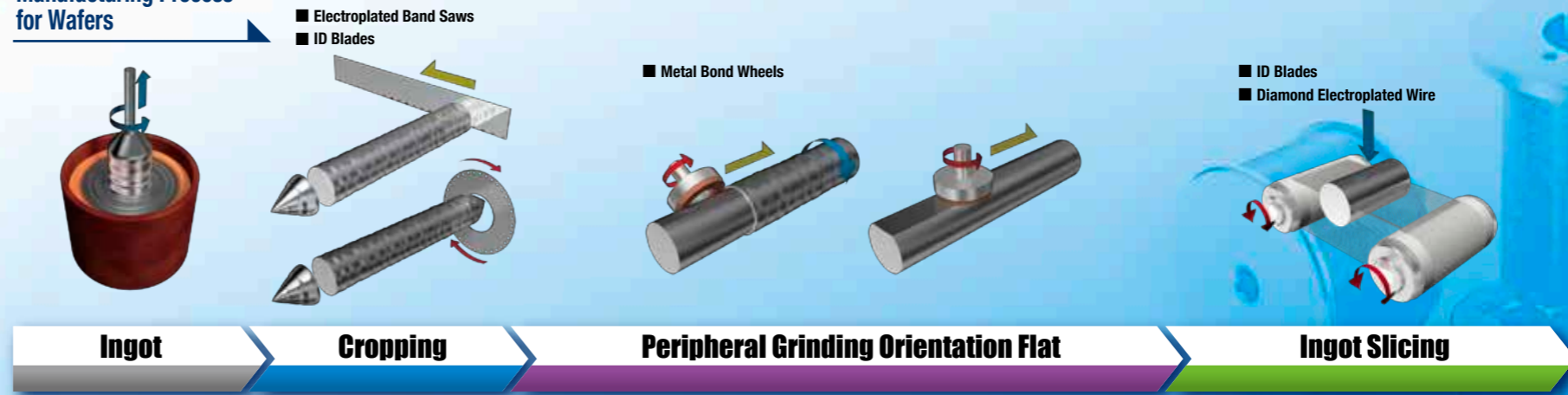
The SUN MIGHTY is a cutting wheel with a nickel-bond diamond layer on the outer rim of the high-tension stainless steel core. With its special form, it discharges chips with a high level of efficiency, holding down the abrasion of the side of the blade edge.



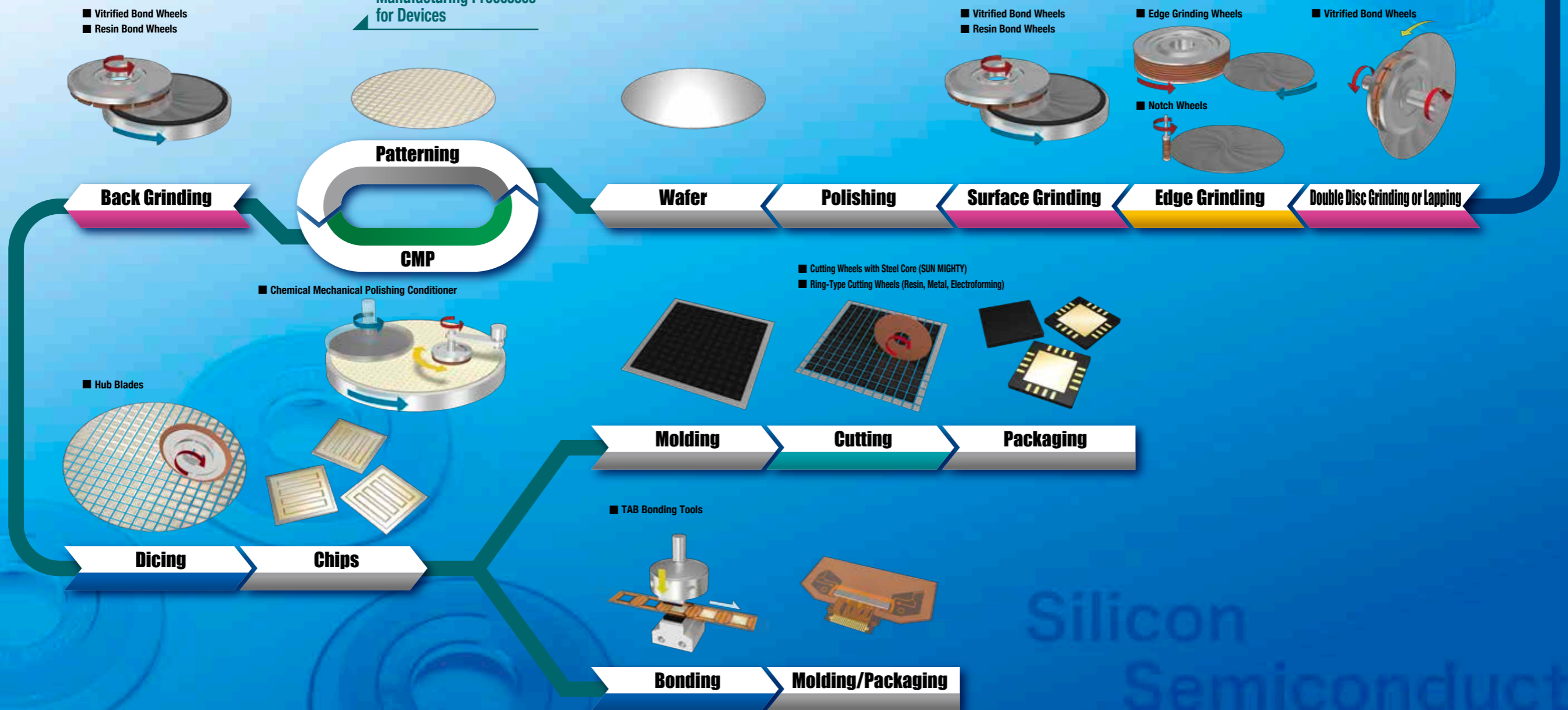
SUN MIGHTY's blade edge

Manufacturing Processes for Silicon Semiconductors

Manufacturing Process for Wafers



Manufacturing Processes for Devices



Silicon Semiconductor

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Mie Factory
Tamagawa Factory
Chiba Tsurumai Factory
Chiba No.2 Factory
Yamanashi Asahi Diamond Industrial Co., Ltd.

Shape the Innovation
私達の革新で、お客様の革新をカタチにする