CMP Conditioners and Wafer Edge Tools

CMP pad conditioning and wafer edge machining: separate tool ranges and machining tasks in the semiconductor value chain.

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CMP conditioning and wafer edge grinding

This programme combines two separate tasks in the semiconductor value chain: CVD diamond conditioners, BSL double-layer and electroplated conditioners activate the polishing pad in the respective CMP process. Profile grinding tools, by contrast, machine silicon and sapphire wafer edges during substrate or wafer manufacture. Wafer edge machining is therefore not classified here as a general front-end device-fabrication step.

In CMP, the conditioner activates the polishing pad surface. PCR (Pad Cut Rate) describes removal from the pad; WRR (Wafer Removal Rate) describes removal from the wafer. Both are matched with pad, slurry and equipment settings. Edge grinding focuses on chamfer width, groove profile, profile retention and the division between rough and fine grinding. The product images illustrate tool forms and applications.

CVD: engineered tips and effective contact areas

CVD conditioners use chemical vapor deposition to coat a patterned surface with diamond. This construction differs from individual diamond grains held by electroplated nickel or brazing. The tip pattern is engineered for the respective CMP process.

Uniform tip size and protrusion support flatness of the effective contact surface. A flat tip apex allows local loading to be engineered. Tip size, number, shape, pattern and protrusion influence PCR and wafer removal. In the illustrated conditioning concept, the engineered tip shape remains largely consistent over use, supporting stable contact conditions and conditioning action. EHWA also describes this development in its patent publications on tip and contact-area design.

The CVD surface provides high chemical stability. Its diamond-coated working surface can reduce exposure of metallic bonding material to process chemistry. The product sheets describe this benefit as avoiding corrosion and metal contamination. The selected disc is matched to the slurry actually used.

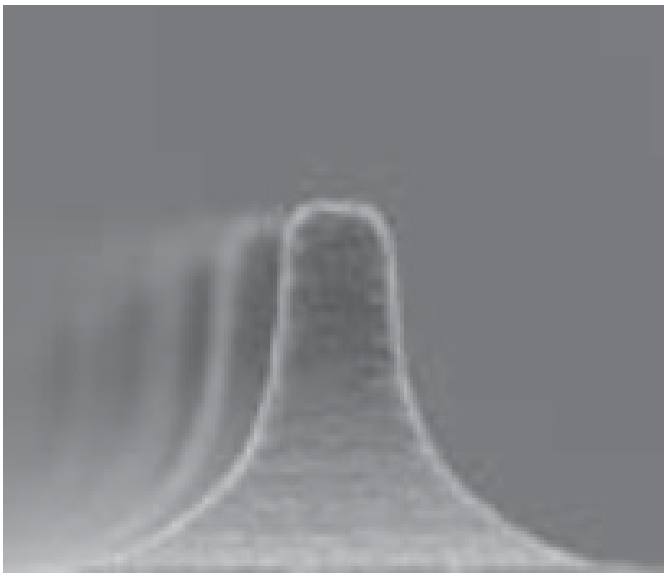
Customisation considers the polished material, pad and slurry. The application matrix lists oxide CMP with ceria-/silica-based slurry and tungsten and copper CMP, each with bulk and barrier steps. Closed-cell and open-pore pads are marked as application areas in all five process columns.

Design feature	Benefit in the conditioning concept
Various tip patterns	Customisation for the respective CMP process
Flat tip apex	Engineered contact area
Pressure per tip	Control of local pad loading
Tip size and number	Patent-related development of contact design
Consistent tip shape	Stable contact conditions over use
Consistent PCR	Stable conditioning action in the intended process

Pad	Oxide CMP: ceria/silica	W CMP: bulk	W CMP: barrier	Cu CMP: bulk	Cu CMP: barrier
Closed-cell	●	●	●	●	●
Open-pore	●	●	●	●	●

CVD CMP conditioning discs.

Regular CVD tip pattern.



Flat working face of a CVD tip.

CVD product ranges and customisation

The CVD product sheets specify an outside diameter of 2-5 inches. Tip size, number and height are customised within the stated ranges. Height is determined according to tip size. These specifications belong to the programme described in the product sheets and provide a basis for application engineering.

A flat apex and engineered tip pattern allow the effective contact area to be tailored. The resulting load per tip is an important design variable. The objective is a sufficiently active pad surface with consistent roughness and economical pad consumption.

Feature	Range stated in product sheet
Outside diameter	2-5 inches
Tip size	Customised, over 5 µm
Tip number	Customised, below 30,000 per disc
Tip height	Customised, below 100 µm; determined by tip size

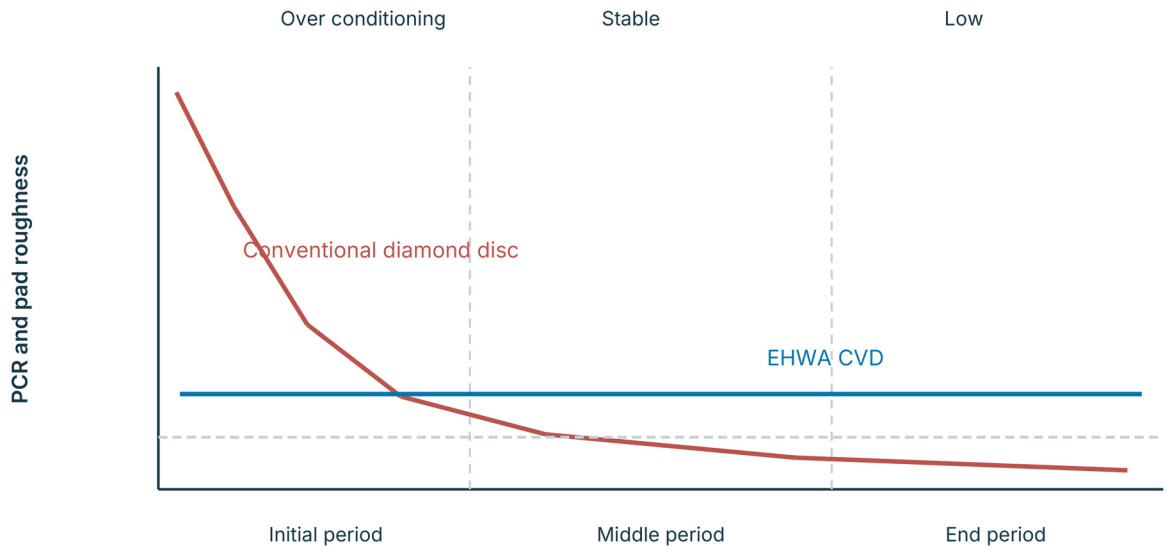
Consistent conditioning through pad use

The product sheets compare a conventional diamond disc and a CVD disc over time. In the conventional design, PCR and pad roughness decline considerably in the illustrated trend: strong initial conditioning is followed by a stable middle period and finally low conditioning action. The CVD line remains above the indicated pad-glazing threshold in the model.

The six corresponding pad profiles illustrate the different action in initial, middle and end periods. The conventional profile changes from a deep cut to a shallower contact profile; the CVD profiles remain similar across the three stages. The diagrams describe a qualitative comparison without numerical time or roughness values.

Uniform tip shape and contact area support process stability over use. Controlled conditioning aims to limit both excessive initial pad cutting and insufficient activation towards the end. This can extend the period during which a disc operates within a suitable working range.

PCR and pad roughness over time: conventional diamond disc and CVD disc

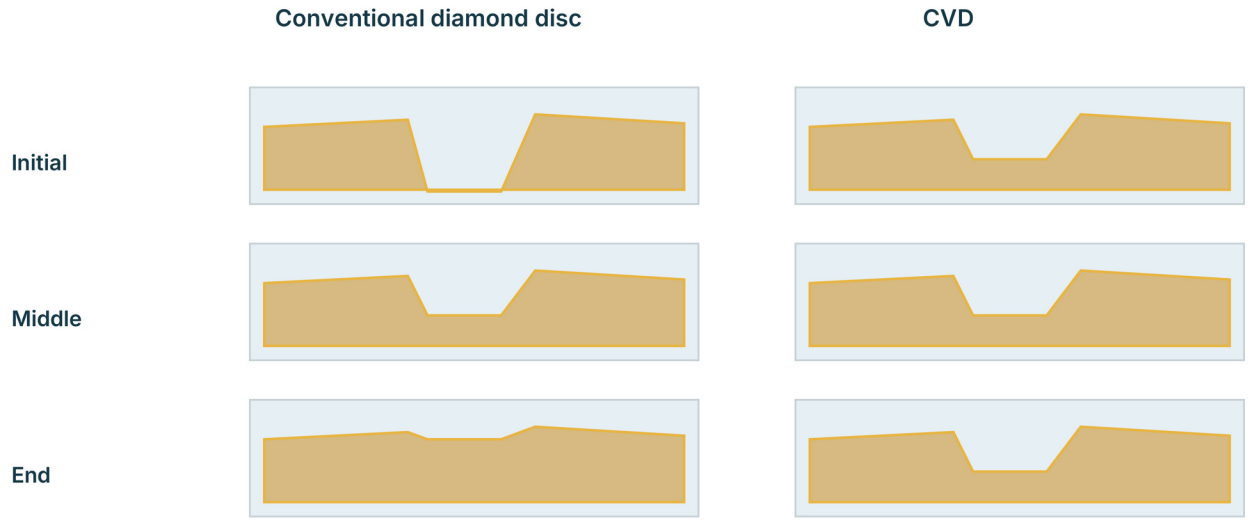


Pad use time – qualitative scale

Dashed: pad-glazing threshold

PCR and pad roughness over time: conventional diamond disc and CVD disc

Pad profiles in initial, middle and end periods: conventional disc and CVD



CMP pad: all six profile states

Pad profiles in initial, middle and end periods: conventional disc and CVD

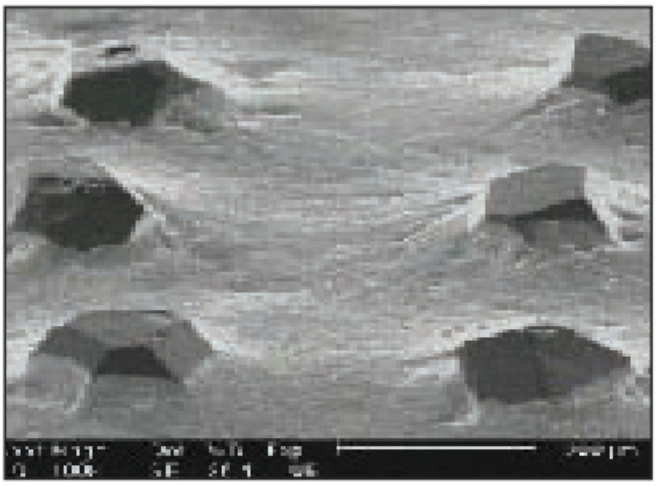
BSL double-layer and electroplated conditioners

In the BSL design, chemical reaction and mechanical contact hold the diamond to the substrate. Strong grain retention provides a basis for reliable pad conditioning. A carbide layer at the interface between diamond and metallic substrate supports corrosion resistance.

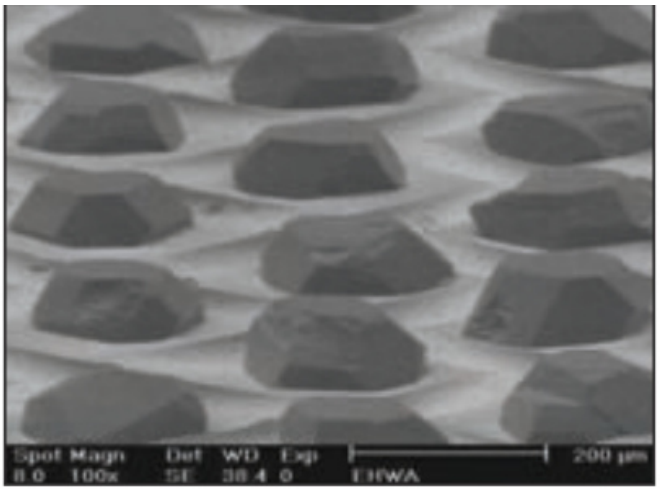
The usable edges of the diamond faces enable an extended effective working life of the grain. High protrusion and generous chip pockets support conditioning and removal of pad debris. The programme includes the new BSL double metal layer design and electroplated variants; the microstructural images show their different diamond arrangements. Selection considers pad, slurry and the required conditioning action.

CMP conditioners: discs, ring and pellets.

Additional view of the CMP conditioner group.



Diamond structure of the BSL double metal layer.



Diamond structure of the electroplated design.

BSL double-layer and electroplated variants: applications and product data

The application overview includes oxide CMP with BPSG, TEOS and PSG, metal CMP with aluminium, tungsten and copper, and STI, PGI, poly-Si and TSV CMP with Cu or poly-Si. These application groups are listed jointly for the conditioner programme.

The equipment list names AMAT, Ebara, Novellus, Strasbaugh and Lam models, as well as other equipment. The stated PCR range is 10-300 µm/h. Tool design and mounting are selected for the specific machine.

Application group	Named materials / processes
Designs	New BSL double metal layer; electroplated design
Oxide CMP	BPSG, TEOS, PSG
Metal CMP	Al, W, Cu
Further processes	STI, PGI, poly-Si; TSV CMP → Cu, poly-Si

Manufacturer	Models listed in product sheet
AMAT	Mirra / Reflexion
Ebara	F-Rex200/300; EPO-222(H)
Novellus	Auriga; CMP200/300; Avantgaard 776 (676); Momentum
Strasbaugh	6DS-SP; 6ED
Lam	Teres
Other equipment	Additional models subject to application engineering
Pad cut rate of the described programme	10-300 µm/h

Defect control: POR and EHWA compared

The comparison plots defect counts for POR and EHWA across 24 sample identifiers: 10A/B/C, 50A/B/C, 100A/B/C, 150A/B/C, 300A/B/C, 600A/B/C, 800A/B/C and 1000A/B/C. The blue POR series and red EHWA series remain distinct. The count scale runs from 0 to 1,400.

The EHWA series is lower for most identifiers shown. This example illustrates the potential of appropriate conditioning to support defect control. As complete process conditions are not specified, the comparison applies to the dataset shown.

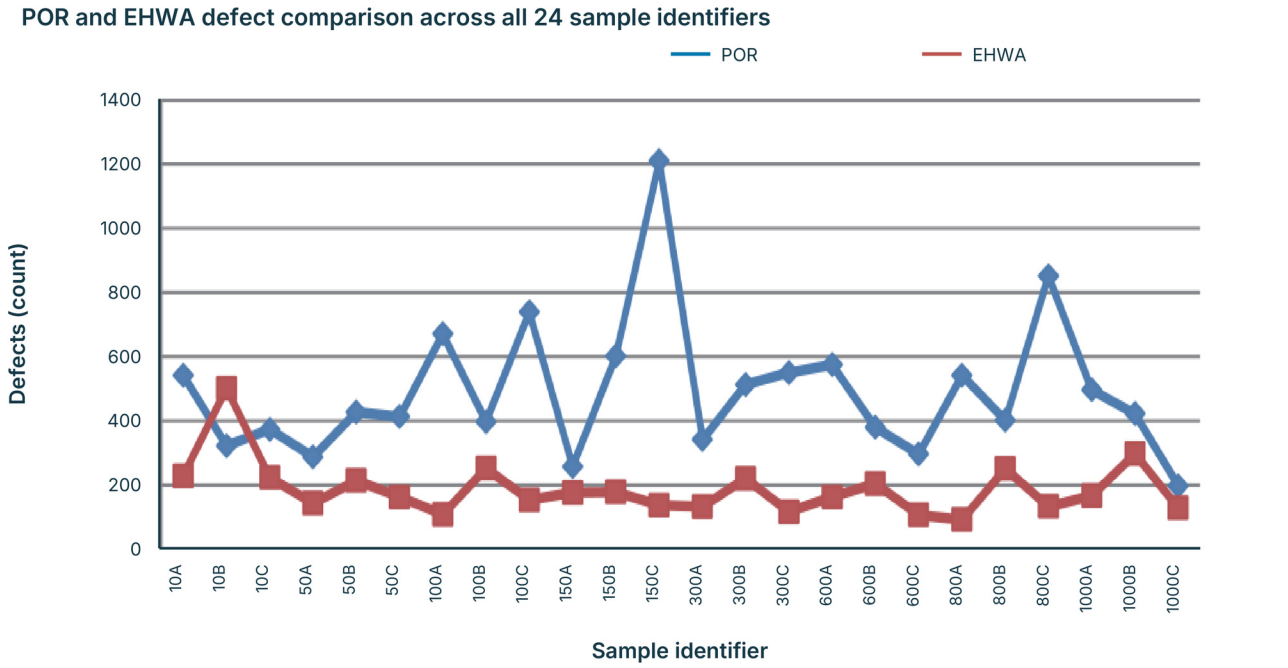


Illustration of the respective source trial.

POR and EHWA defect comparison across all 24 sample identifiers

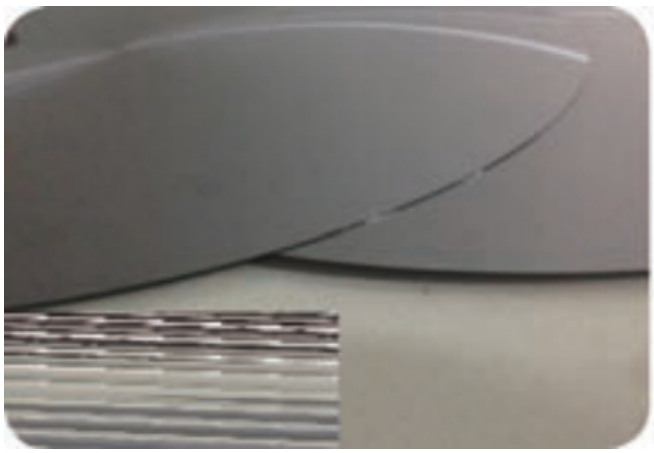
Tools for silicon and sapphire wafer edges

Different groove shapes allow tools to be engineered for different wafer edges. High tool rigidity supports uniform chamfer width. Good groove-profile retention stabilises the edge shape during machining. One tool can be designed for multiple rough and fine grinding stages.

The tool group shows profile grinding wheels and shank tools. Applications include edge grinding of silicon and sapphire wafers. The workpiece images show wafers, a wafer stack and sapphire stock forms. The product table does not specify a diameter unit; diameter and groove form are confirmed during tool selection. The two groove columns list the same identifiers.

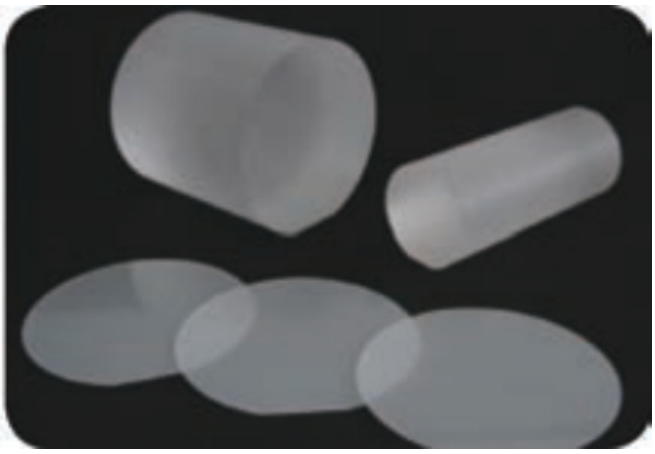
Type	Diameter	Groove (1)	Thickness [mm]	Grit size	Groove (2)
MD-DW	Ø3.9	5G	5-20	#325-#3000	5G
MD-1FF6Y	Ø202	8G	5-20	#325-#3000	8G

Profile wheels and shank tools for wafer edge grinding.



Wafer edge and stacked wafers.

Wafers as workpiece examples.

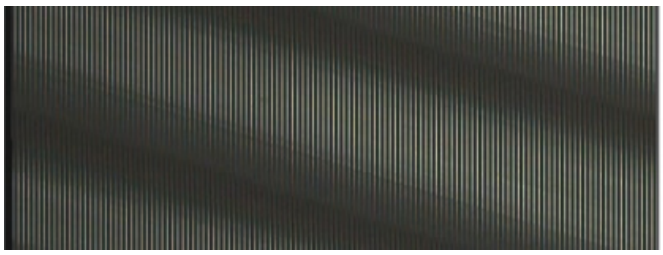


Sapphire workpieces and stock forms.

Surfaces and groove measurements

The surface images show sapphire and silicon after edge grinding. An additional measurement image complements the example. Three plots compare A1/A2, Ang1/Ang2 and R by groove against a reference and grooves 1G to 6G. A1/A2 identifies horizontal profile references, Ang1/Ang2 the angular references, and R the radius. These examples support matching the groove profile to the required edge shape. Scales and numerical labels apply to their respective plot; no additional dimensional unit is specified.

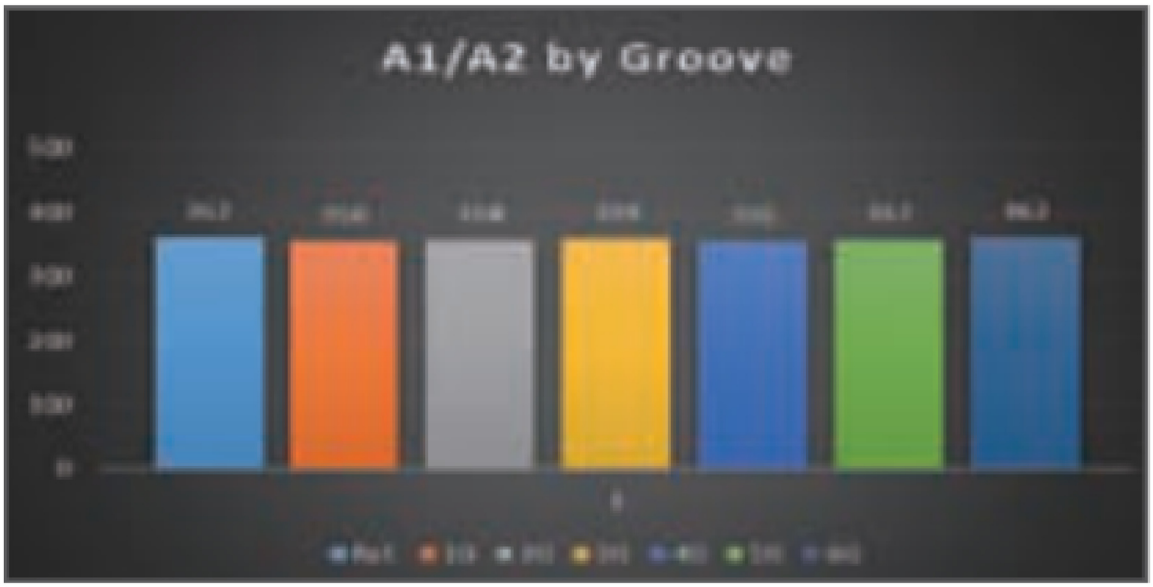
Sapphire surface image.



Silicon surface image.

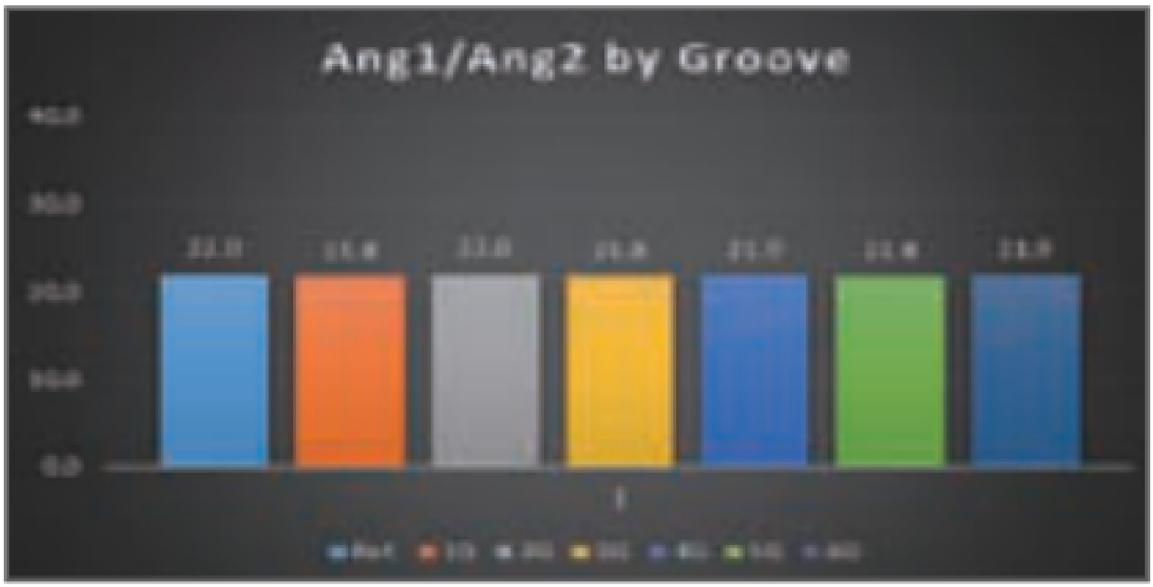
Additional measurement image in the edge-grinding example.

A1/A2 by groove



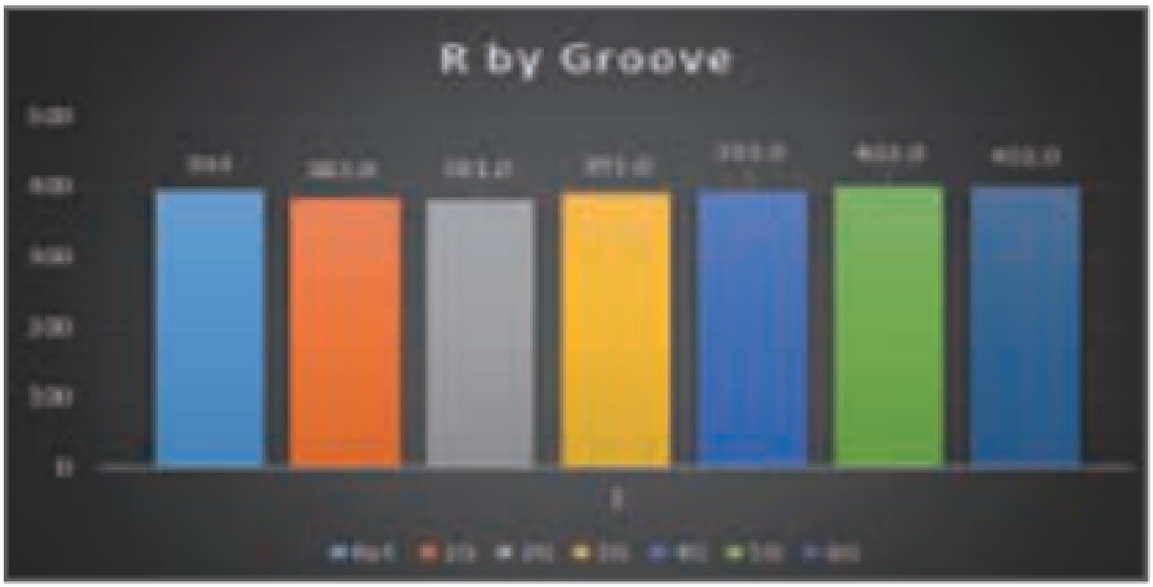
A1/A2 by groove: Ref. and 1G to 6G.

Ang1/Ang2 by groove



Ang1/Ang2 by groove: Ref. and 1G to 6G.

R by groove



R by groove: Ref. and 1G to 6G.

Discuss your CMP or wafer edge application

For CMP, machine, mounting, pad, slurry, polished material, PCR and wafer removal data support selection. For edge grinding, include wafer material, dimensions, edge profile and the division between rough and fine grinding. Existing process data or a component drawing provide a starting point. EHWA Europe supports matching the tool design to your process.

Sources and edition

The original documents group both ranges under the title “Front-End Application”. This edition distinguishes CMP pad conditioning from wafer edge machining as separate tasks.

The product sheets carry the print edition 01/2017. This edition was editorially redesigned on 13 October 2026; the editorial date does not represent a new technical approval.

- EHWA: Semiconductor Front End - CVD, CMP and Wafer Edges, pages 1-3 (Q051).
- EHWA: Semiconductor Front End - CVD, CMP and Wafer Edges, pages 1-4 (Q110).
- EHWA: Semiconductor Front End - CVD, CMP and Wafer Edges, pages 1-4 (Q122).
- EHWA: Semiconductor Front End - CVD, CMP and Wafer Edges, pages 1-4 (Q205).
- EHWA: Semiconductor Front End - CVD, CMP and Wafer Edges, pages 1-4 (Q207); identical file to Q205.

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