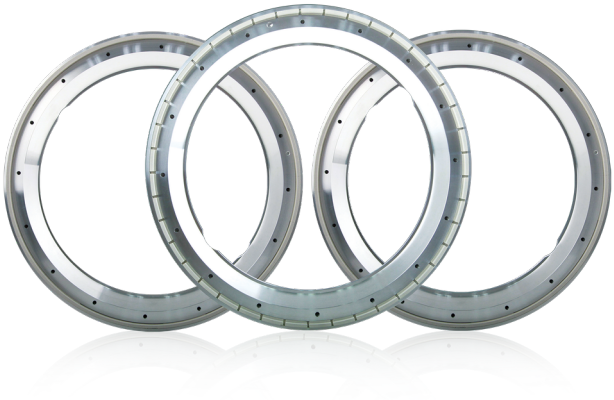
Wafer Processing: NANOPOL, Back Grinding, Dicing and Dry Polishing

Wafer Processing: NANOPOL, Back Grinding, Dicing and Dry Polishing



EHWA Europe GmbH

www.ehwadia.de

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Wafer machining from rough grinding to polishing

EHWA DIAMOND - since 1975

EHWA coordinates diamond grit, bond and pore structure with the requirements of the particular wafer. This complete family edition covers vitrified NANOPOL tools, resin and metal-bonded versions, sapphire and SiC applications, microblades and dicing blades, and subsequent dry polishing. The programmes differ by material, grinding stage, machine configuration and target surface.

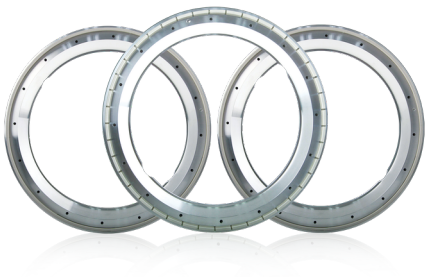
Z1 denotes rough grinding and Z2 fine grinding. In the polishing examples, Z3 denotes the subsequent polishing stage. Grit designations and EHWA specification codes are retained. Identical technical content is presented together; different ranges, codes and test conditions have separate tables. The documented results describe specific applications and support technical selection.

The chapters connect stock removal, consistent tool load, reduced edge chipping, surface quality and die strength. Particularly thin silicon wafers and compound structures incorporating copper, moulding compound, polyimide and solder require coordinated tools and process stages. Start with the workpiece material, then consider the machine, mounting, initial and target thickness, and available machining time.

In the NANOPOL chapters, “compound wafer” denotes moulded/composite structures containing materials such as epoxy moulding compound (EMC), silicon dies, copper, polyimide and solder. This differs from compound semiconductors such as GaAs or SiC. Materials such as SiC are explicitly named in the respective tool programme.

Editorial version: 13 October 2026. This date identifies the editorial compilation.

Moulded/composite wafers (compound wafers): programme and technology



NANOPOL grinding wheels for moulded/composite wafers (compound wafers).



Product detail of a NANOPOL wheel with vitrified-bond grinding segments.

The selection matrix distinguishes Z1 rough grinding from Z2 fine grinding up to polishing level. In the matrix, #400, #600, #800 and #1000 are in the Z1 range; #2000, #3000, #4000, #5000 and #6000 are in the Z2 range. The following ranges reproduce the highlighted series coverage.

EHWA series	Highlighted grit range
VSP Series	#400 to #6000
VSBT Series	#800 to #3000
VSPS Series	#2000 to #6000
VK8B	#5000 to #6000
VK8HS	#3000 to #6000

EHWA describes the following NANOPOL features and application capabilities:

• Surface roughness and die strength can be improved through suitable wheel and process design.

• Grinding stress and wafer edge chipping can be reduced.

• Diamond distribution within the grinding segment can be made consistent.

• Porosity, pore shape and pore size can be adjusted.

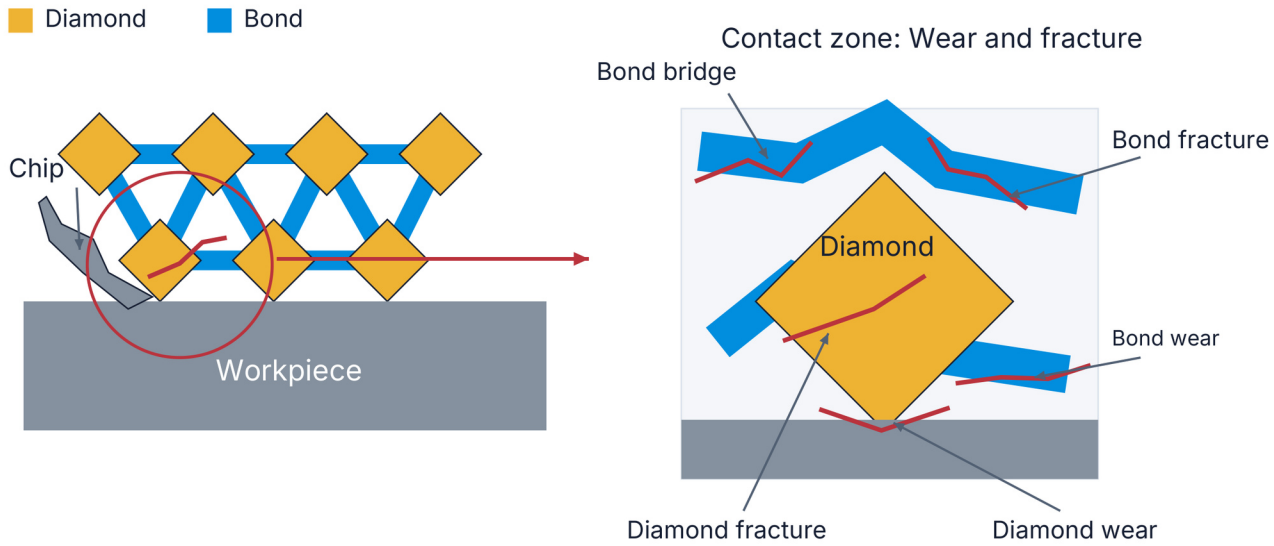
• EHWA describes processing ultra-thin silicon wafers down to 17 µm thickness. The underlying process conditions are not fully specified in this catalogue; achievable thickness is assessed for the actual application.

• The compound designs are described for TSV and conventional compound wafers, including the fingerprint applications mentioned in the document.
These features describe design capabilities. They do not replace wheel selection for your specific wafer composition.

Grinding mechanism: silicon and adhering material constituents

The EHWA silicon grinding diagram shows chip formation together with diamond grain and bond wear and fracture. Renewal of the grinding surface exposes further diamond grains. The interaction between diamonds, bond bridges and pores supports continued material removal.

Model: Si-wafer grinding

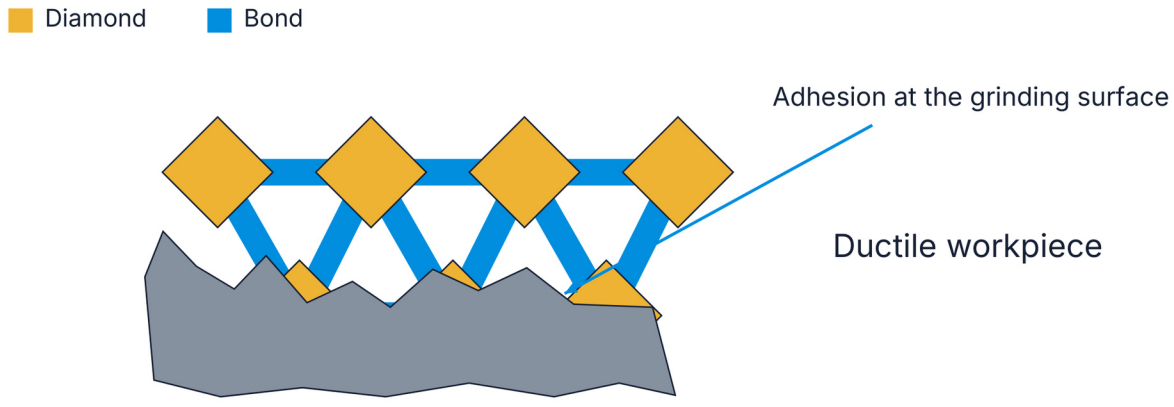


Schematic illustration

Silicon grinding diagram: chip formation, diamond wear, diamond fracture, bond wear and bond fracture.

With adhering material constituents, this surface renewal may be insufficient. The EHWA diagram shows a ductile material adhering to the grinding surface. The renewal mechanism described for silicon therefore cannot be transferred unchanged to every compound structure. Grain and bond wear also depend on the process when grinding ductile materials; adhesion does not mean these mechanisms are universally absent.

Model: Grinding ductile materials



Schematic illustration

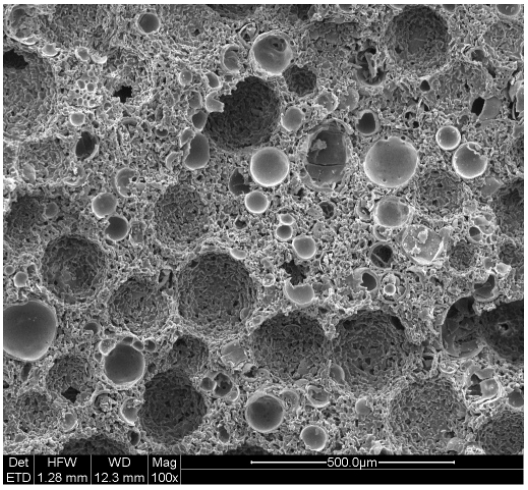
Diagram of material adhering to the grinding surface.

EHWA describes lower bond hardness and reduced bond content as a wheel design approach. These changes can produce thinner bond bridges and encourage renewal of the grinding surface. Adhering

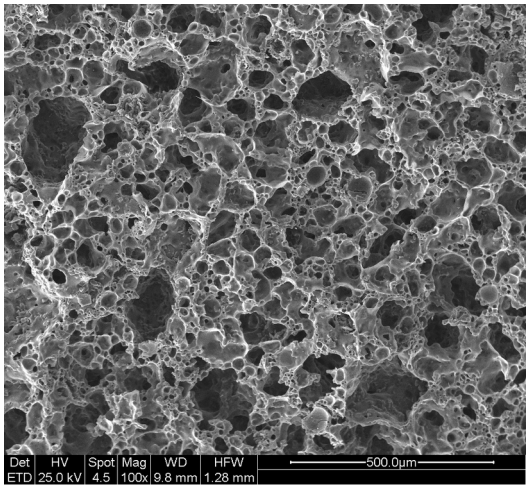
material is intended to be removed as the grinding segment renews itself. The required wheel wear is balanced against free-cutting performance, surface requirements and useful wheel life.

Wheel structure for silicon and compound wafers

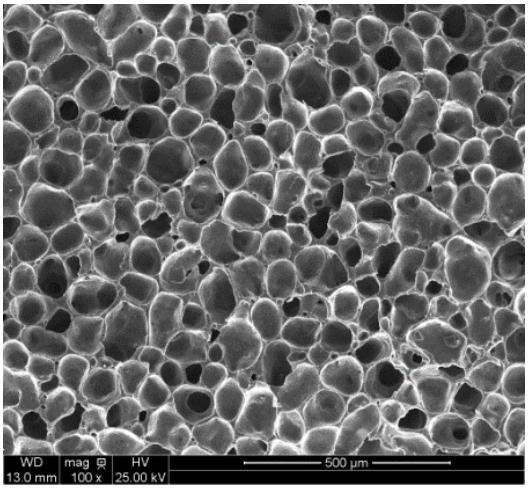
The four images compare grinding segment structures for rough and fine grinding of silicon and compound wafers. Pore structure is one aspect of wheel design. The images show specific designs; they do not establish a single pore size for the entire NANOPOL family.



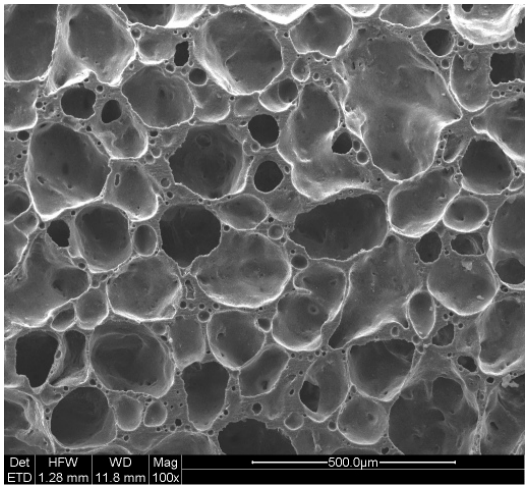
Structure of a silicon wafer wheel for rough grinding; original scale retained.



Structure of a compound wafer wheel for rough grinding; original scale retained.



Structure of a silicon wafer wheel for fine grinding; original scale retained.



Structure of a compound wafer wheel for fine grinding; original scale retained.

Compound structures and wheel specifications

The structure diagrams show mould compound, silicon chips or dies, wafer, adhesive and glass carrier. Another structure includes EMC, silicon chips, tin solder balls and copper vias. The marked removal areas belong to these examples. The dimensions 500 µm, 250 µm and 780 µm in the first layer diagram remain associated with their respective dimension arrows; they are not general wafer dimensions.

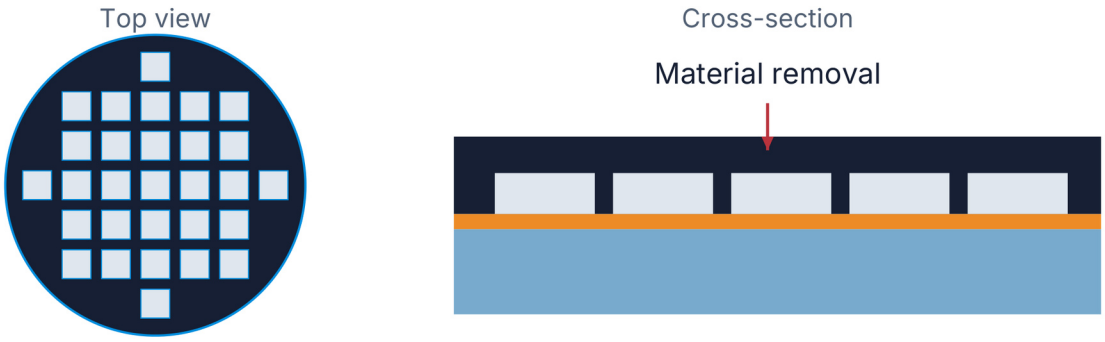
Example: Compound-wafer layer stack



Schematic illustration

Example layer structure with mould compound, die, wafer, adhesive and glass; dimensions 500 µm, 250 µm and 780 µm follow the illustrated arrows.

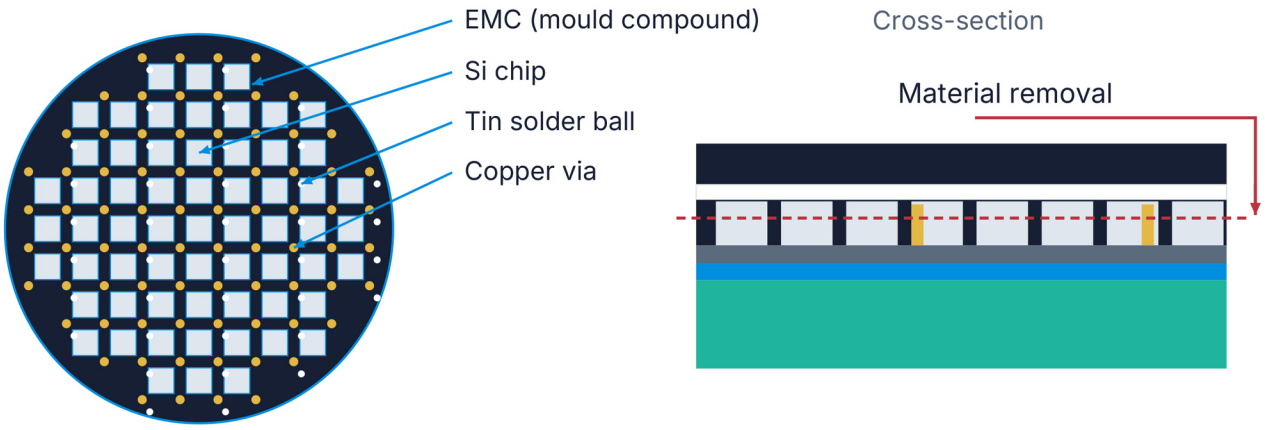
Compound wafer: Indicated removal region



Schematic illustration

Example compound wafer with silicon chips and the indicated material removal area.

EMC/Si structure with solder and copper vias



Schematic illustration

Example EMC/silicon structure with tin solder balls and copper vias; the removal area is indicated.

Material structure	Combination listed in the EHWA document
Compound, for example EMC	#325 to #2000 VSP3 or #325 to #2000 VSP5
Compound and silicon chip	Z1 #400 VSP3 + Z2 #4000 to #5500 VK8HS
Compound, silicon chip and copper via	Z1 #400 VSP3 + Z2 #4000 to #5500 VK8HS
Compound, silicon chip, copper via, polyimide and solder	Design A: Z1 #800 VSP3 + #3000 VK8HS4; design B: Z1 #800 VSP3 + #4000 VSPS10

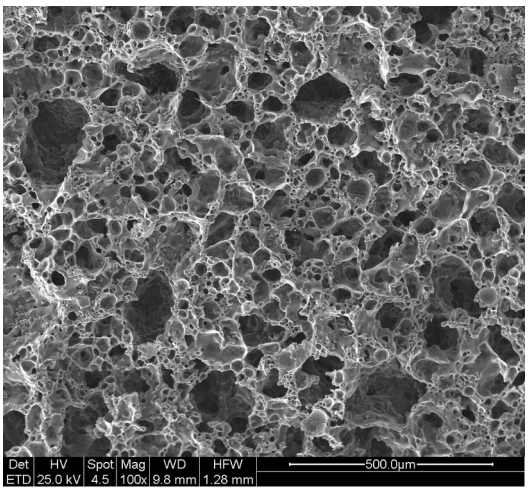
These mappings relate to the illustrated structures. For different proportions of silicon, mould compound or metal, material removal, adhesion, grinding current and surface requirements are considered together again. The complete specification is designed for the actual material composition.

Two wheel concepts for compound wafers

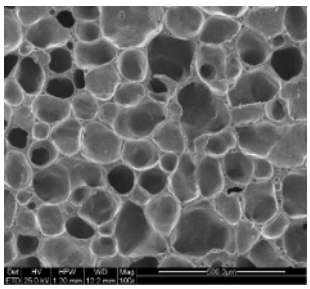
EHWA identifies EMC, polymers, copper and tin as constituents of material structures that can adhere to the grinding segment surface. The document describes two concepts intended to support renewal of that surface.

VSP3 and VK8HS: renew the grinding segment

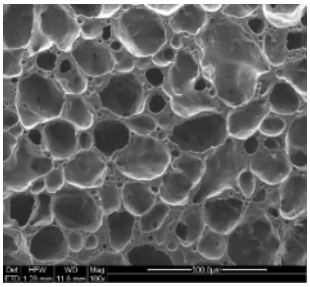
The first concept uses a grinding segment structure that wears more readily. A loaded or smeared grinding surface is intended to renew itself as a result. The illustrated designs are #800-VSP3, #4000-VK8HS and #5000-VK8HS. The three structure images are identified in the document as SEM images at ×100.



Structure of the #800-VSP3 design, SEM ×100; original scale retained.



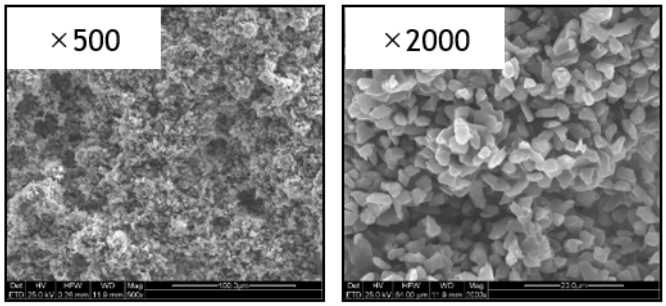
Structure of the #4000-VK8HS design, SEM ×100; original scale retained.



Structure of the #5000-VK8HS design, SEM ×100; original scale retained.

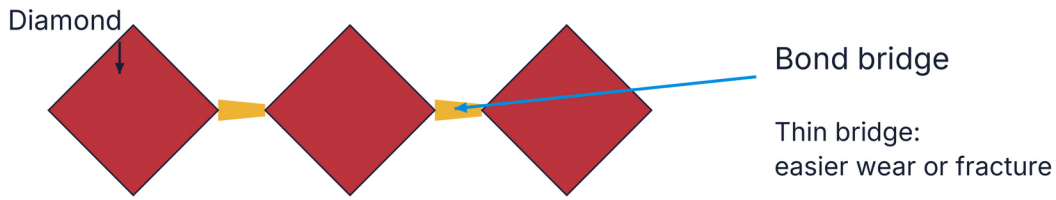
VSP5 and VSPS10: thin bond bridges

If loading continues with the first structure, EHWA describes thinner bond bridges between the diamond grains. These bridges are intended to wear or fracture more readily, encouraging renewal of the grinding surface. Adhering constituents are removed from the surface as the wheel wears. The document identifies VSP5 and VSPS10 for this approach and shows #3000-VSPS10 at ×500 and ×2000.



Structure of the #3000-VSPS10 design with both SEM images at ×500 and ×2000; both original scales retained.

Thin bond bridges between diamond grains



Schematic illustration

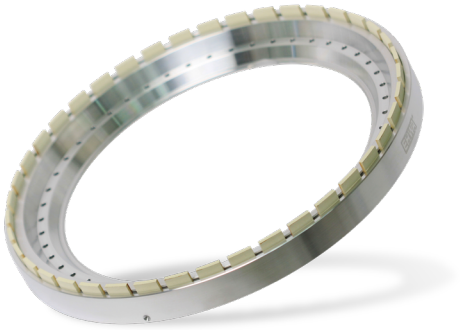
Diagram of a thin bond bridge between diamond grains: the bridge can wear or fracture more readily.

The #3000-VSPS10 example in this structure comparison and #4000 VSPS10 in the material mapping remain separate designs. The series name alone does not establish identical grit size or interchangeability.

Silicon wafers: programme and technology



NANOPOL grinding wheels for silicon wafers.



Product detail of a NANOPOL wheel for silicon wafers.

The silicon selection matrix places #400, #600, #800 and #1000 in Z1 rough grinding. The Z2 fine range up to polishing level includes #2000, #3000, #4000, #5000, #6000, #8000, #10000, #20000 and #30000. The following series ranges are highlighted:

EHWA series	Highlighted grit range
VSZT	#400 to #2000
VK8B	#3000 to #5000
VKBT	#3000 to #20000
VNP	#5000 to #30000
VGP	#6000 to #30000

For silicon wafers, EHWA describes improved surface roughness and die strength, reduced grinding stress and edge chipping, and consistent diamond distribution. Porosity, pore shape and pore size can be adjusted. The document also identifies ultra-thin silicon wafers down to 17 µm thickness here. Achievable results depend on the complete wheel and process configuration; these features are matched to the required surface and thickness.

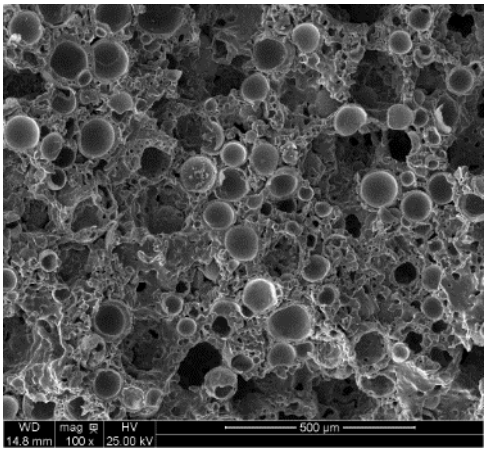
Z1: specifications and test example

The Z1 comparison was carried out on a DGP8761. The complete wheel specifications are:

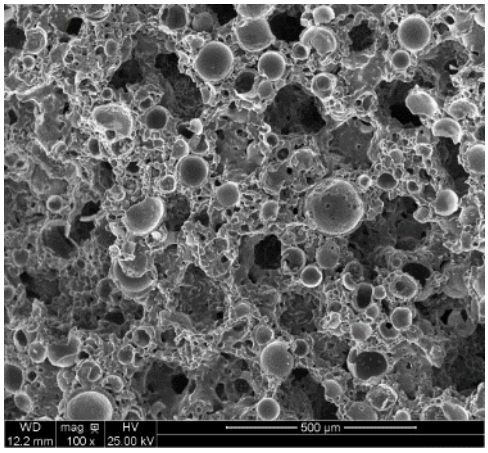
- Design A: NP-D4-303D3.5W10X-600-VSZT
- Design B: NP-D4-303D3.0W10X-800-VSZT

Property	Design A: 600-VSZT	Design B: 800-VSZT
Mean grit size	approximately 20 µm	approximately 16 µm
Maximum grit size	approximately 63 µm	approximately 41 µm
Reported concentration	75	75
Porosity	approximately 75 vol.%	approximately 75 vol.%
Bond	VSZT	VSZT
Wheel/chuck speed	2700/300 min^{-1}	3200/300 min^{-1}
Reported feed sequence	5-3-1 µm/s	5-3-1 µm/s
Grinding current	approximately 13.0 A	approximately 14.0 A
Useful wheel life	15,000 pieces	12,000 pieces

Concentration is listed as 75 without a percentage unit in the document; porosity is explicitly expressed as volume percent. The feed sequence is reproduced unchanged. The different wheel speeds belong to the respective test designs and remain part of the comparison.



Structure of Z1 design NP-D4-303D3.5W10X-600-VSZT, SEM ×100; original scale retained.

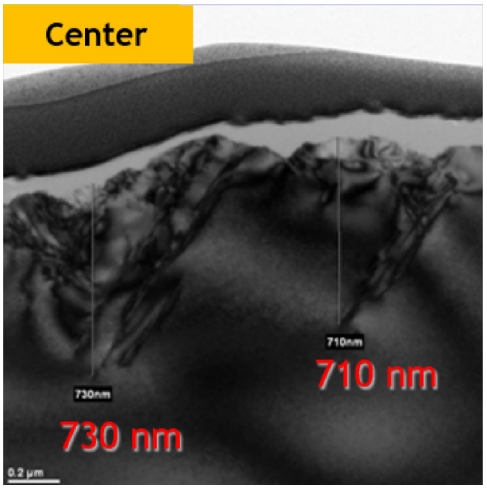


Structure of Z1 design NP-D4-303D3.0W10X-800-VSZT, SEM ×100; original scale retained.

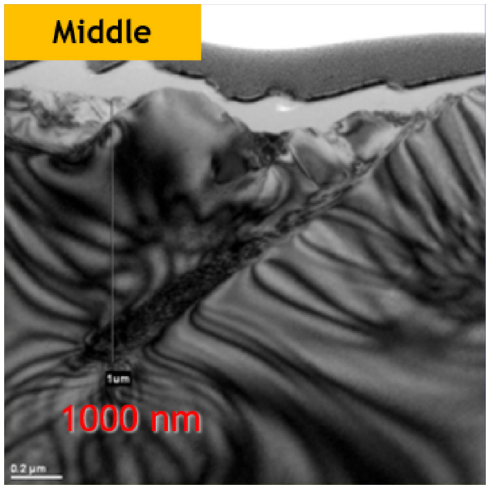
Damage layer after Z1 grinding

The images compare the wheels identified in the document as Resin #325 and Vitrified #600. Centre, middle and edge remain separate measurement positions. Two values are marked at the centre in the resin example.

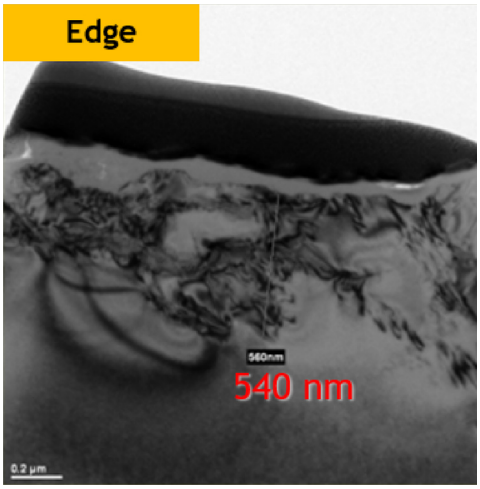
Wheel in the image comparison	Centre	Middle	Edge
Resin #325	730 nm and 710 nm	1000 nm	540 nm
Vitrified #600	650 nm	480 nm	450 nm



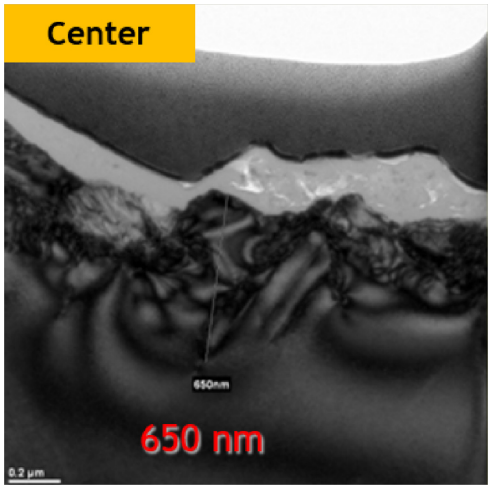
Resin #325, centre: marked damage depths 730 nm and 710 nm; original measurement lines and scale retained.



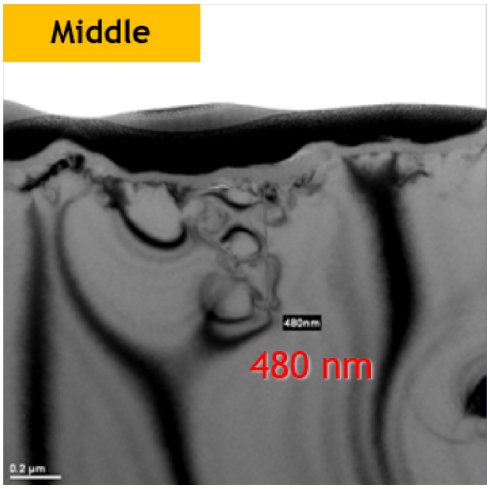
Resin #325, middle: marked damage depth 1000 nm; original measurement line and scale retained.



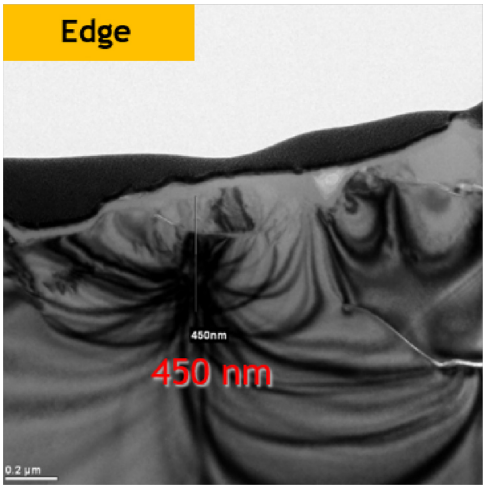
Resin #325, edge: marked damage depth 540 nm; original measurement line and scale retained.



Vitrified #600, centre: marked damage depth 650 nm; original measurement line and scale retained.



Vitrified #600, middle: marked damage depth 480 nm; original measurement line and scale retained.



Vitrified #600, edge: marked damage depth 450 nm; original measurement line and scale retained.

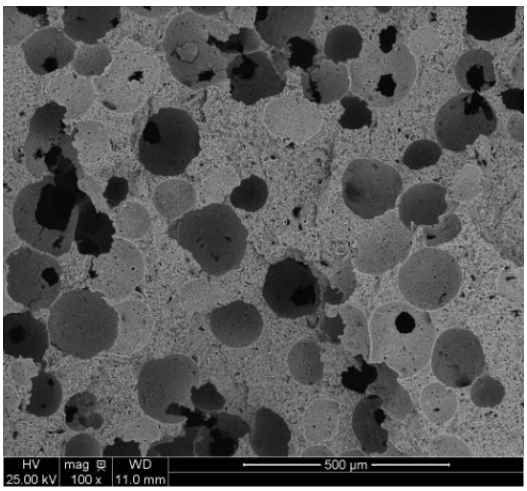
The values belong to the illustrated cross-section images. They describe this image comparison and do not establish a general damage depth for all resin-bond or vitrified-bond wheels. The process conditions for the two image sets are not fully documented in the source.

Z2: specifications, roughness and useful wheel life

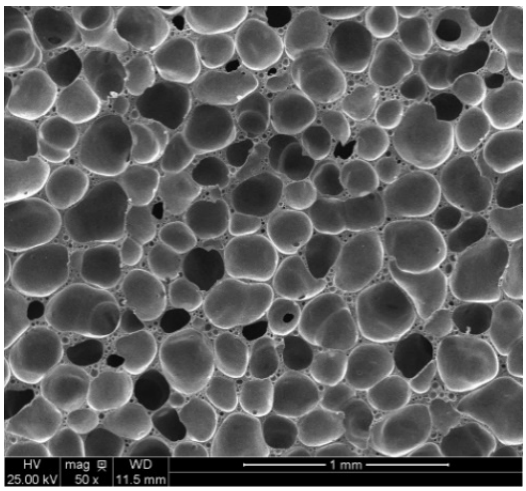
The Z2 comparison also identifies the DGP8761. Roughness was measured using a Wyco Veeco NT9100. The complete specifications are:

- Design C: NP-D4-303D3.5W10X-5000-VKBT25
- Design D: NP-D4-303D3.0W7X-8000M-VNPSSR

Property	Design C: 5000-VKBT25	Design D: 8000M-VNPSSR
Mean grit size	approximately 2.0 µm	approximately 0.55 µm
Maximum grit size	≤ 5.5 µm	≤ 1.2 µm
Feed rate	0.6 µm/s	0.2 µm/s
Grinding current	13.5 A	15.5 A
Useful wheel life	23,000 pieces	4,500 pieces
Ra roughness	approximately 4.8 nm	approximately 1.3 nm
Rmax roughness	approximately 56 nm	approximately 15 nm



Structure of Z2 design NP-D4-303D3.5W10X-5000-VKBT25; original scale and acquisition labels retained.



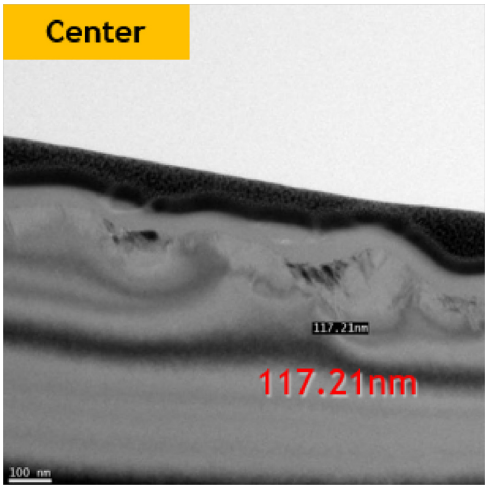
Structure of Z2 design NP-D4-303D3.0W7X-8000M-VNPSSR; original scale and acquisition labels retained.

The wheels differ in specification and feed rate. The test illustrates the relationship between surface requirements, processing conditions and useful wheel life. It is not a wheel-life comparison under identical conditions. Selection considers required roughness, available processing time and existing grinding stages together.

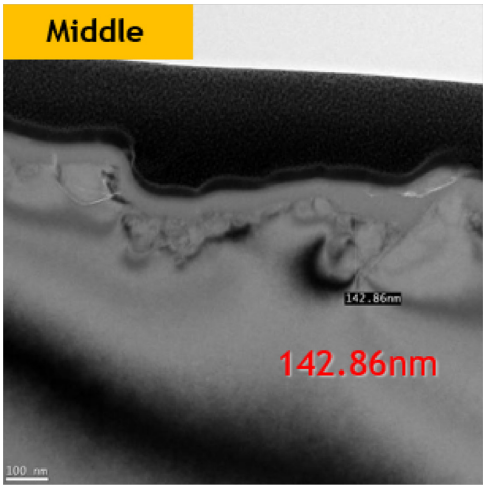
Damage layer with the #5000 and #8000 designs

The following images show vitrified-bond designs labelled Vitrified #5000 and Vitrified #8000. Centre, middle and edge remain individually identified measurement positions.

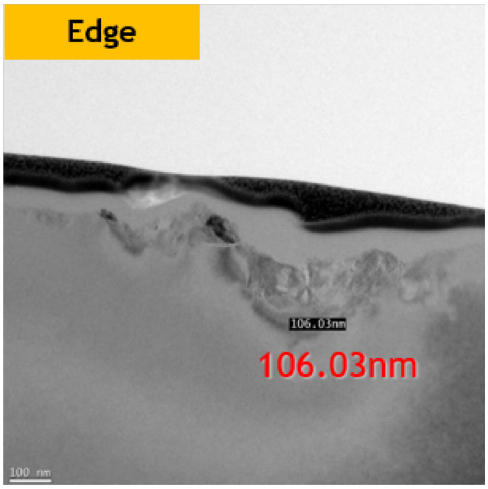
Wheel in the image comparison	Centre	Middle	Edge
Vitrified #5000	117.21 nm	142.86 nm	106.03 nm
Vitrified #8000	49.07 nm	no numerical value reported	84.82 nm



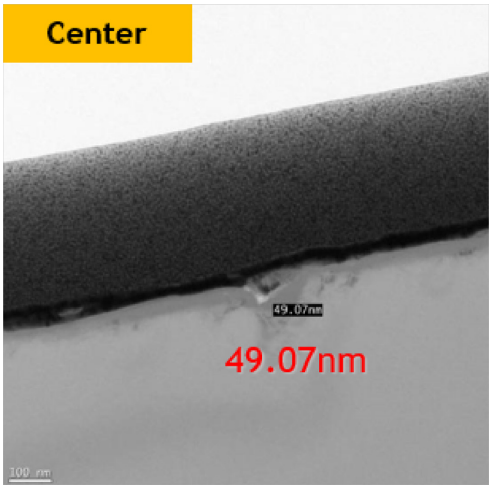
Vitrified #5000, centre: marked damage depth 117.21 nm; original measurement line and scale retained.



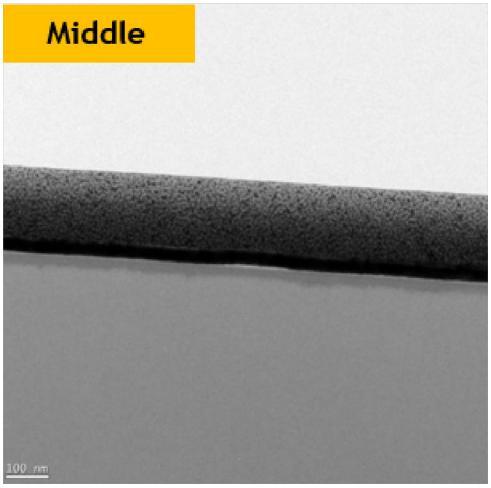
Vitrified #5000, middle: marked damage depth 142.86 nm; original measurement line and scale retained.



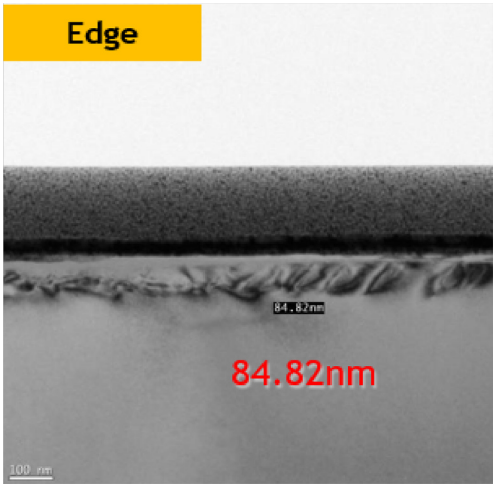
Vitrified #5000, edge: marked damage depth 106.03 nm; original measurement line and scale retained.



Vitrified #8000, centre: marked damage depth 49.07 nm; original measurement line and scale retained.



Vitrified #8000, middle: no numerical value reported in the document; original scale retained.



Vitrified #8000, edge: marked damage depth 84.82 nm; original measurement line and scale retained.

No measured value is added for the middle image of the #8000 design. The image labels #5000 and #8000 are not equated with the complete specifications of the preceding test without additional evidence. The values describe the illustrated images; they do not establish a universally guaranteed damage depth.

NANOPOL selection matrix for multiple materials

Documents Q221 and Q233 add a joint selection matrix to the material-specific programmes. It distinguishes silicon from SiC, sapphire, LT/LN, glass and EMC. LT/LN retains the combined material group used in the source; EMC means epoxy moulding compound. The matrix lists #400, #600, #800 and #1000 under Z1, and #2000, #3000, #4000, #5000, #6000, #8000, #10000, #20000 and #30000 under Z2. The original colour coding is represented here by a material column.

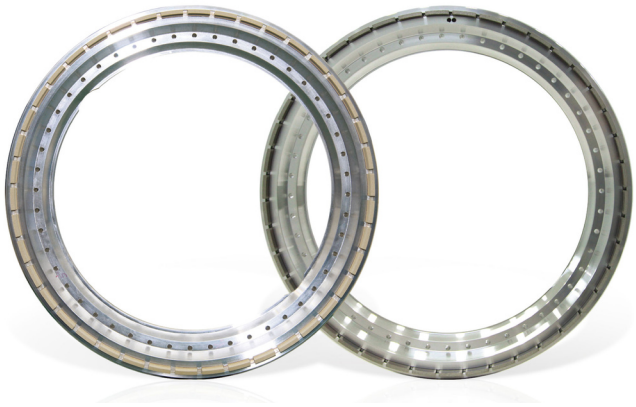
Series	Material group	Marked range
VSZT	Si	#400-#3000
VNP	SiC / Glass	#1000-#2000
VSBT	Sapphire / Glass	#800-#3000
VSP	LT/LN / Sapphire / EMC	#400-#5000
VSPS	EMC	#2000-#6000
VK8B	Si	#4000-#6000
VK8B	SiC / EMC	#5000-#6000
VK8HS	EMC	#3000-#6000
VNP	Si	#6000-#30000
VNP	SiC	#6000-#8000
VKBT25	Si	#5000-#20000

Independent silicon selection matrix in the combined sheet

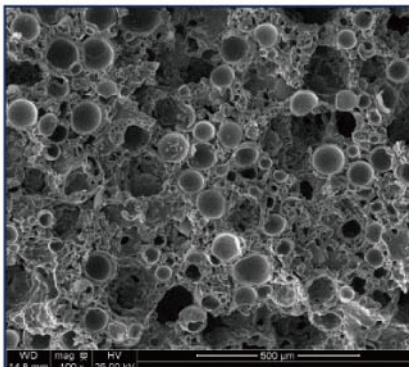
Combined sheet Q272 shows an independent silicon programme using the same grit list. Its ranges are kept separate from the main NANOPOL programme. The matrix supports selection between coarser removal and fine surface finishing; it does not approve every intermediate grit for every machine.

Series	Q272: marked range
VSZT	#400-#3000
VK8B	#4000-#6000
VKBT	#4000-#20000
VNP	#6000-#30000
VGP	#8000-#30000

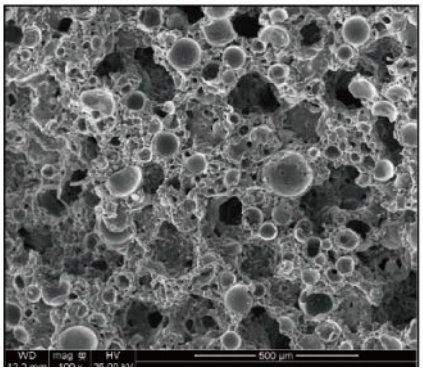
The Z1 and Z2 test tables in the combined sheet agree with the complete main-programme tables: Z1 uses NP-D4-303D3.5W10X-600-VSZT and NP-D4-303D3.0W10X-800-VSZT; Z2 uses NP-D4-303D3.5W10X-5000-VKBT25 and NP-D4-303D3.0W7X-8000M-VNPSSR. The machine is specified as DGP8761. The individual images from the combined sheet are additionally retained.



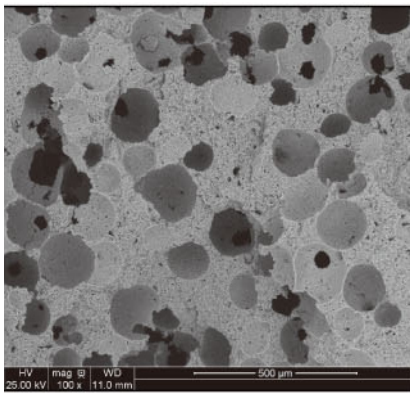
NANOPOL silicon tools in the combined sheet.



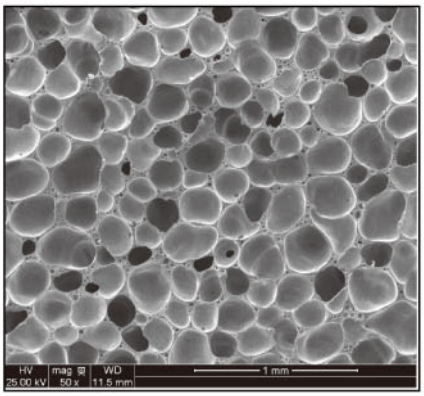
Z1 #600: combined-sheet micrograph.



Z1 #800: combined-sheet micrograph.



Z2 #5000: combined-sheet micrograph.

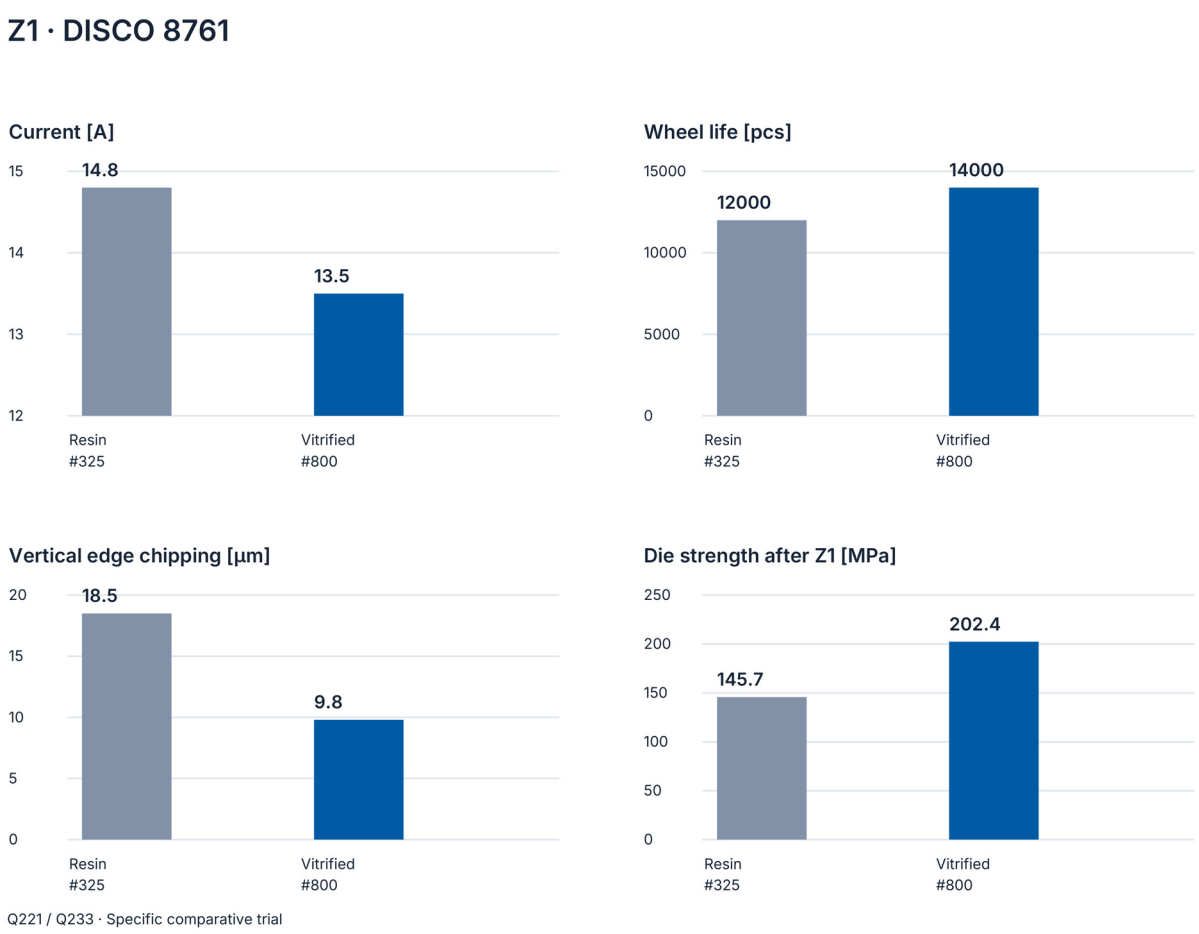


Z2 #8000M: combined-sheet micrograph.

Z1: vitrified and resin-bonded versions compared

On the DISCO 8761, Q221 compares resin #325 with vitrified #800. Q233 repeats the four results. In this test, the vitrified version shows lower current, greater wheel life, less vertical edge chipping and higher die strength after Z1. These values belong to this comparison; general tool selection also considers feed rate, mounting and the remaining process chain.

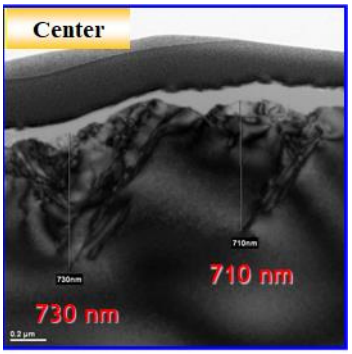
Measured quantity	Resin #325	Vitrified #800
Grinding current [A]	14.8	13.5
Wheel life [pcs]	12000	14000
Vertical edge chipping [µm]	18.5	9.8
Die strength, Z1 only [MPa]	145.7	202.4



Four Z1 comparisons on the DISCO 8761: current, wheel life, vertical edge chipping and die strength.

Damage layer: image designations in the comparative editions

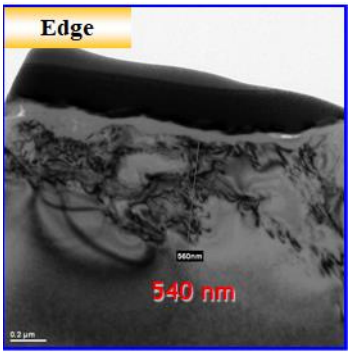
Comparative edition Q221 shows damage depths at the centre, middle and edge. The upper row is labelled Resin #325. The lower row is labelled “Vitri #8000” there; Q284 uses “Vitrified #600” for the corresponding numerical series. Q233 repeats the measurement images without the same complete tool designation. The source designations are retained separately rather than harmonised into one specification.



Resin #325, centre: 730 nm and 710 nm.



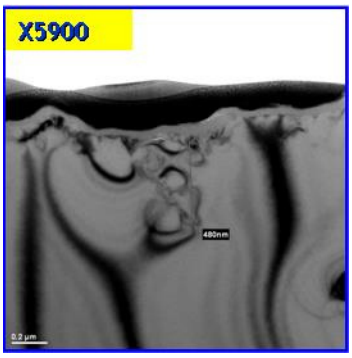
Resin #325, middle: 1000 nm.



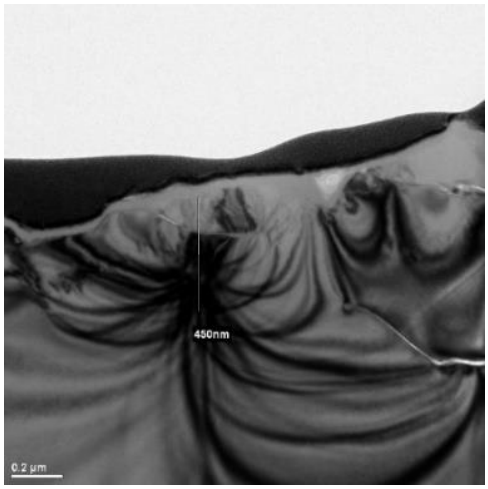
Resin #325, edge: 540 nm.



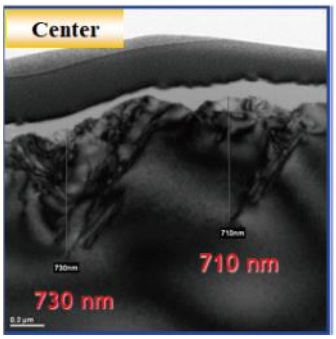
Q221 “Vitri #8000”, centre: 650 nm.



Q221 “Vitri #8000”, middle: 480 nm.



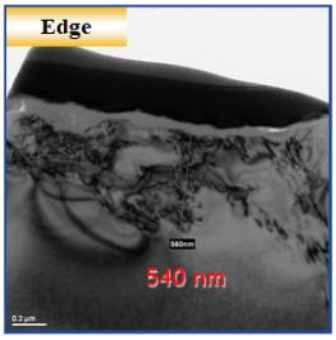
Q221 “Vitri #8000”, edge: 450 nm.



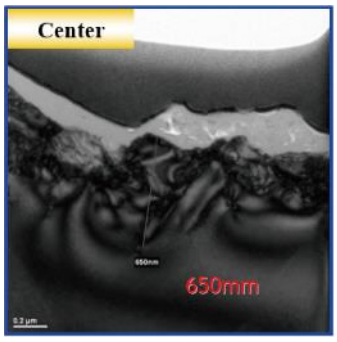
Q233, upper image row, centre: original measurement values and scale retained.



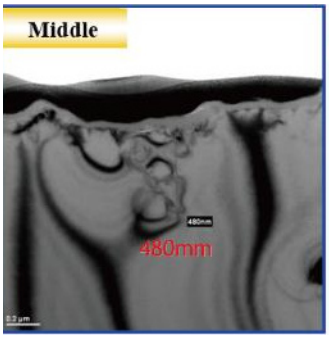
Q233, upper image row, middle: original measurement values and scale retained.



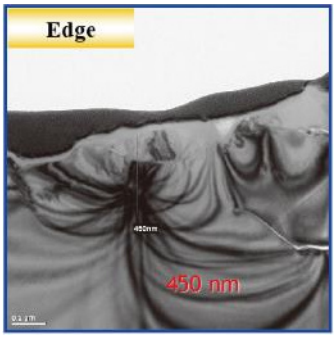
Q233, upper image row, edge: original measurement values and scale retained.



Q233, lower image row, centre: original measurement values and scale retained.



Q233, lower image row, middle: original measurement values and scale retained.



Q233, lower image row, edge: original measurement values and scale retained.

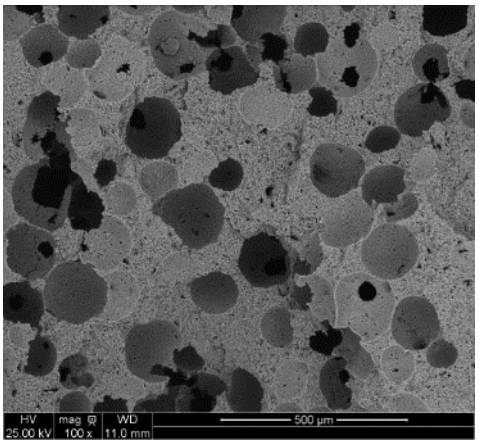
Silicon fine grinding: additional specifications and test data

Documents Q221 and Q233 contain a further Z2 comparison on the DISCO 8761. Segment height is specified as 7 mm. Grit data and roughness values agree between the two documents, while Q233 uses shorter specification codes. The full Q221 codes are therefore explicitly paired with the Q233 designations. This comparison is retained alongside the main programme: current, feed and wheel life differ from the Q284/Q272 test.

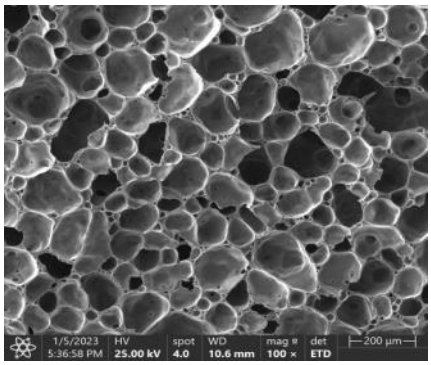
Surface measurement used a Wyko Veeco NT9100. The differences in feed and wheel life help relate the required surface target to economical processing time.

Characteristic	#5000 version	#8000M version
Q221 code	#5000-VKBT25M3-P12	#8000M-VNP-HBF
Q233 code	#5000-VKBT25M3	#8000M-VNP
Mean grit size [µm]	~2.0	~0.55
Maximum grit size [µm]	≤5.5	≤1.2
Current / feed	13.5 A / 0.6 µm/s	12.7 A / 0.2 µm/s
Wheel life [pcs]	17000	3000
Ra [nm]	~4.8	~1.3
Rmax [nm]	~56	~15

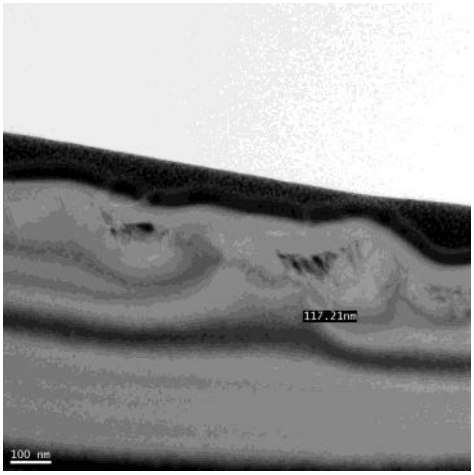
The additional damage images in Q221 show #5000 at 117.21 / 142.86 / 106.03 nm and #8000 at 49.07 nm in the centre and 84.82 nm at the edge. No measured number is added for the middle #8000 image. Q233 and the main programme also show this numerical series; the original images retain their scales and measurement markings.



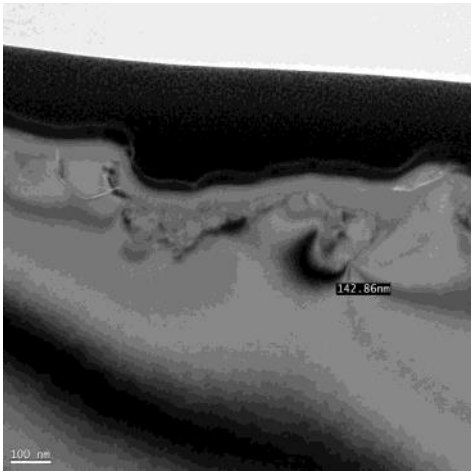
Microstructure of #5000-VKBT25M3-P12; original scale retained.



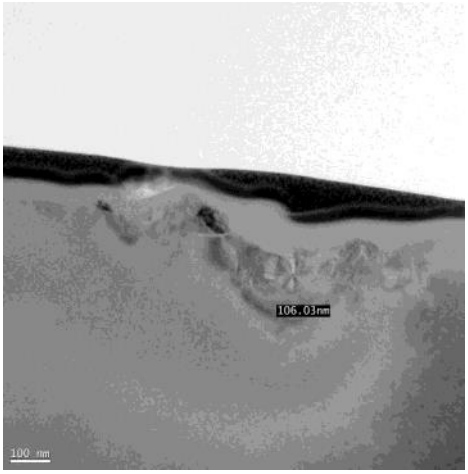
Microstructure of #8000M-VNP-HBF; original scale retained.



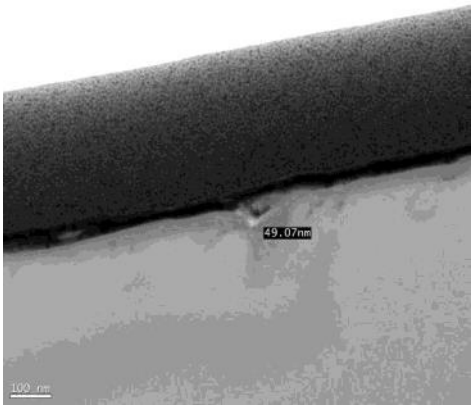
Vitrified #5000, centre: original Q221 measurement image with markings and scale.



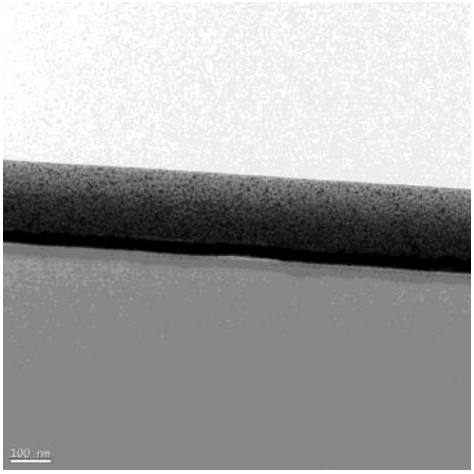
Vitrified #5000, middle: original Q221 measurement image with markings and scale.



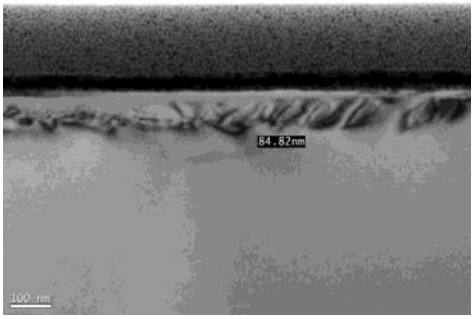
Vitrified #5000, edge: original Q221 measurement image with markings and scale.



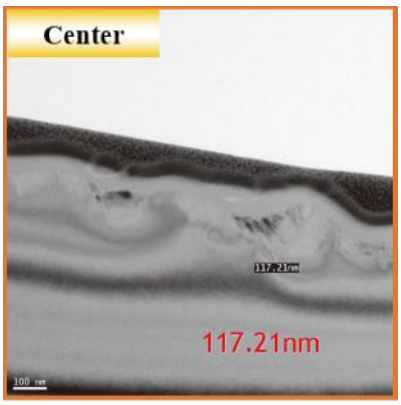
Vitrified #8000, centre: original Q221 measurement image with markings and scale.



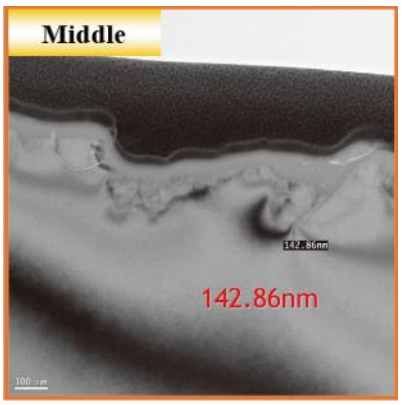
Vitrified #8000, middle: original Q221 measurement image with markings and scale.



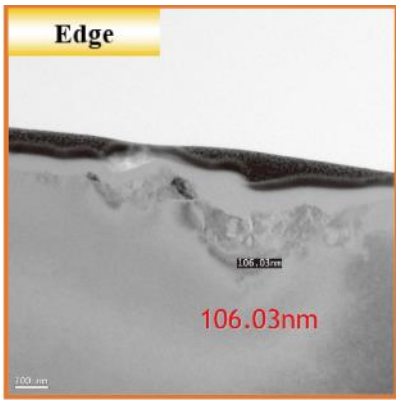
Vitrified #8000, edge: original Q221 measurement image with markings and scale.



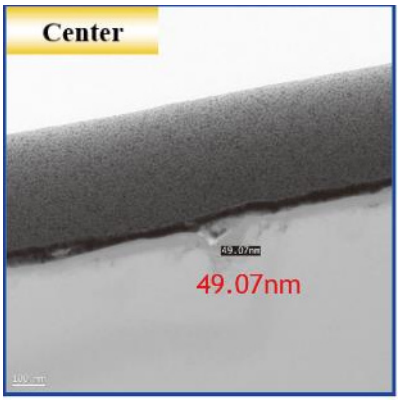
Vitrified #5000, centre: original Q233 measurement image with markings and scale.



Vitrified #5000, middle: original Q233 measurement image with markings and scale.



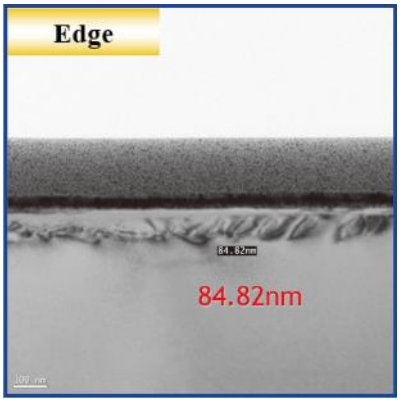
Vitrified #5000, edge: original Q233 measurement image with markings and scale.



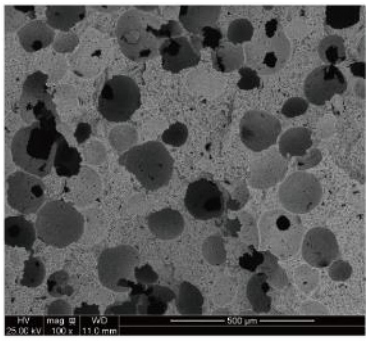
Vitrified #8000, centre: original Q233 measurement image with markings and scale.



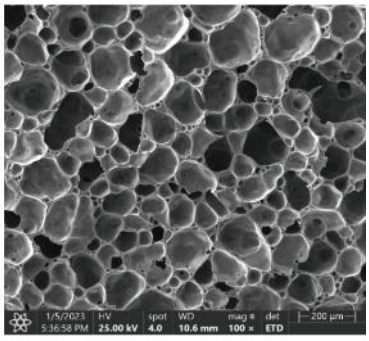
Vitrified #8000, middle: original Q233 measurement image with markings and scale.



Vitrified #8000, edge: original Q233 measurement image with markings and scale.



#5000 micrograph from Q233; original scale retained.

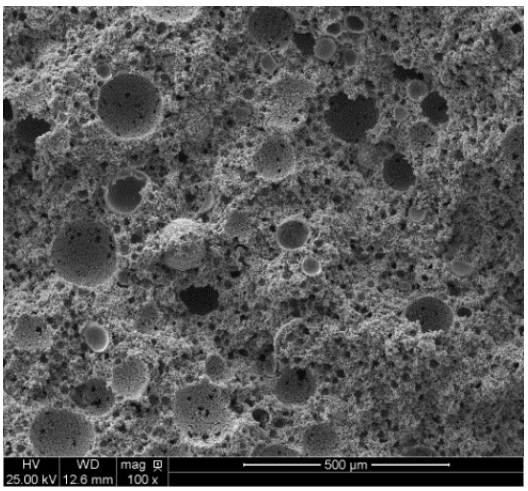


#8000M micrograph from Q233; original scale retained.

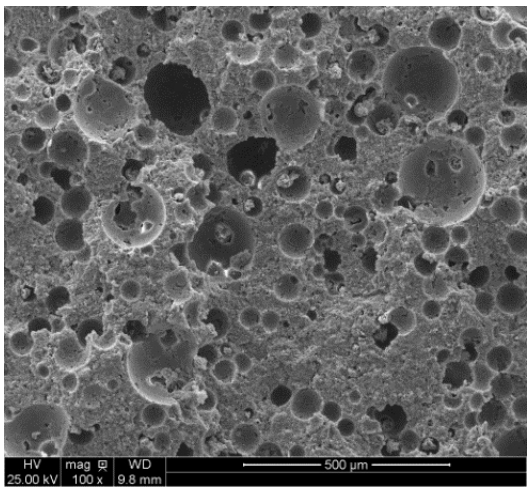
SiC: grit, wear and surface finish

Q221 adds an SiC comparison to the silicon programme. Different grinding amounts are specified for the two versions. Reported wheel wear therefore describes two specific processing conditions. The very fine version has markedly smaller grit and a finer measured surface. Surface measurement used a Wyko Veeco NT9100; each Rmax value retains its original unit.

Characteristic	#2000 version	#8000M2 version
Specification	#2000-VNP8-GC	#8000M2-VNP-PSR
Mean grit size [µm]	~7.0	~0.55
Maximum grit size [µm]	≤26.0	≤1.2
Wheel wear [µm]	20	15
Grinding amount [µm]	100	20
Ra [nm]	~18	~1.5
Rmax	~1.3 µm	~14 nm



SiC version #2000-VNP8-GC, micrograph with original scale.



SiC version #8000M2-VNP-PSR, micrograph with original scale.

Additional compound specifications

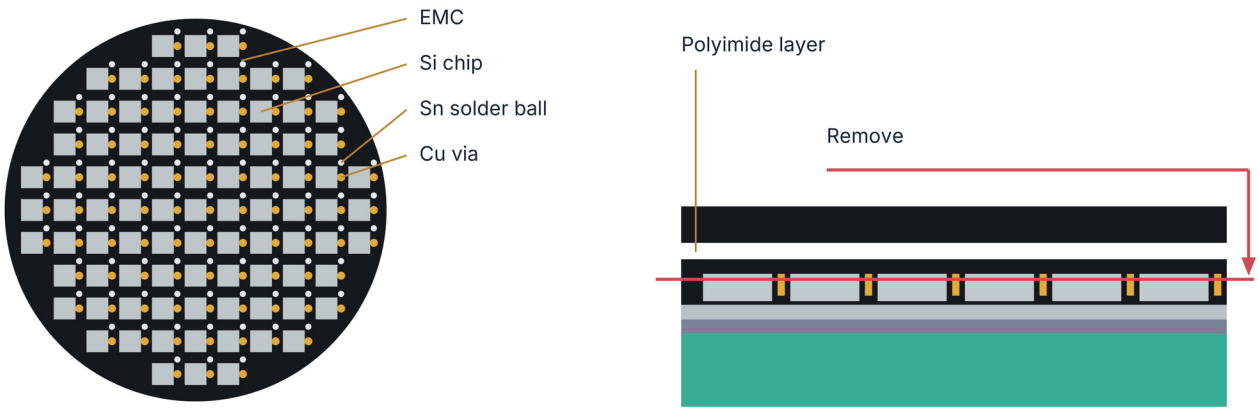
The compound tables in Q012/Q026 and Q221/Q233 supplement the full specifications in the main programme. The material structures are distinguished individually: pure moulding compound; compound with silicon chips; additionally copper vias; and the complex structure incorporating polyimide and solder. The older selection lists VSPBT7 as a second alternative for the complex structure. Q221/Q233 list VSPS10 only at that position. These variants are expressly retained rather than transferring their codes into the later main programme.

The drawings explain silicon, EMC, copper and solder, plus a polyimide layer. The simpler earlier drawing has no individually designated copper or solder markers. Appropriate bond and pore structures support particle removal and the processing of different material constituents on the same grinding surface.

Material structure	Q012 / Q026	Q221 / Q233
Pure EMC	#800-#2000 VSP3 / #800-#2000 VSP5	same
EMC + Si chip	Z1 #800 VSP3 + Z2 #5000 VK8HS / #5000 VK8B	same
EMC + Si chip + Cu via	Z1 #800 VSP3 + Z2 #5000 VK8HS / #5000 VK8B	same
EMC + Si chip + Cu via + Polyimide + Solder	Z1 #800 VSP3 + #3000 VSPS10 / #3000 VSPBT7	Z1 #800 VSP3 + #3000 VSPS10

The source headings also list Fingerprint Strip and Compound Molded Wafer for TSV/Fan-Out as application designations. Micrographs retain each original silicon/compound and rough/fine assignment.

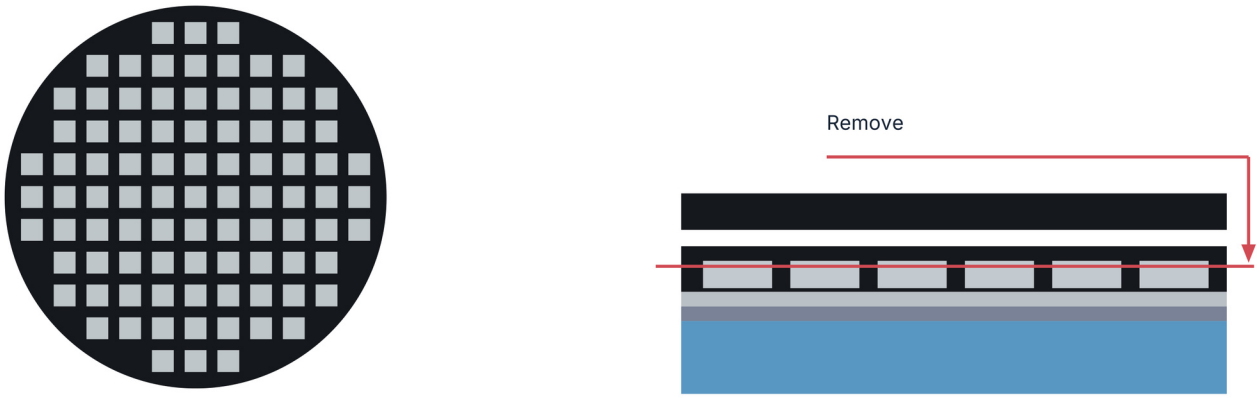
Compound wafer and removal level



Schematic structure without added dimensions.

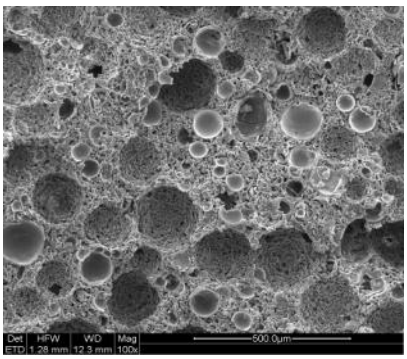
Compound structure with EMC, silicon chips, copper, solder and polyimide layer; schematic removal level.

Compound wafer and removal level

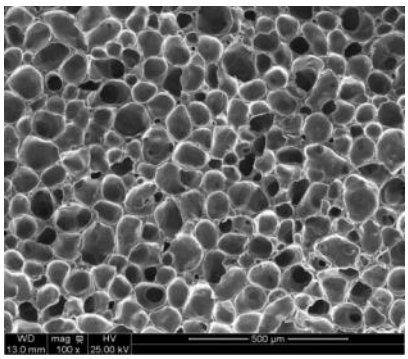


Schematic structure without added dimensions.

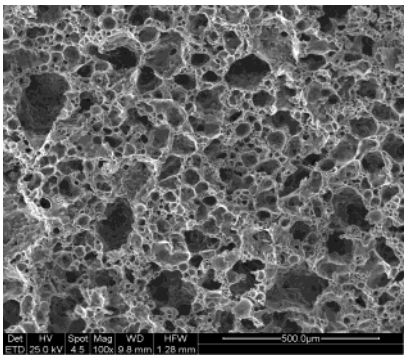
Simpler compound drawing in the earlier edition; removal level and layers without added material markers.



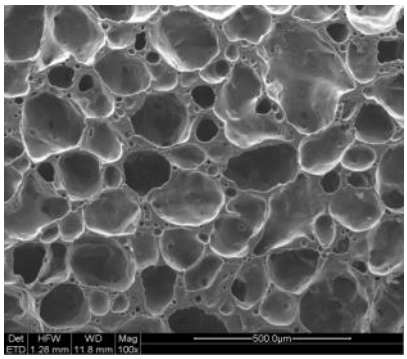
Silicon, rough grinding: Q221 micrograph.



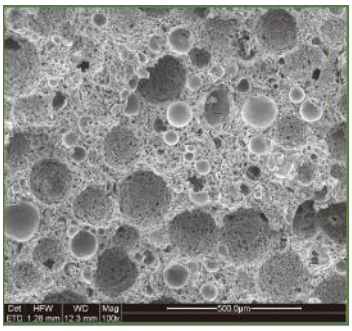
Silicon, fine grinding: Q221 micrograph.



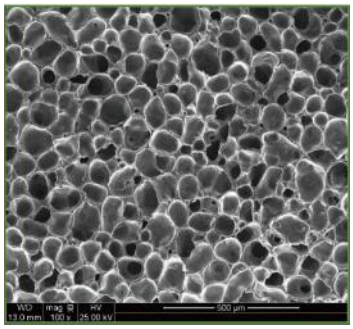
Compound, rough grinding: Q221 micrograph.



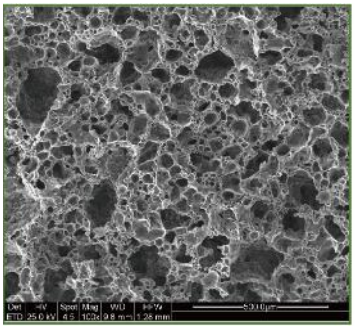
Compound, fine grinding: Q221 micrograph.



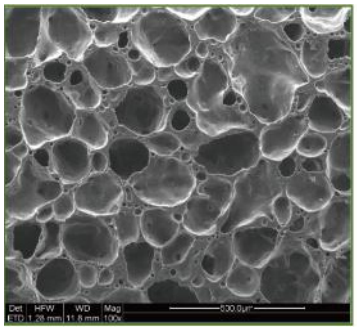
Silicon, rough grinding: Q233 micrograph; independent source assignment.



Silicon, fine grinding: Q233 micrograph; independent source assignment.



Compound, rough grinding: Q233 micrograph; independent source assignment.

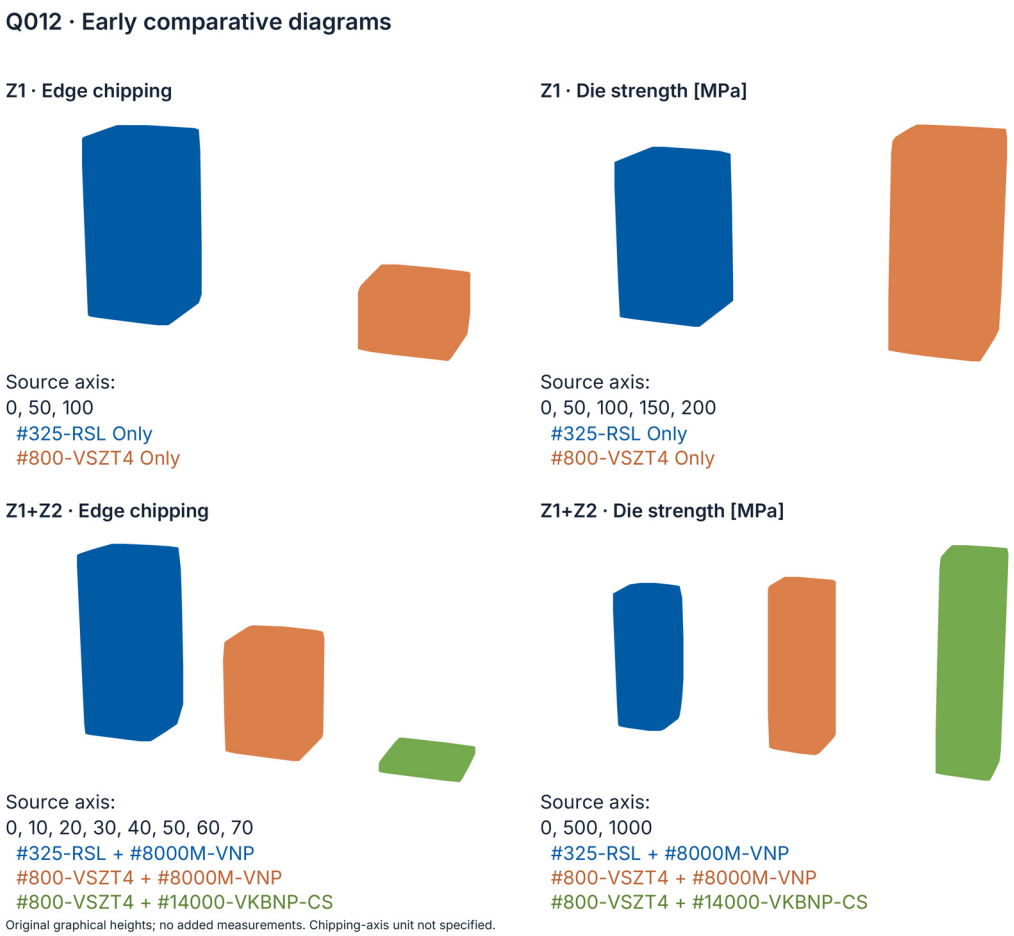


Compound, fine grinding: Q233 micrograph; independent source assignment.

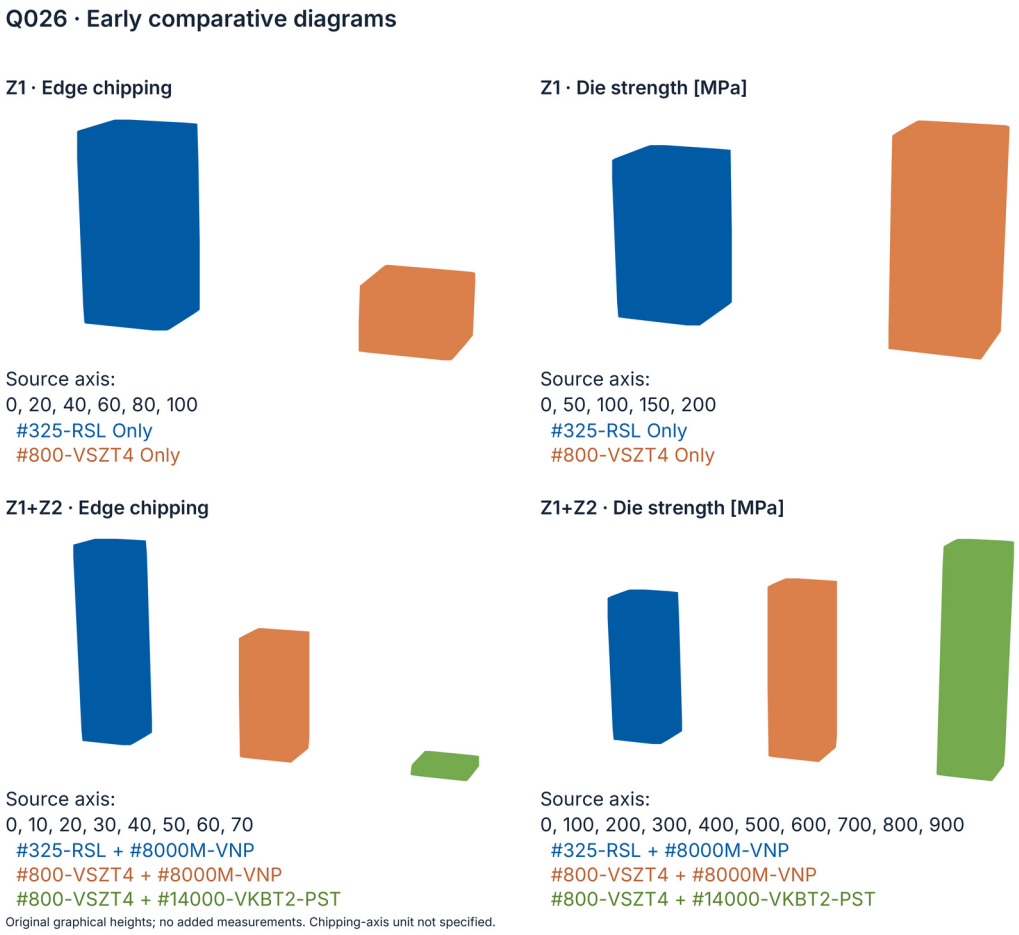
Early Z1 and combined Z1+Z2 comparison diagrams

The two editions printed in January 2017 compare edge chipping and die strength after Z1 and after combined Z1+Z2. They show the change from #325-RSL to #800-VSZT4 and different fine-grinding stages. Individual measured numbers are not printed on the bars; their relative heights are therefore retained as graphical comparisons. The strength axis is labelled MPa. No unit is specified for the edge-chipping axis.

The two Z1 versions are #325-RSL Only and #800-VSZT4 Only. The Z1+Z2 combinations are #325-RSL + #8000M-VNP, #800-VSZT4 + #8000M-VNP, and the tool-specific third combination. In Q012 this is #800-VSZT4 + #14000-VKBNP-CS; in Q026 it is #800-VSZT4 + #14000-VKBT2-PST. These codes are not equated with later trials. The new diagrams retain the original axis scales and graphical heights without deriving additional numerical measurements.



Q012: early Z1/Z1+Z2 comparisons; bar heights without additional measured numbers.



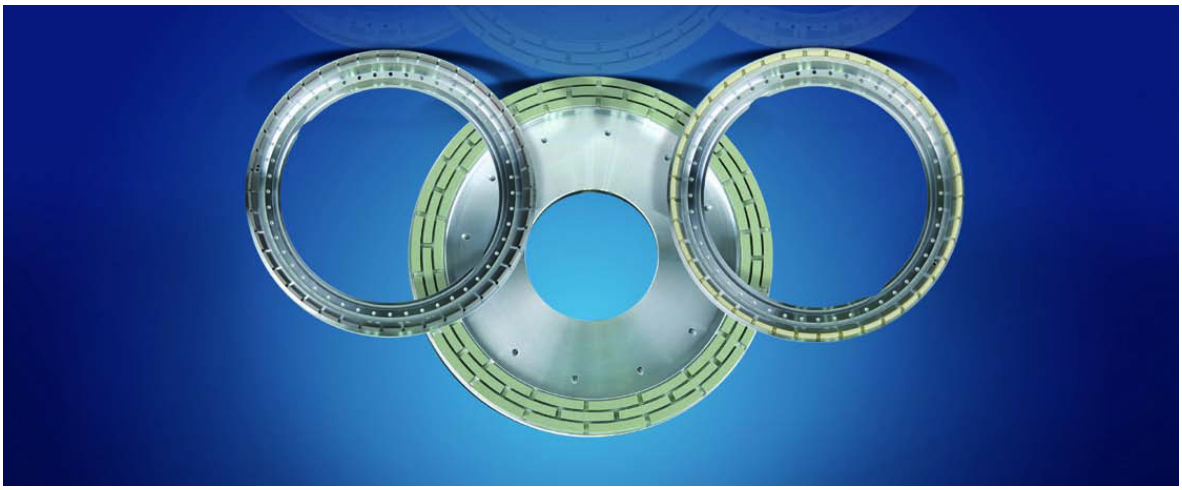
Q026: early Z1/Z1+Z2 comparisons; bar heights without additional measured numbers.

Sapphire and hard materials: programme variants

The sapphire documents describe high stock-removal performance and long wheel life in metal-bonded rough grinding, and fine surfaces in vitrified fine grinding. The programme targets sapphire, SiC, glass and other hard materials such as zirconia. Q030 additionally names brittle materials. Tool construction and processing parameters can be adapted to different machines and grinding methods.

Both documents carry a January 2017 print date. Their programme tables nevertheless differ in series, diameters, segment heights and grit ranges. D denotes diameter, W segment width and X segment height. Slant and Segment retain the source form designations.

Source	Stage	Series	D [mm]	W [mm]	X [mm]	Grit	Form
Q003	Rough	MX / MS Series	200-300	3-5	3-10	#170-#500	Slant / Segment
Q003	Fine	MS / VSP / VSBT Series	200-300	3-5	3-10	#600-#5000	Slant / Segment
Q030	Rough	MX Series	250 / 300 / 380	3-5	5-10	#170-#600	Slant / Segment
Q030	Fine	MF / VSP Series	200 / 250 / 300	3-5	5-10	#800-#1500	Slant / Segment



Tool versions in the sapphire programme.

Eight sapphire and ceramic application examples

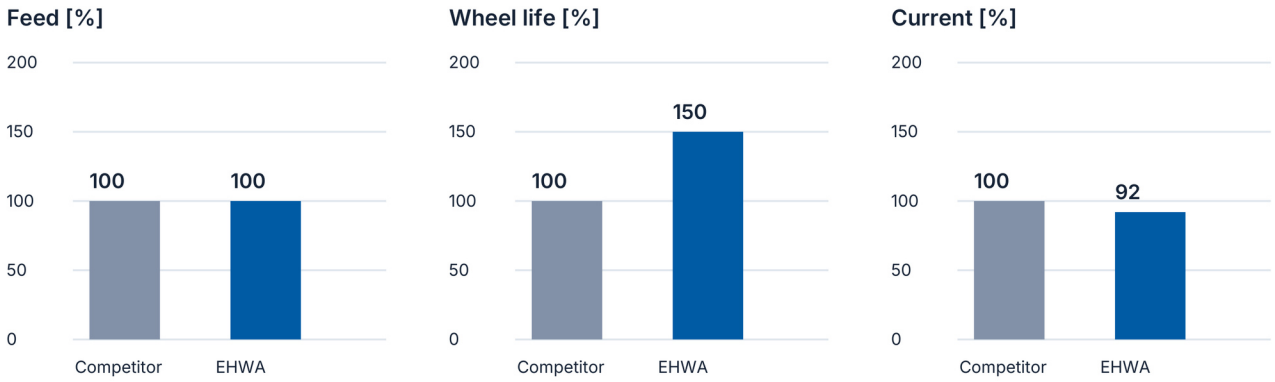
Q003 and Q030 contain the same eight application cases and printed comparative numbers. They are presented once in full. The sources distinguish wafer size, WAX or TAPE mounting, rough/fine tools and fully automatic machining. Percentages are relative values within the particular trial rather than general performance guarantees.

Numbers in the table are always ordered competitor / EHWA. In the 6-inch rough-grinding case, wheel life is expressly 115 / 97; this independent reference presentation is not normalised to 100. In the 8-inch fine-grinding case, both life bars carry the printed value 100 despite their different original graphical heights. The new edition uses the printed numbers.

Case	Workpiece / mounting	Tool	Feed [%]	Wheel life [%]	Current [%]
1	2-4" Sapphire / WAX	#270-MX	100 / 100	100 / 150	100 / 92
2	2-4" Sapphire / WAX	#400-MX	-	100 / 150	100 / 95
3	4" Sapphire / WAX / fully automatic	#325-MX16	100 / 167	100 / 143	100 / 94
4	4" Sapphire / WAX / fully automatic	#1200-VSP	100 / 125	100 / 200	100 / 95
5	6" Sapphire / TAPE / fully automatic	#270-MX	100 / 100	115 / 97	-
6	6" Sapphire / TAPE / fully automatic	#1200-VSP	100 / 125	100 / 125	100 / 95
7	8" Ceramic / TAPE / fully automatic	#325-MX	100 / 123	100 / 110	100 / 90
8	8" Ceramic / TAPE / fully automatic	#1000-MF	100 / 105	100 / 100	100 / 85

Application case 1 · #270-MX

Q003 / Q030 · Trial-specific percentages



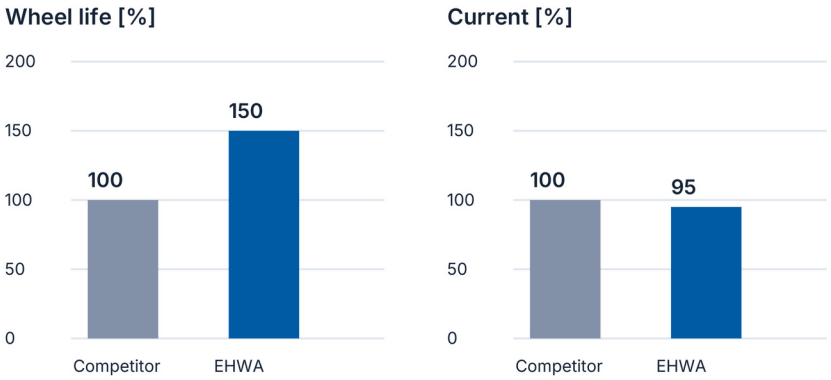
Reference values unchanged; not a general performance commitment.

Application example 1: original comparative values, competitor and EHWA.

Application case 2 · #400-MX

Q003 / Q030 · Trial-specific percentages

No value specified

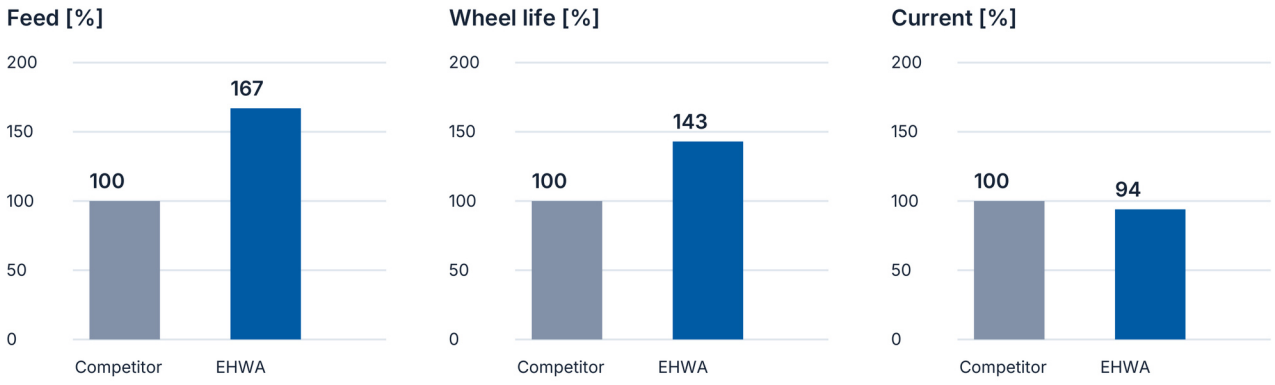


Reference values unchanged; not a general performance commitment.

Application example 2: original comparative values, competitor and EHWA.

Application case 3 · #325-MX16

Q003 / Q030 · Trial-specific percentages

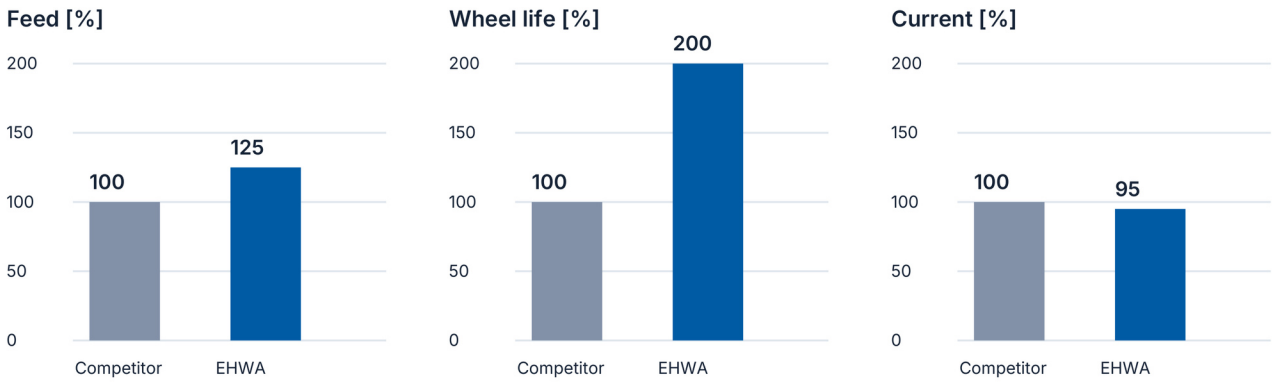


Reference values unchanged; not a general performance commitment.

Application example 3: original comparative values, competitor and EHWA.

Application case 4 · #1200-VSP

Q003 / Q030 · Trial-specific percentages

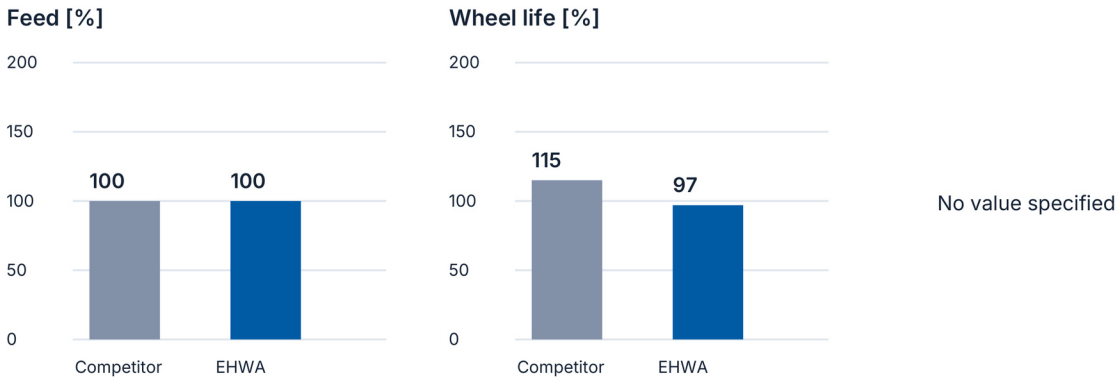


Reference values unchanged; not a general performance commitment.

Application example 4: original comparative values, competitor and EHWA.

Application case 5 · #270-MX

Q003 / Q030 · Trial-specific percentages

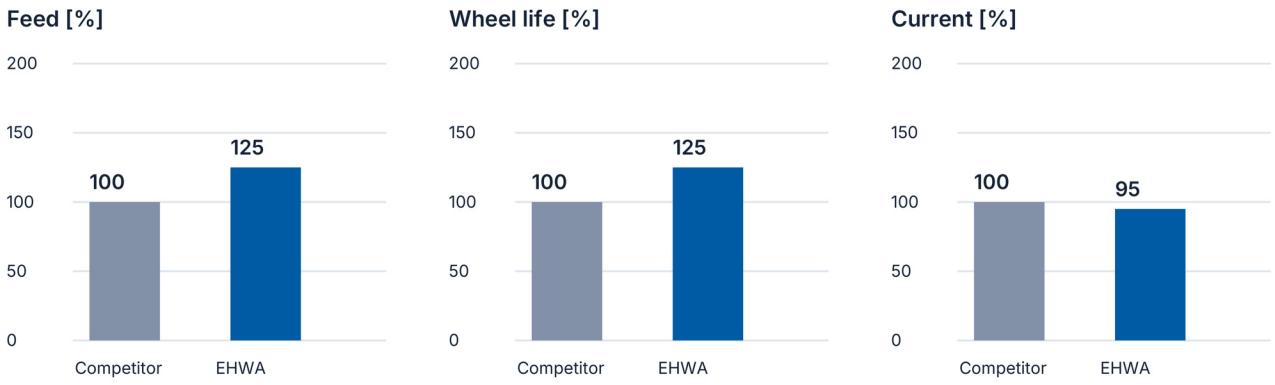


Reference values unchanged; not a general performance commitment.

Application example 5: original comparative values, competitor and EHWA.

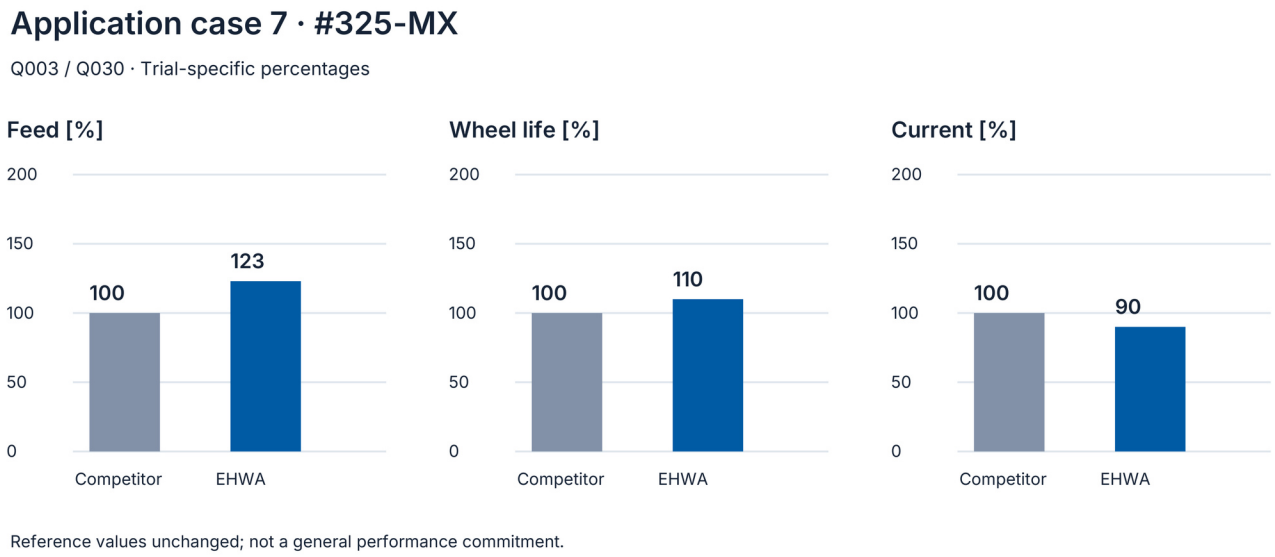
Application case 6 · #1200-VSP

Q003 / Q030 · Trial-specific percentages

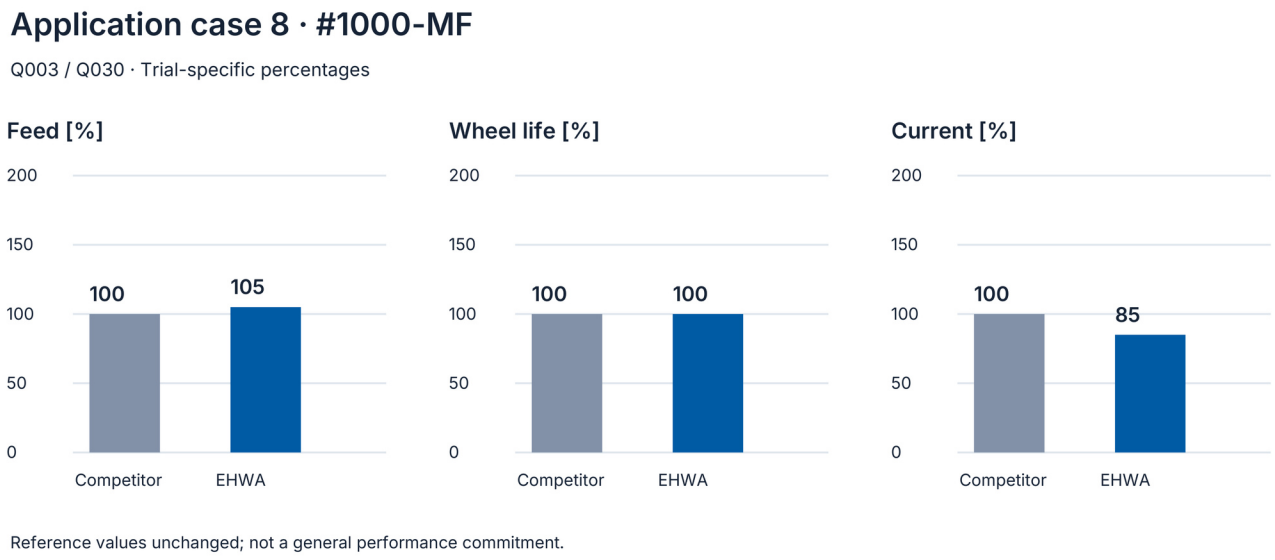


Reference values unchanged; not a general performance commitment.

Application example 6: original comparative values, competitor and EHWA.



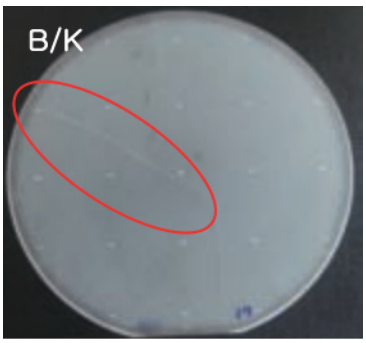
Application example 7: original comparative values, competitor and EHWA.



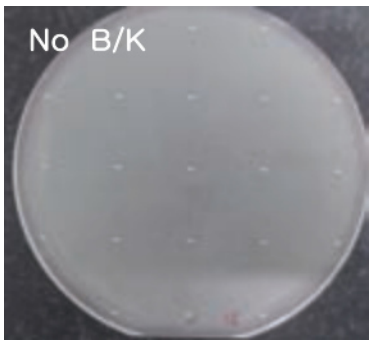
Application example 8: original comparative values, competitor and EHWA.

6-inch sapphire: surface and wafer images

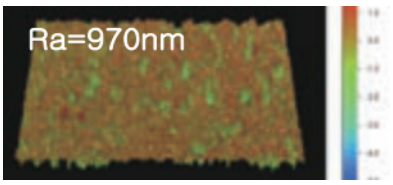
For rough grinding with #270-MX on 6-inch sapphire using TAPE mounting, the originals show wafer photographs marked B/K for the competitor and No B/K for EHWA. These abbreviations are retained as source designations. The associated surface images carry Ra 970 nm for the competitor and Ra 857 nm for EHWA. These two images supplement the specific trial rather than describing every sapphire tool.



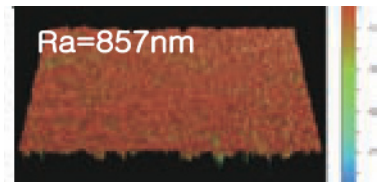
Competitor wafer, source designation B/K.



EHWA wafer, source designation No B/K.



Competitor surface: Ra 970 nm.



EHWA surface: Ra 857 nm.

Resin-bonded and vitrified back-grinding versions

The document printed in December 2018 distinguishes two Z1 concepts. Vitrified tools #400-#800 enable higher feed and consequently higher units per hour; low, consistent current supports long wheel life. Resin-bonded tools #325-#600 target reduced edge chipping and damage on thin wafers, with good grinding performance and useful tool life.

For Z2, EHWA describes resin #2000-#4000 with low, stable current and longer life than the comparative tool. Finer #3000-#4000 versions target improved roughness and fewer grinding marks. D, W and X are defined as diameter, width and depth. Q101 does not print a unit beside the dimension list below.

The independent selection lists are not row-by-row specification combinations. Machine abbreviations, grits and bonds are therefore listed separately.

Selection list	Q101 data
D	Ø200-Ø204 / Ø250 / Ø300-Ø304
W	2-4
X	5-7
Bond type	Resin BG01 / Vitrified BG02
Machine / SK type	DISCO D / OKAMOTO O / TSK T
Mesh size	#270 / #325 / #400 / #600 / #800 / #1200 / #1500 / #2000 / #3000 / #4000
Bond name	VA / VCL / RB / RS / REC / RDC / SWB / SWA / SWC / SWD / SWE



Back-grinding wheels in the December 2018 programme.

Back grinding: DISCO and TSK trials

The Z1 trials compare EHWA porous resin bond RSL with a porous competitor bond. Z2 compares EHWA wear-resistant porous resin bond SWD. The tables retain each comparative grit and the machine-specific wheel-life values. The source designates the current figures as maximum grinding current at normal feed. K here means one thousand wafers per wheel.

The edge images marked X40 show a remaining wafer thickness of 90 µm after rough grinding with #600 RSL and 50 µm after fine grinding with #3000 SWDL. The image designation SWDL is retained alongside table bond SWD.

Z1

Characteristic	EHWA / DISCO	EHWA / TSK	Competitor / DISCO	Competitor / TSK
Bond / grit	RSL / #400-#600	RSL / #400-#600	Porous resin / #320	Porous resin / #320
Machine	DISCO 8760	TSK PG300	DISCO 8760	TSK PG300
Current [A]	~12-13	~9-10	~13-14	~10-11
Wheel life [wafers/wheel]	~18K	~12K	~13K	~10K
Rmax [µm]	~3-4	~3-4	~4-5	~4-5

Z2

Characteristic	EHWA / DISCO	EHWA / TSK	Competitor / DISCO	Competitor / TSK
Bond / grit	SWD / #2000-#3000	SWD / #2000-#3000	Porous resin / #2000	Porous resin / #2000
Machine	DISCO 8760	TSK PG300	DISCO 8760	TSK PG300
Current [A]	~12-13	~9-10	~13-14	~10-11
Wheel life [wafers/wheel]	~18K	~12K	~12K-20K	~12K
Ra [nm]	~7-8	~7-8	~7-8	~7-8



Edge image X40: wafer thickness 90 µm after rough grinding, #600 RSL.



Edge image X40: wafer thickness 50 µm after fine grinding, #3000 SWDL.

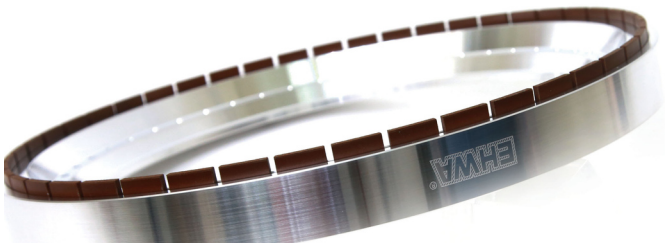
Metal and resin programme for multiple wafers

Q270 describes wheels for simultaneous grinding of multiple wafers, long life and high bulk removal. Suitable wheel designs and processing parameters are offered for different machines and grinding methods. Listed applications are silicon, sapphire, SiC, glass and hard materials such as zirconia. The diameter and segment ranges in this sheet are expressly kept separate from the earlier sapphire programme.

Stage	Series	D [mm]	W [mm]	X [mm]	Grit
Rough	RS / MS Series	200-380	2-5	3-10	#170-#800
Fine	SW Series	200-380	2-5	3-10	#1200-#4000



Metal-bonded wheels for wafer processing.



Segmented resin-bonded version.

Microblades: bond, application and cutting surface

These thin precision blades target effective cutting at high rotational speeds and fast feed rates. Free-cutting versions support a stable cut and can reduce edge chipping. The selection matrix connects resin and metal versions with relative bond hardness and the application groups glass/quartz/ceramic, LTCC, FBFA/CSP/LED, QFN, CABGA and LED/MLF. All range arrows are retained; the Resin/Metal boundary lies within RB15.

The eleven designations are BNM Series, BS Series, BT Series, RB15, MB15, MF, MA, MB Series, MPQ2, MBA and MG4. The independent lower matrix row lists Electroforming Type, metal Ni, the hardness relation “Metal, Resin <”, and cutting of Si, GaAs and PKG (Tape-CSP). This row is not interpreted as an additional confirmed assignment to individual series.

EHWA New Blade changes the side cutting surface. The comparison images specify a maximum of 20 µm for the conventional surface and 6 µm for side enhancement. These numbers describe the side feature marked in the detail image rather than the overall blade thickness. The conventional schematic shows exposed diamonds potentially interfering with copper wiring. The enhanced surface is shown without that interference. PCB, Cu and EMC regions and both actual cut images retain their individual assignments.



Microblade versions.



EHWA New Blade, individual tool.

Microblades: relative hardness and application ranges

BNM Series	BS Series	BT Series	RB 15	MB 15	MF	MA	MB Series	MPQ2	MBA	MG4
Resin type			Metal type							

Increasing relative hardness

Glass / Quartz / Ceramic

LTCC

FBFA / CSP / LED

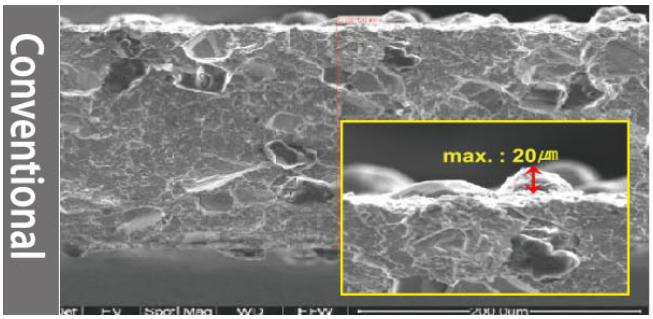
QFN

CABGA

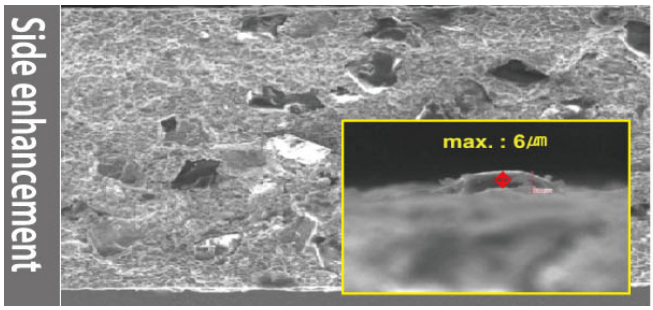
LED / MLF

Electroforming type (Ni)	Hardness > metal / resin	Si, GaAs, PKG (Tape-CSP) Cutting

Microblade selection matrix with all series and application ranges.

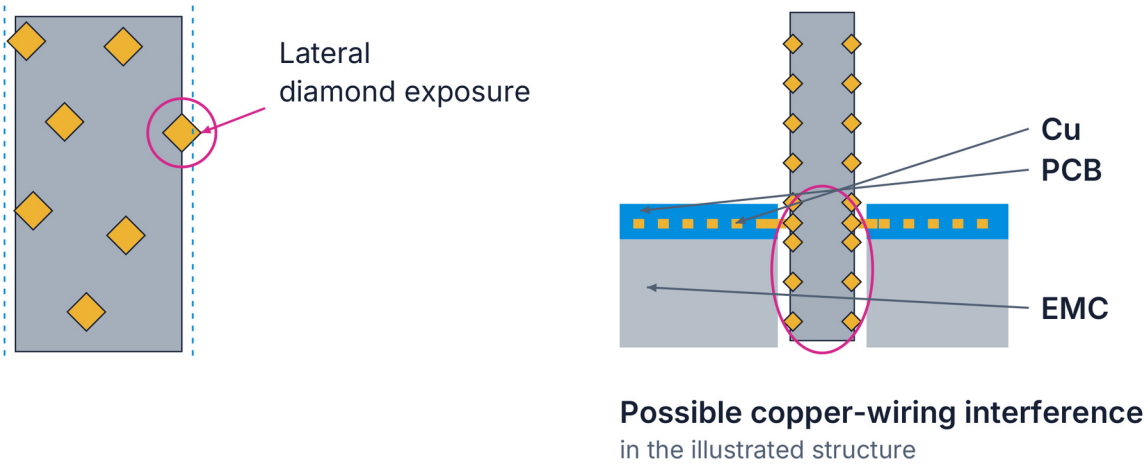


Conventional side surface, original image.



Enhanced side surface, original image.

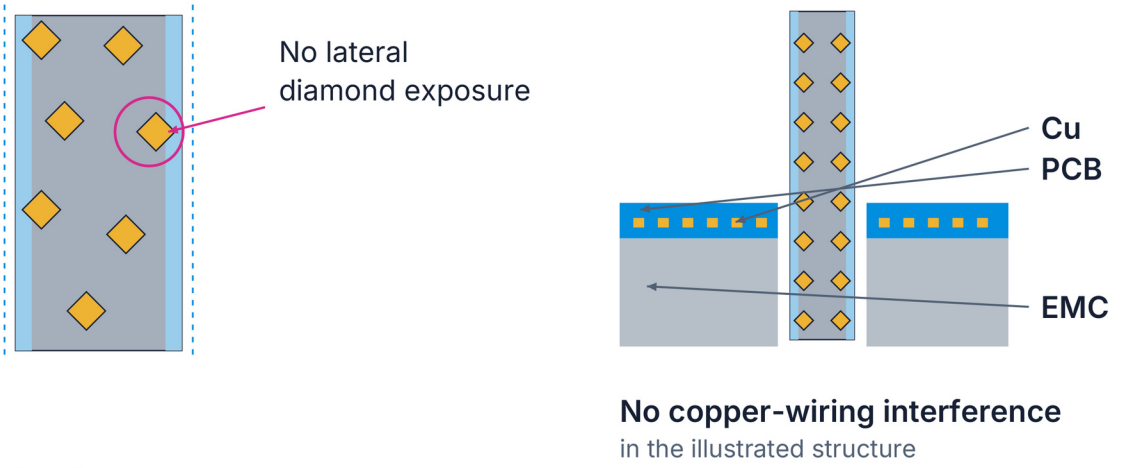
Conventional blade side



Schematic illustration

Conventional interaction: exposed diamond and copper wiring.

Side-enhanced blade



Schematic illustration

Enhanced interaction without the depicted copper-wiring interference.



Actual cut image for the conventional version.



Actual cut image for the side-enhanced version.

Dicing blades: cut geometry and chipping

EHWA describes thin, precise blades with consistent quality supported by controlled grit-size distribution. Higher feed rates support productivity; tool and process are matched to the particular wafer and required cut appearance.

The silicon-wafer schematic distinguishes position 1 on the top side and position 2 on the back side. Blade thickness, kerf width, cut depth and free blade exposure remain separate quantities. The original associates finer grit with small top-side chipping, and coarser grit with effective cutting and lower load on individual grains at the back side. Cooling follows the machine and complete dicing process. The original sheet's blanket wet/dry assignment to the two wafer sides is not a general operating instruction.

The new bond development is shown for silicon and compound semiconductors. Stated targets are small top, side and back chipping, and greater productivity through fast feeds. The two cut images show these separate assessment positions.



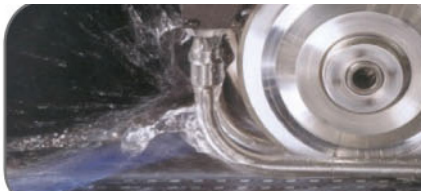
Hub dicing blades.



Dicing-blade detail.

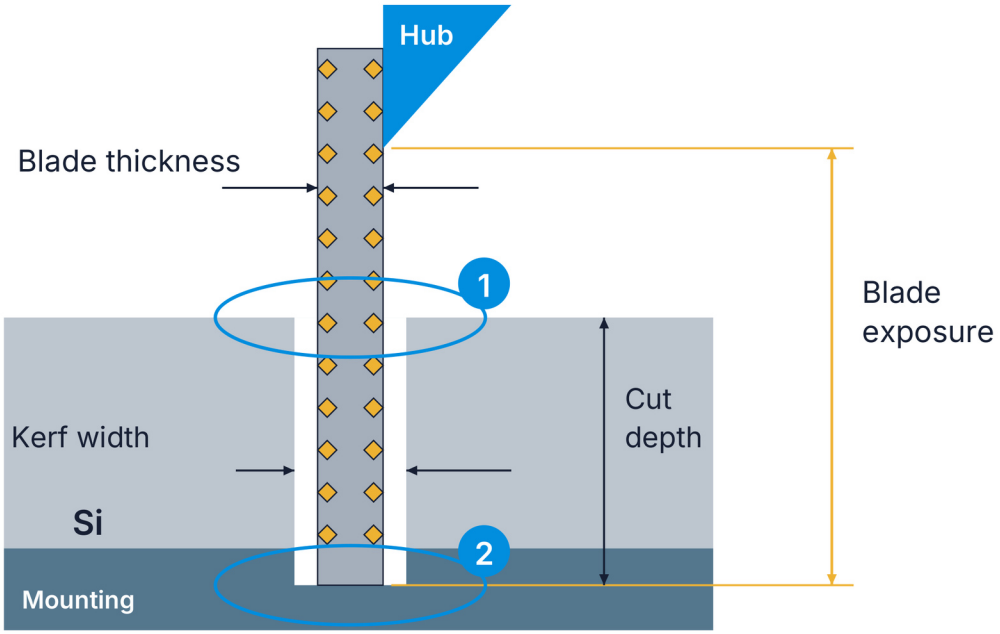


Individual hub version.



Dicing in the machine.

Si-wafer dicing: tool and cut geometry



1: Top edge · 2: Backside edge

Schematic illustration

Dicing geometry: positions 1/2, thickness, kerf, cut depth and exposure.



New bond: top-side chipping.



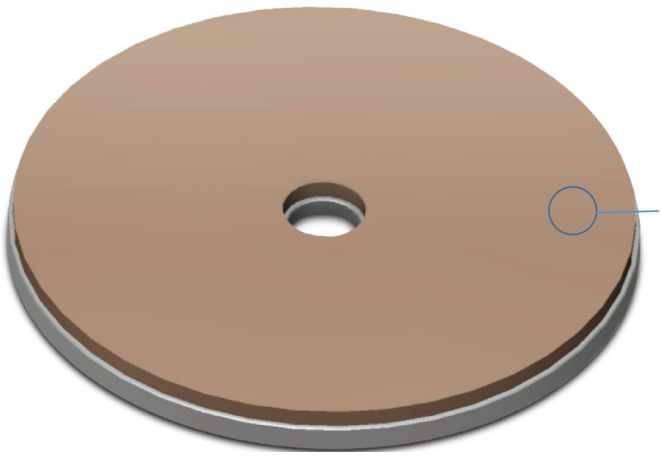
New bond: side and back chipping.

DP: wool felt, zirconia and process sequence

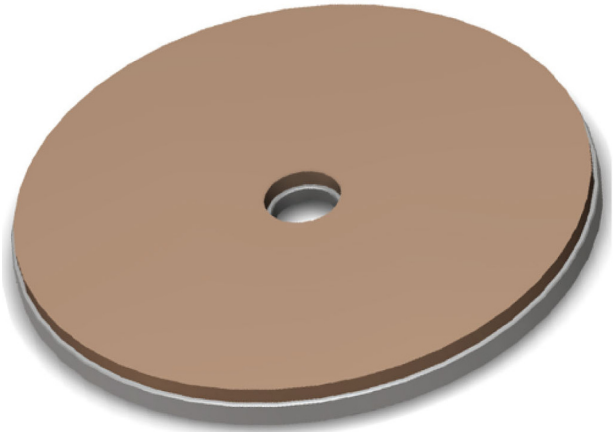
The DP dry-polishing pad combines wool felt with ZrO_2; the sheet specifies a size of 250 nm. The micrographs show felt before impregnation and the structure after impregnation with resin and ZrO_2. The workpiece images list 8- and 12-inch silicon wafers. The illustrated machine and two pad views supplement the particular application.

The three process stages retain their complete EHWA codes. DP provides surface finishing after grinding; polishing selection considers the incoming surface and the required strength and roughness levels.

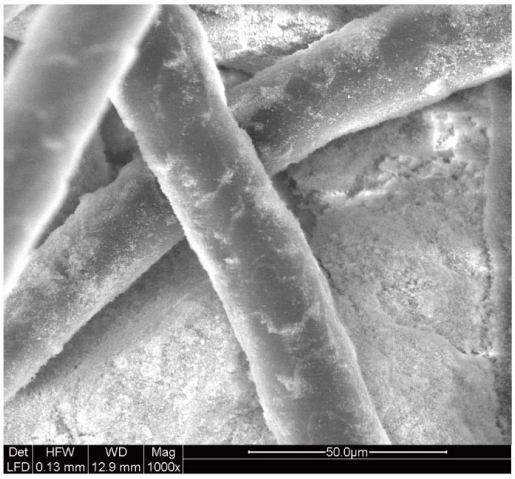
Stage	Q272 tool code
Z1	EHWA BG01-D2-203D4.0W5X-325-RSL
Z2	EHWA NP-D2-203D3.0W5X-5000J-VK8B
Z3	EHWA DP-350D-LJC250



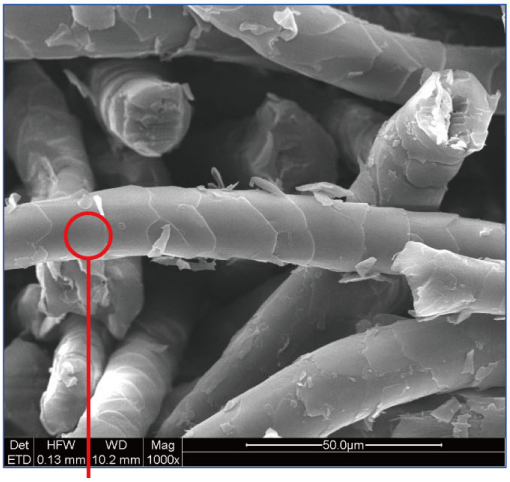
DP dry-polishing pad, front view.



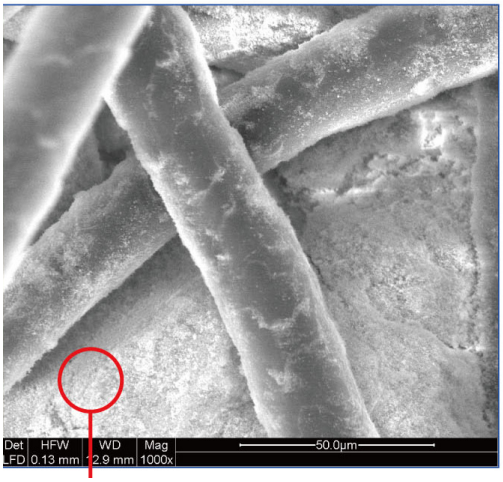
DP dry-polishing pad, angled view.



Pad felt structure with original scale.



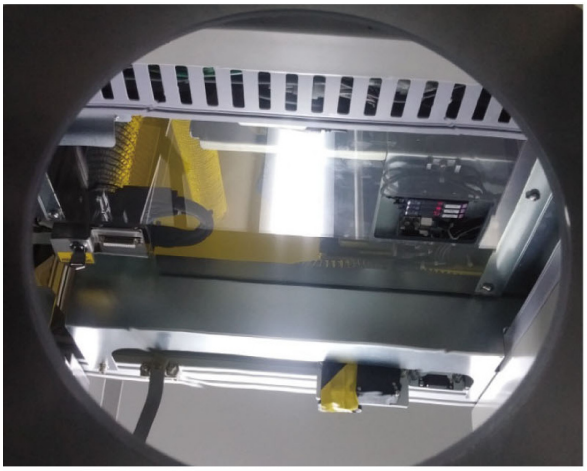
Before impregnation: wool felt.



After impregnation: resin and ZrO_2.

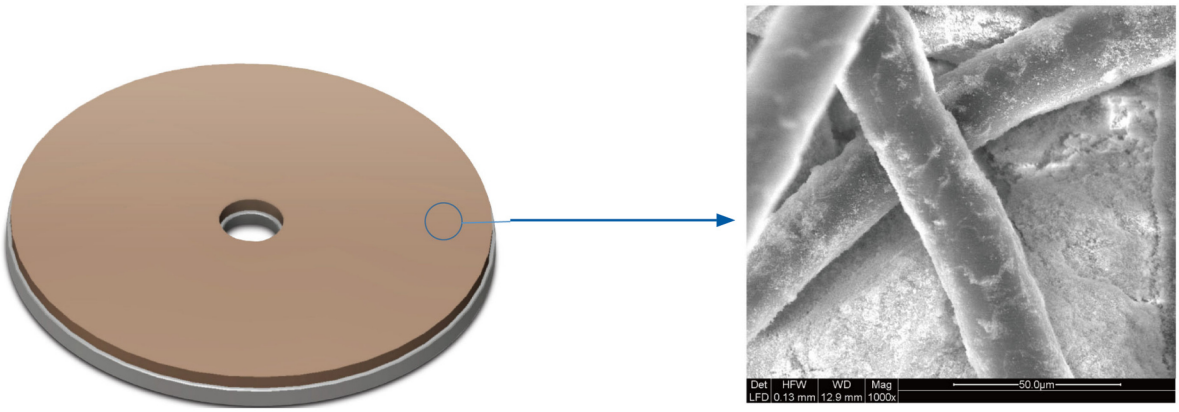


Silicon wafers, listed sizes 8 and 12 inches.



Illustrated polishing application in the machine.

DP: pad and felt structure



Wool felt with ZrO2 · 250 nm

Microstructure with original scale

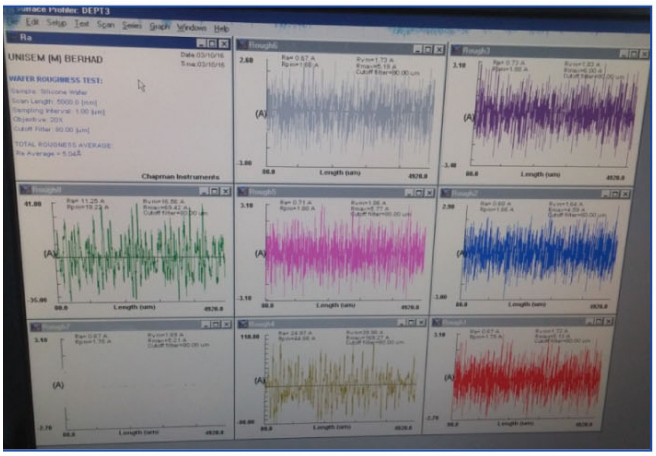
Original images unchanged; linking arrow newly drawn.

DP pad and associated felt structure: original images with newly drawn linking arrow.

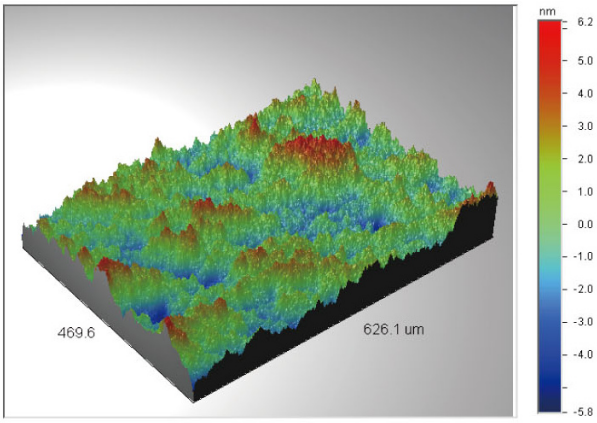
DP: two separate roughness measurements

Q272 documents two measurement methods. The MP2000+ “Total Roughness Average” field gives Ra Average 5.04 Å. The typographic unit is confirmed by the corresponding original display in Q219/Q232. Optical 3D surface measurement using Wyko NT3300 instead gives Ra 1.17 nm, Rq 1.48 nm and Rt 11.97 nm. These results are kept separate because the measurement methods and evaluations differ. The original evaluations are retained as individual scientific images.

Measurement method	Parameter	Value
MP2000+	Sampling interval	1.0 µm
MP2000+	Objective	20X
MP2000+	Cutoff filter	80.00 µm
MP2000+	Ra Average	5.04 Å
Wyko NT3300 / Optical 3D Surface	Ra	1.17 nm
Wyko NT3300 / Optical 3D Surface	Rq	1.48 nm
Wyko NT3300 / Optical 3D Surface	Rt	11.97 nm



MP2000+ evaluation: Ra Average 5.04 Å.



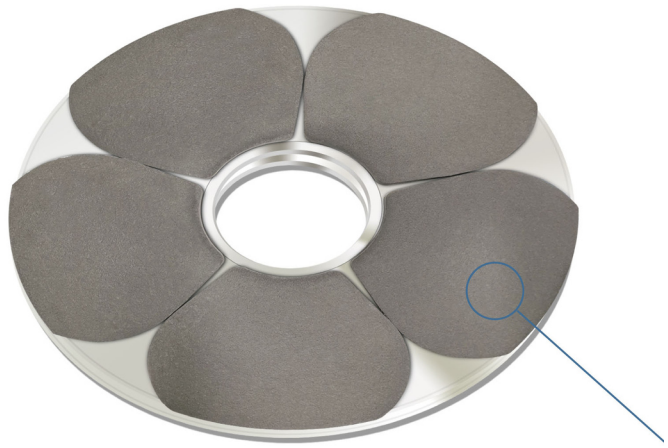
Wyko NT3300: optical 3D surface measurement.

Gettering dry-polishing pad: structure and trial

The combined sheet names the tool GDP - Gettering Dry Polishing Pad. Its bar chart additionally uses abbreviation GPP on the result axis. Both source designations remain identifiable; the trial is presented here under the expanded GDP product name. Gettering polishing combines surface processing with a gettering effect coordinated to the particular process. The general functional description comes from primary process documentation; it adds no unmeasured EHWA performance figures.

The trial processes 12-inch silicon with BG tape AMC APB1-330 on a DISCO DGP8761. The stated quantity is ten dummy wafers, not tool life. Z1 and Z2 are EHWA back-grinding tools; Z3 is the EHWA gettering polishing pad. The segmented pad geometry and micrographs at X500, X2000 and X10000 are retained.

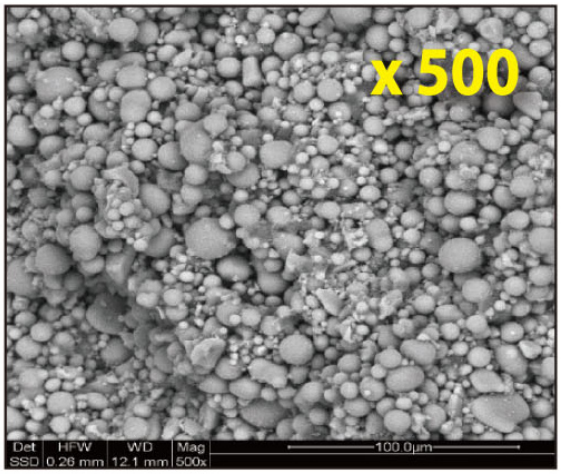
Surface images are separated by position: centre Ra 0.92 nm, middle 1.05 nm and edge 1.17 nm. The die-strength comparison gives 560 MPa after Z2 and 730 MPa for EHWA GDP. These results belong to this process sequence.



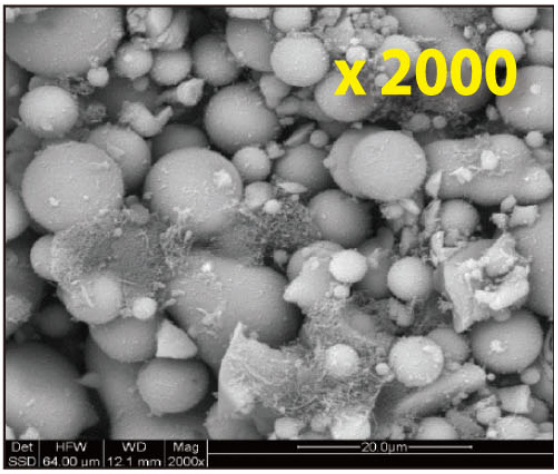
Gettering polishing pad, segmented version.



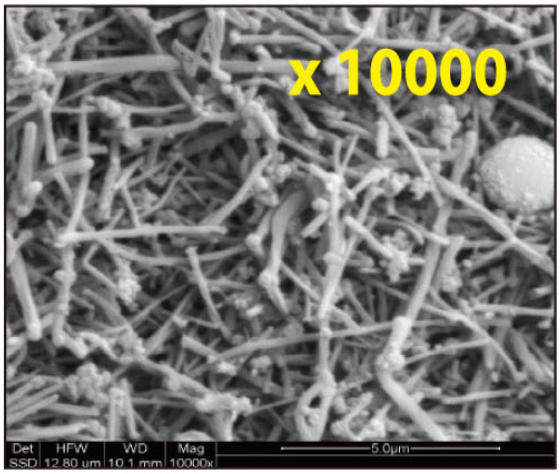
Two views of gettering polishing pads.



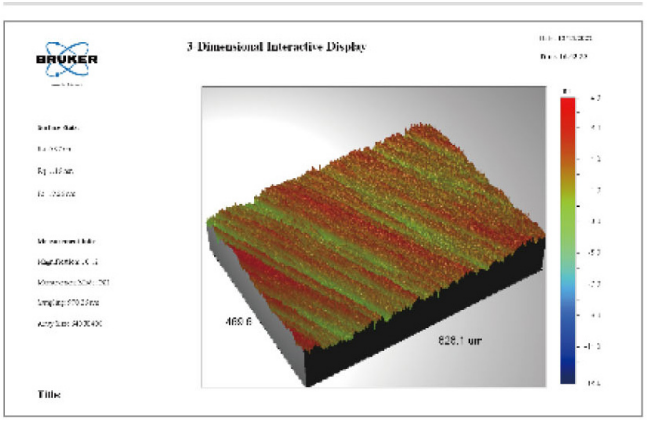
Gettering polishing pad: microstructure X500.



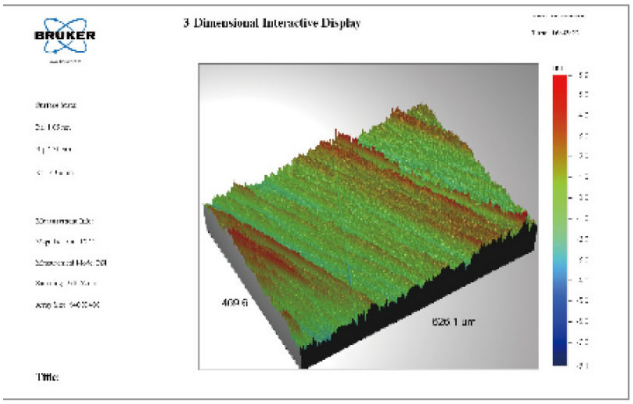
Gettering polishing pad: microstructure X2000.



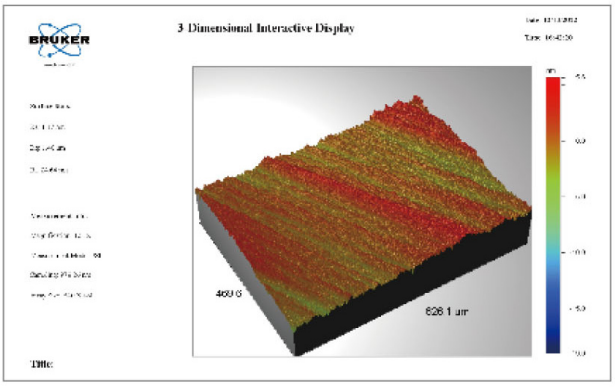
Gettering polishing pad: microstructure X10000.



Centre surface: Ra 0.92 nm.

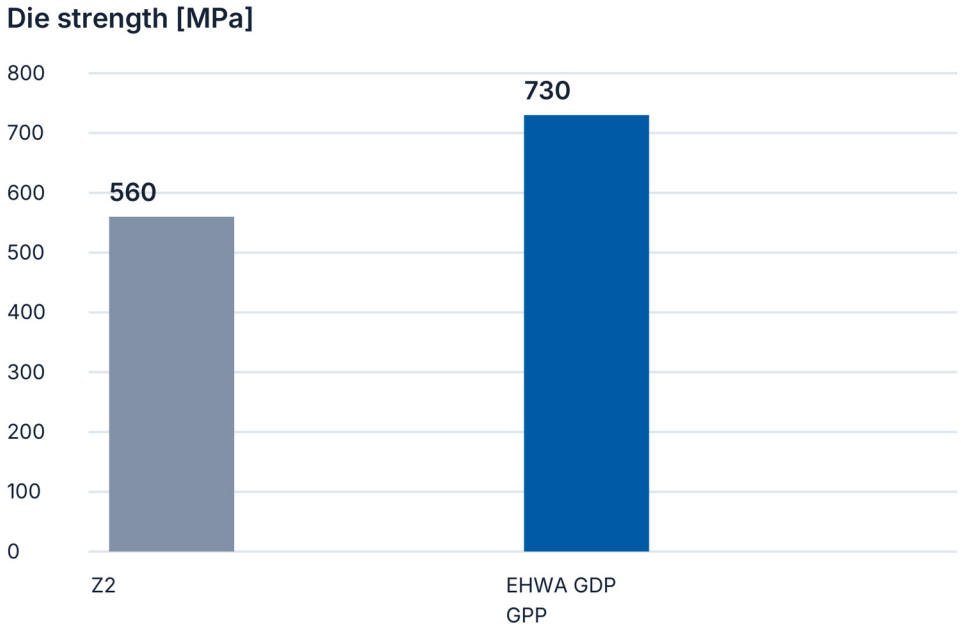


Middle surface: Ra 1.05 nm.



Edge surface: Ra 1.17 nm.

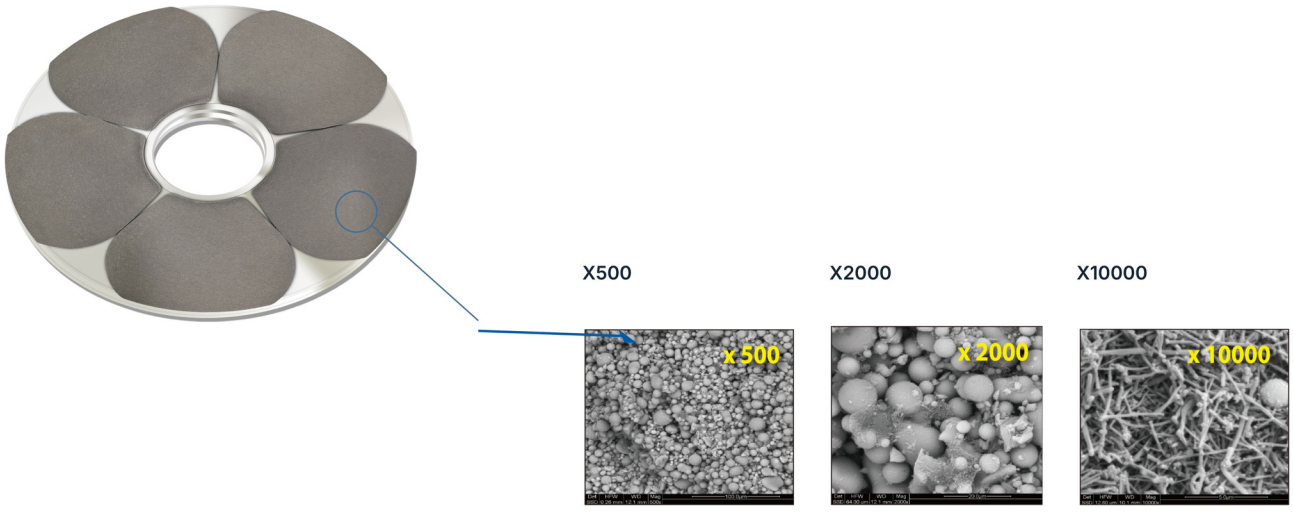
Die strength after Z2 and gettering polishing



Q272 · 12" Si · AMC APB1-330 · DISCO DGP8761 · 10 dummy wafers

Die strength in the illustrated trial: Z2 560 MPa, EHWA GDP 730 MPa; source axis GPP.

GDP: pad and magnification sequence

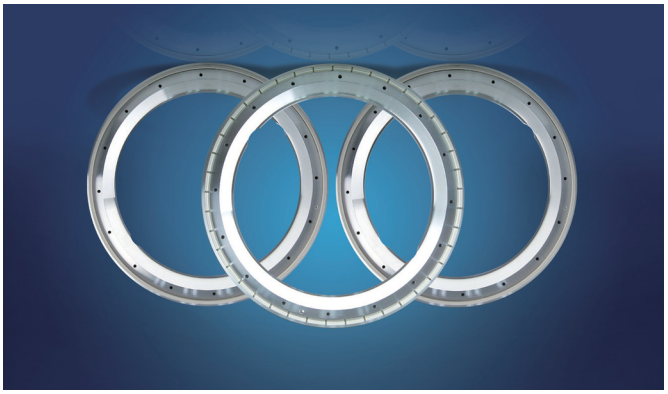


Original scales and scientific markings retained.

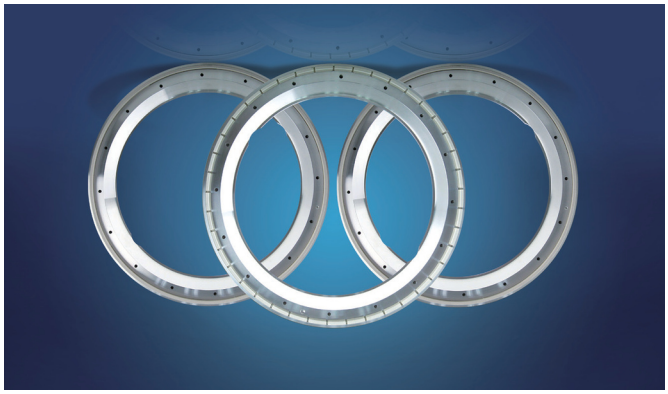
GDP pad and three micrographs: magnification sequence with original scales.

Additional product views in the programme editions

Programme sheets Q274 and Q275 use the same material-specific selection ranges as the complete main NANOPOL programme. Their independent tool views are retained. Q012 and Q026 show the earlier three-wheel group; Q221 adds a complete-wheel view and the recurring product group. Repeated decorative header images are presented once without removing technical product forms.



NANOPOL wheel group, earlier edition Q012.



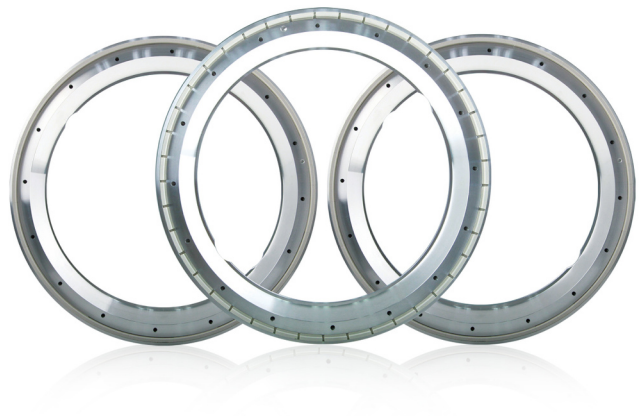
NANOPOL wheel group, earlier edition Q026.



Recurring NANOPOL product group in Q221.



NANOPOL complete-wheel view Q221.



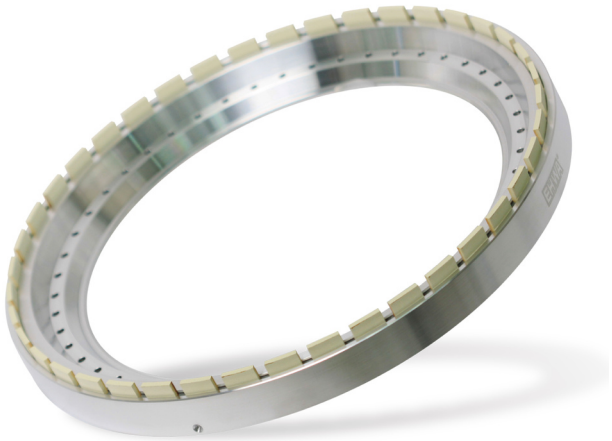
Compound grinding wheels, programme sheet Q274.



Compound programme segment detail Q274.



Silicon grinding wheels, programme sheet Q275.



Individual silicon-programme view Q275.



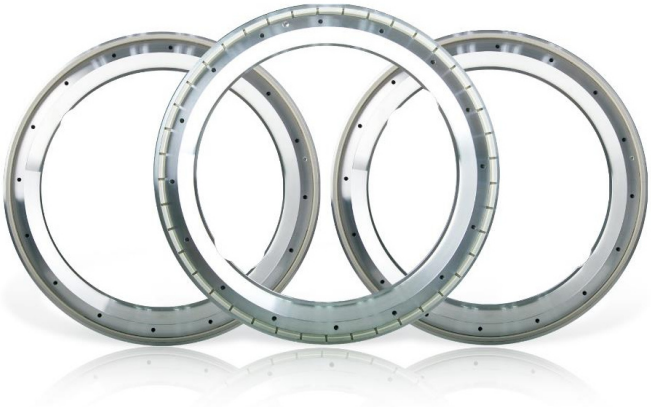
Additional tool view in Semicon document Q233.



Segment detail in Semicon document Q233.



Product detail from the recurring Q221 header, retained once.



Grinding-wheel group in Semicon document Q233.

Development project named in the source

Q272 names “development of diamond tool technology and performance evaluation technology for manufacturing high-tech components”. It lists EHWA DIAMOND, PlanarSEMI, KITECH, Seoul National University and HANA Micron as participating organisations. The source note identifies Technology Innovation Program RS-2024-00455529, funded by Korea's Ministry of Trade, Industry and Energy (MOTIE). This is retained as project information from the sheet rather than a general certification or worldwide ranking claim.

Discuss your wafer-processing application

Provide the material structure, wafer diameter, initial and target thickness, machine and mounting. Existing Z1/Z2/Z3 codes, rotational speeds, feeds, grinding current, roughness measurement method and current wheel life help with selection. For compound wafers, add the simultaneously processed material constituents and observed loading or chipping. For cutting blades, kerf, free exposure and actual cooling arrangement are useful.

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Selection connects required removal, surface target and economical processing time. Start with the information already available; further details can be added during technical discussion.

Technical sources

The complete contents of the following twelve EHWA documents form the technical basis. Print dates are stated only where printed in the document. Trials retain their respective tools and conditions.

- EHWA: Sapphire Wafer Back Grinding Wheel 1 (printed 01/2017), pages 1-3.
- EHWA: NANO POL - Vitrified Back Grinding Wheel (printed 01/2017), pages 1-1.
- EHWA: NANO POL - Vitrified Back Grinding Wheel (second version, 01/2017), pages 1-1.
- EHWA: Sapphire Wafer Back Grinding Wheel (printed 01/2017), pages 1-3.
- EHWA: Back Grinding Wheel (printed 12/2018), pages 1-2.
- EHWA: NANOPOL - nine-page programme, pages 1-9.
- EHWA: NANOPOL - Semicon programme, pages 1-4.
- EHWA: Back Grinding Wheel, Micro Blade and Dicing Blade, pages 1-1.
- EHWA: DP, NANOPOL and GDP, pages 1-1.
- EHWA: NANOPOL - Compound Wafer Grinding Wheel, pages 1-1.
- EHWA: NANOPOL - Si Wafer Grinding Wheel, pages 1-1.
- EHWA: NANOPOL - complete ten-page programme, pages 1-10.