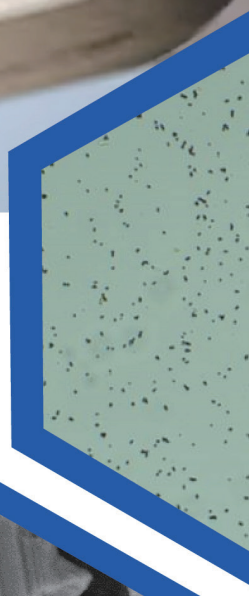



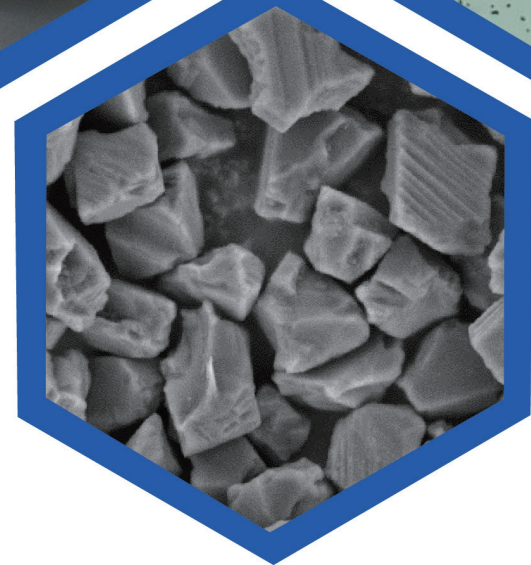


SOLUTION FOR LAPPING/ PRECISION POLISHING

World-leading diamond slurries



-  *HAPD / HSPD*
-  *HAPH / HSPH*
-  *HAM / HSM*



CREATE ENDLESS POSSIBILITIES WITH THE POWER OF DIAMOND



Qual Diamond
Hi-tech Corporation

ABOUT THE COMPANY

Qual Diamond specializes in developing and producing diamond powders and diamond slurries/suspensions for precision polishing. Qual Diamond's success is powered by collaborative relationships with our customers, profound technical expertise, and dedicated workforce. Our technical team has 60+ years of combined experience in synthetic diamond, material science, and nanotechnology.

Innovation and quality are in our DNA. Qual Diamond is the leading producer and supplier of highly deagglomerated and pure diamond nano- and micro-particles. Our proprietary surface treatment methods and stringent quality requirements deliver consistent results and cost benefits to our customers. These methods are developed by our nanotechnology lab, which alone generates over 20 Intellectual Properties (IP) on surface modification and nano-deagglomeration technologies.

Another laboratory at our San Diego location is dedicated to developing methods and solutions for our customers. The lapping and polishing laboratory is equipped with lapping machines and other essential equipment for lapping and precision polishing. This laboratory provides us with the capabilities to test customers' samples in-house and develop customized solutions that cater to different customers' project requirements. We publish periodic case studies and share insights and tips on precision polishing with results generated by the lab.

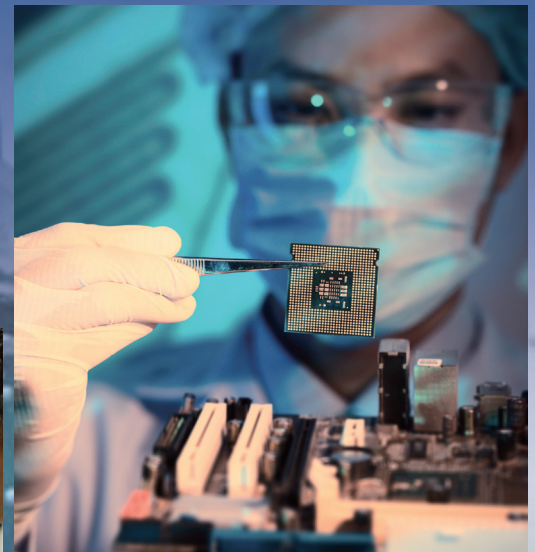
Qual Diamond is also ISO 9001 and ISO 14001 certified and compliant. We control every step of the process from procuring raw materials to producing finished products. We utilize high-precision instruments from Europe and the US for particle sizing, elemental analysis, and impurity detection. All raw materials are eco-friendly and recyclable. Whether your applications are in aerospace, photonics, electronics, advanced ceramics, automotive, or medical devices, our dedicated team is ready to help you develop a bright future and create endless possibilities with the power of diamonds.

OUR MOTTO:

"Quality is Our Life; Customers Are Our Priority."

OUR MISSION:

Become the best-in-class manufacturer and supplier of diamond products for advanced industries.



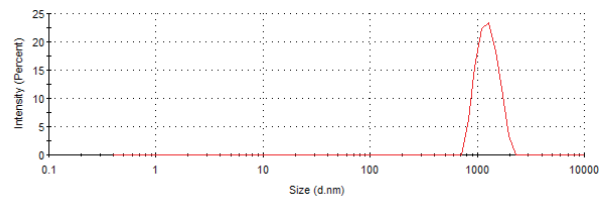
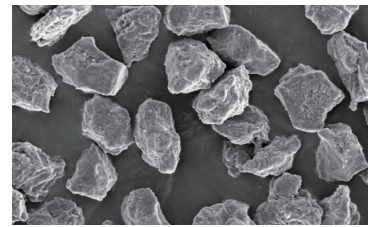


HSPD/HAPD Diamond Slurry

Hydroqual Standard Detonated Polycrystalline Diamond Slurry
 Hydroqual Advanced Detonated Polycrystalline Diamond Slurry



HAPD in different size of containers



SEM & Size Distribution

INTRODUCTION:

Qual Diamond Hydroqual HSPD/HAPD diamond slurries are formulated using a hydro-based matrix. The slurries are consisted of detonated polycrystalline diamond particles suspended in a hydro-based matrix. Suspension is made possible by a proprietary surface modification technology, which prevents diamond particles from agglomerating. They are widely used in lapping and precision polishing of different materials used in semiconductors, photonics and optics, advance ceramics, and metallography. ceramics, and metallography.

FEATURES:

- Available sizes range from 0.1 to 10 μm .
- Stable at a wide temperature range: $-20^{\circ}\text{C} - 40^{\circ}\text{C}$.
- The rough polycrystalline diamond particle surface has numerous sharp edges, giving high material removal rates.
- Higher friability than monocrystalline diamond also contributes to faster material removal rates.
- Fine finishes.
- Less sub-surface deformation.
- Ideal for high-performance lapping and polishing.
- Tight particle size distribution due to deagglomeration technology.
- Chemically stable formulation.
- Environmentally friendly ingredients.
- Ease of cleaning up after lapping/polishing.

Size	Grit Distribution			PH value
	D10, μm	D50, μm	D99, μm	
0-0.25	0.1	0.1	0.4	7.5-9.0
0-0.5	0.1	0.3	0.8	7.5-9.0
0.5-1	0.2	0.4	1.5	7.5-9.0
1-2	1.0	1.2	2.9	7.5-9.0
1-3	1.0	2.0	3.9	7.5-9.0
2-3	1.5	2.5	4.0	7.5-9.0
3-5	3.0	4.0	6.8	7.5-9.0
5-7	4.0	6.1	8.5	7.5-9.0
6-12	5.5	8.8	15.5	7.5-9.0
7-10	6	8.9	12.8	7.5-9.0
Available Concentration:	1mg/ml, 2mg/ml, 5mg/ml, 10mg/ml, 25mg/ml, 50mg/ml			
Available Viscosity:	A <30 B 30-100 C 100-180 D 200-300 E >500			
Available Package:	250ml 500ml 1L 1G			

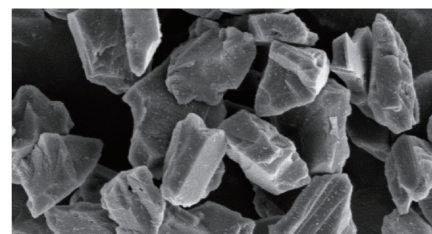


HSPH/HAPH Diamond Slurry

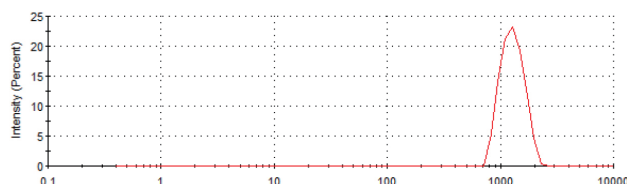
Hydroqual Standard High-Pressure High-Temperature Polycrystalline Diamond Slurry
 Hydroqual Advanced High-Pressure High-Temperature Polycrystalline Diamond Slurry



HAPH in different size of containers



SEM



Size distribution

INTRODUCTION:

Qual Diamond Hydroqual HSPH/HAPH diamond slurries are formulated using a hydro-based matrix. The slurries are consisted of high-pressure high-temperature polycrystalline diamond particles resuspended in a hydro-based matrix. Resuspension is made possible by a proprietary surface modification technology, which prevents diamond particles from agglomerating. In terms of the numbers of sharp edges and finished roughness, HAPH/HSPH lie somewhere between detonated polycrystalline and monocrystalline diamond slurries.

FEATURES:

- ◆ Available sizes range from 1-60 µm.
- ◆ Stable at a wide temperature range: -20 °C – 40 °C.
- ◆ High material removal rates due to abundant sharp edges.
- ◆ Higher friability than monocrystalline diamond also contributes to faster material removal rates.
- ◆ Fine finishes.
- ◆ Tight particle size distribution due to deagglomeration technology.
- ◆ Chemically stable formulation.
- ◆ Ease of cleaning up after lapping/polishing.

Size	Grits Distribution			PH value
	D10,µm	D50,µm	D99,µm	
0-0.2	0.1	0.13	0.35	7.5-9.0
0-0.25	0.1	0.16	0.4	7.5-9.0
0-0.5	0.1	0.33	0.64	7.5-9.0
0.5-1	0.45	0.78	1.65	7.5-9.0
1-2	0.8	1.3	3.1	7.5-9.0
1-3	0.92	1.23	3.5	7.5-9.0
2-3	1.1	2.6	4.9	7.5-9.0
3-5	2.2	3	5.1	7.5-9.0
5-7	4.1	5.6	9.5	7.5-9.0
6-12	4.8	8.9	13.7	7.5-9.0
7-10	6.3	8.5	14	7.5-9.0
10-20	11.5	14.6	22.7	7.5-9.0
20-30	18.9	24.6	39.4	7.5-9.0
30-40	26.3	33.4	50.9	7.5-9.0
40-50	31.6	40	60.4	7.5-9.0
Available Concentration:	1mg/ml, 2mg/ml, 5mg/ml, 10mg/ml, 25mg/ml, 50mg/ml			
Available Viscosity:	A <30 B 30-100 C 100-180 D 200-300 E >500			
Available Package:	250ml 500ml 1L 1G			

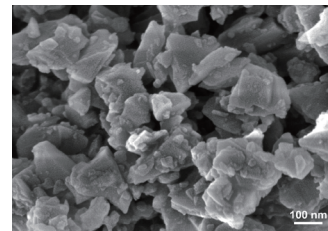


HSM/HAM Diamond Slurry

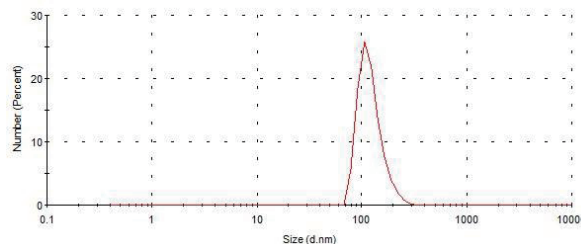
Hydroqual Standard High-Pressure High-Temperature Monocrystalline Diamond Slurry
 Hydroqual Advanced High-Pressure High-Temperature Monocrystalline Diamond Slurry



HAM/HSM in different size of containers



SEM



Size distribution

INTRODUCTION:

Qual Diamond's Hydroqual HSM/HAM diamond slurries are formulated using a hydro-based matrix. The slurries are consisted of high-pressure high-temperature monocrystalline diamond particles resuspended in a hydro-based matrix. Resuspension is made possible by a proprietary surface modification technology, which prevents diamond particles from agglomerating. This specially formulated slurry is resistant to evaporation when exposed to air, making it an excellent alternative to oil-based diamond slurry. HSM/HAM are ideal for lapping and polishing of materials high on the Vickers scale: sapphire, silicon carbide, tungsten carbide, spinel, etc.

FEATURES:

- Available sizes range from 0.1-60 μm .
- Stable at a wide temperature range: $-20\text{ }^{\circ}\text{C} - 40\text{ }^{\circ}\text{C}$.
- High material removal rates due to the lower friability of monocrystalline diamond.
- High material removal rates due to abundant rough edges.
- High purity (99-99.5%).
- Tight particle size distribution due to deagglomeration technology.
- Chemically stable formulation.
- Environmentally friendly ingredients.
- Ease of cleaning up after lapping/polishing.

Size	Grit Distribution			PH value
	D10, μm	D50, μm	D99, μm	
0-0.2	0.1	0.16	0.28	7.5-9.0
0-0.25	0.1	0.15	0.4	7.5-9.0
0-0.5	0.15	0.2	0.45	7.5-9.0
0.5-1	0.25	0.42	1.35	7.5-9.0
1-2	0.71	1.11	2.06	7.5-9.0
1-3	1.2	1.7	3.2	7.5-9.0
2-3	1.5	1.95	3	7.5-9.0
3-5	2.5	3.2	5.1	7.5-9.0
5-7	3.9	5.3	9.1	7.5-9.0
4-6	3.1	5.2	7.3	7.5-9.0
6-12	5.2	8.4	13.8	7.5-9.0
7-10	5.2	7.1	12.4	7.5-9.0
10-20	8.5	16.2	22.5	7.5-9.0
20-30	17.2	24	42	7.5-9.0
30-40	23.2	31.1	51.3	7.5-9.0
40-50	28.4	47.5	61.7	7.5-9.0
Available Concentration:	1mg/ml, 2mg/ml, 5mg/ml, 10mg/ml, 25mg/ml, 50mg/ml			
Available Viscosity:	A <30 B 30-100 C 100-180 D 200-300 E >500			
Available Package:	250ml 500ml 1L 1G			

QUALITY CONTROL

DIAMOND POWDER & DIAMOND SLURRY QUALITY PROCEDURE DIAGRAM

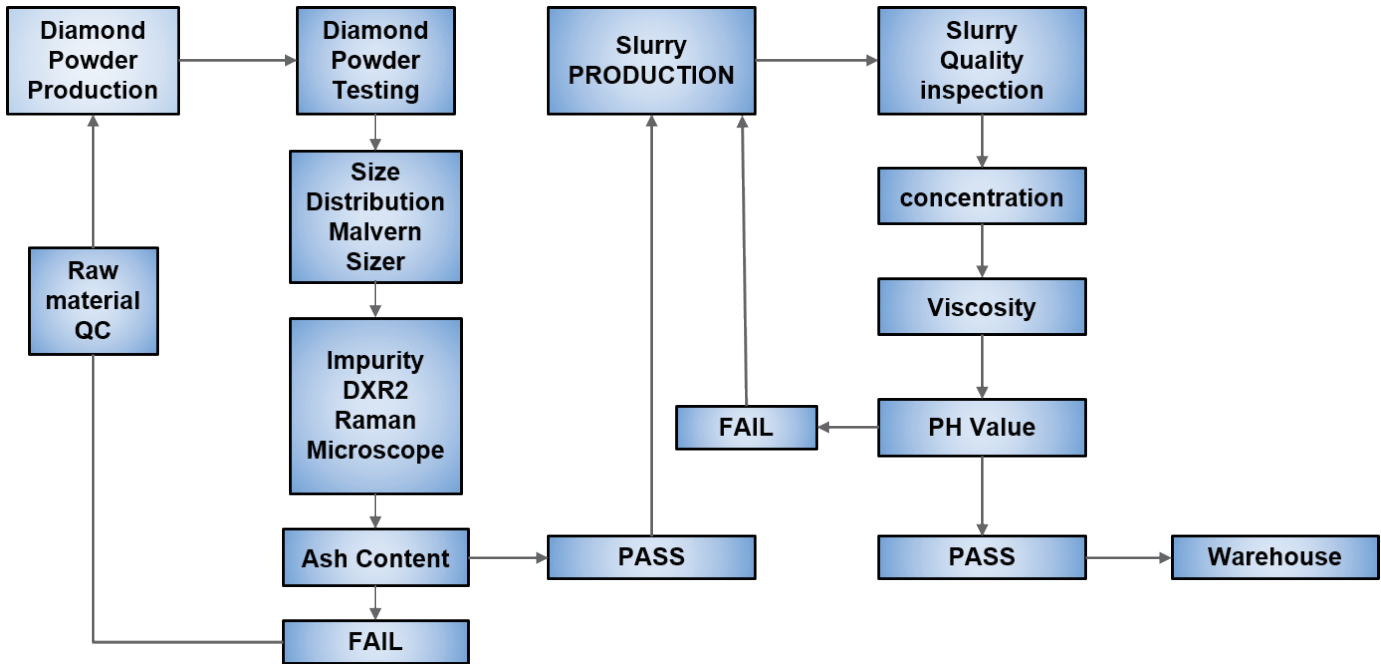


Fig. 1. Qual Diamond quality procedure diagram.

- ◆ All Qual Diamond diamond products are made in the USA.
- ◆ We are ISO 9001:2015 certified and compliant.
- ◆ QD diamond products go through a multi-point quality inspection process to ensure our products meet or exceed customer expectations (see Fig. 1.)
- ◆ Diamond particles quality and purity control: Raman Spectrometer
- ◆ Particle size, zeta potential, molecular mass, and distribution: Malvern zetasizer, microscopy.
- ◆ Nano-/Micro-diamond treatment analysis: FTIR spectrometer, Raman spectrometer, Malvern zetasizer, microscopy (SEM, TEM), UV-Vis spectrometer.



SOLUTIONS FOR THE SEMICONDUCTOR INDUSTRY

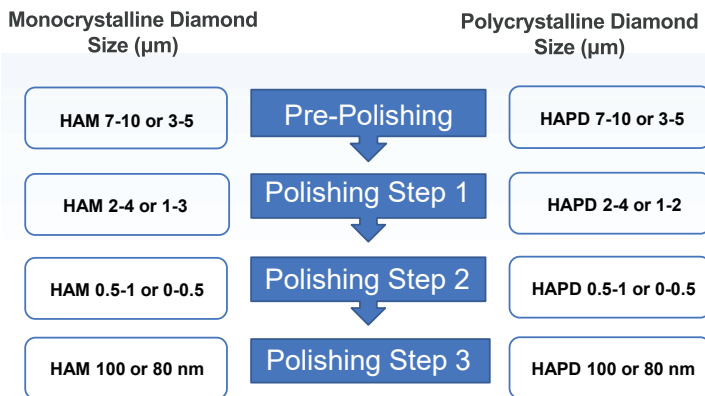
OVERVIEW:

Advances in wafer fabrication, simulation, MEMS, and nanomanufacturing have ushered in a new era in the semiconductor industry. Yet, the thinning of silicon wafer is still being carried out by mechanical precision polishing. Even though the number of electronic apparatuses, such as those used in PCB manufacturing, has grown significantly, challenges in machining prescribed thickness and roughness requirements remain. These requirements are critical for the performance of the semiconductor components.

Qual Diamond (QD) diamond slurries are

manufactured with diamond particles treated with a proprietary surface modification method. The treatment results in the deagglomeration of fine diamond particles, prolonged suspension in a hydro-based or glycol-based matrix, and narrow size distribution. As a result, QD diamond slurries offers consistent edge-to-edge thickness and high precision finishes that easily meet and exceed requirements set by the semiconductor industry. All the diamond slurries in the Hydroqual series can be used in each stage of lapping and precision polishing of components for the semiconductor industry.

SOLUTIONS:



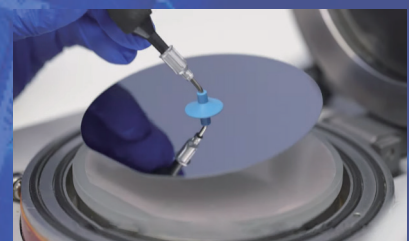
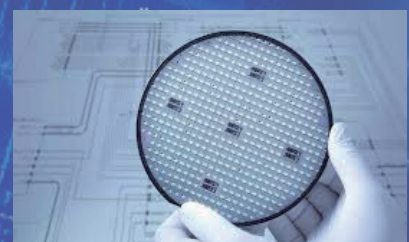
The listed sizes are for guidance only. Specific material results may vary. Please consult our technical team.

APPLICATION:

Industries	Materials	Hydroqual Mono Diamond Slurry	Hydroqual Poly D Diamond Slurry
Semi-conductor	Al ₂ O ₃	✓	✓
	SiO ₂	✓	✓
	Cadmium telluride	✓	✓
	Gallium Arsenide	✓	✓
	Gallium Phosphide	✓	✓
	Indium Phosphide	✓	✓
	lithium Niobate	✓	✓

ADVANTAGES:

- * Higher material removal rate.
- * Reduced number of process steps.
- * Lower slurry consumption.
- * Uniform edge-to-edge thickness.
- * Fine finishes with high precision.
- * Environmentally friendly.
- * Ease of cleaning due to aqueous matrix



SOLUTIONS FOR THE OPTICS & PHOTONICS INDUSTRY

OVERVIEW:

Products of the optics and photonics industry can be found in our everyday life. They can be found in smartphones, computers, fiber optics, laser systems, telescopes, medical devices, advanced electronics and systems, and more. In the coming decades, the impacts the optics and photonics industry have on societies will continue to grow exponentially. New ideas for products exploiting the properties of optics and photonics from more efficient lighting to concentrating solar energy for power generation continue to sprout at a breakneck pace, presenting both opportunities and challenges to the manufacturing of optical components.

A wide range of materials are used in the optics and photonics industry. Sapphire, zinc selenide, zinc sulfide, germanium, calcium fluoride, magnesium fluoride, silicon carbide, beryllium, yttrium-aluminum garnet, and gallium nitride, just to name a few.

APPLICATION:

Industries	Materials	Hydroqual Mono Diamond Slurry	Hydroqual Poly D Diamond Slurry
Optics & Photonics	Fused Silica	✓	✓
	Sapphire	✓	✓
	Ceramic	✓	✓
	Zinc Selenide	✓	✓
	Zinc Sulfide	✓	✓
	Germanium	✓	✓
	Optical Sapphire	✓	✓
	Optical glass filter	✓	✓
	Infrared Crystal Silicon	✓	✓
	MgF ₂	✓	✓
	CaF ₂	✓	✓
	BaF ₂	✓	✓
	Lithium Fluorine	✓	✓

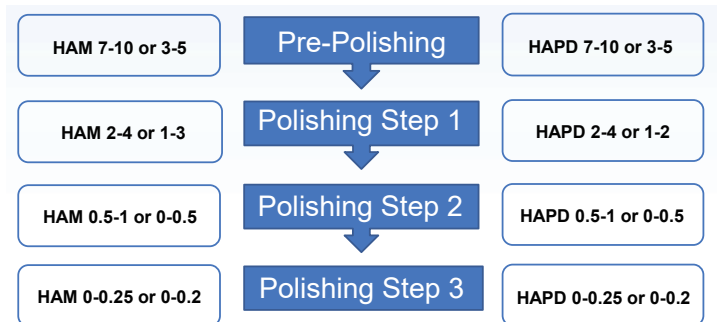
Precision polishing of these materials are currently in high demand and will only continue to skyrocket. Having a reliable source or supplier of high-quality diamond slurries used in lapping and precision polishing optical components is critical for the success and profitability of a service provider or manufacturer.

Qual Diamond (QD) diamond slurries are manufactured with diamond particles treated with a proprietary surface modification method. The treatment results in the deagglomeration of fine diamond particles, prolonged suspension in a hydro-based or glycol-based matrix, and narrow size distribution. As a result, QD diamond slurries offers consistent and high precision finishes that easily meet and exceed requirements set by the optics and photonics industry. All the diamond slurries in the Hydroqual series can be used in each stage of lapping and precision polishing of components for the optics and photonics industry.

SOLUTIONS:

Monocrystalline Diamond Size (µm)

Polycrystalline Diamond Size (µm)



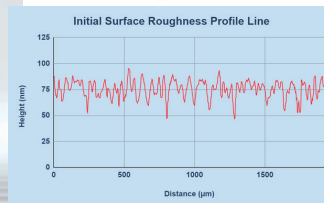
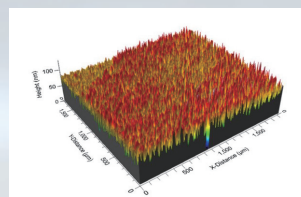
The listed sizes are for guidance only. Specific material results may vary. Please consult our technical team.

BENEFIT:

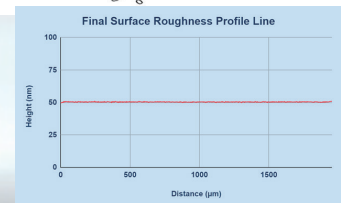
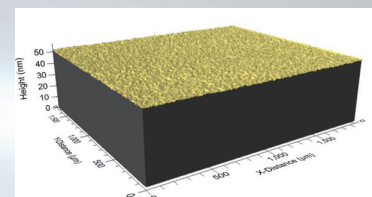
- * Higher material removal rate.
- * Reduced number of process steps.
- * Lower slurry consumption.
- * Fine finishes with high precision.
- * Environmentally friendly.
- * Ease of cleaning due to aqueous matrix.



Germanium Polishing Case Study

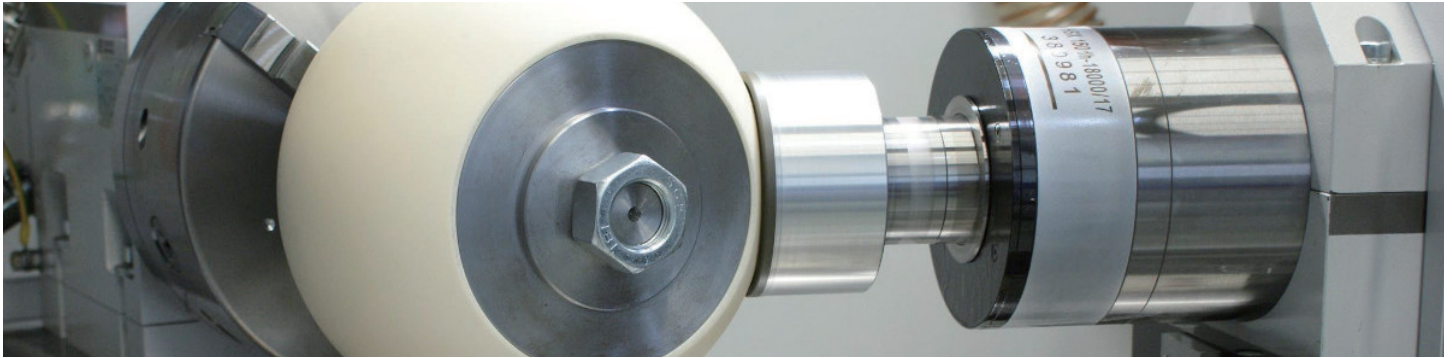


Initial surface roughness of Germanium sample: Ra = 6.2 nm



Final surface roughness of Germanium sample: Ra = 0.16 nm

SOLUTIONS FOR THE ADVANCED CERAMICS INDUSTRY



OVERVIEW:

The commonly encountered advanced ceramic materials are silicon carbide, aluminum nitride, alumina, zirconia, titania, mercury cadmium telluride, boron carbide, silicon nitride, tungsten carbide, and silicates. These materials are commonly found in electronic and electrical equipment due to their strong electrical conductivity and high corrosion resistance. They are also used in body armor, cutting tools, and engines.

As the number of new advanced ceramic materials continue to increase in the market, the demands for precision polishing also skyrocket. The high hardness values of advanced ceramic materials make precision polishing with abrasives other than diamond challenging.

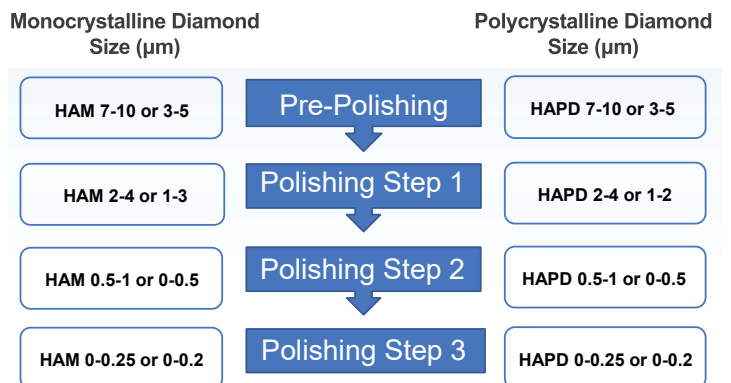
Diamond abrasives in the form of slurry are often the choice when it comes to precision polishing of advanced ceramic materials.

Qual Diamond (QD) diamond slurries are manufactured with diamond particles treated with a proprietary surface modification method. The treatment results in the deagglomeration of fine diamond particles, prolonged suspension in a hydro-based or glycol-based matrix, and narrow size distribution. As a result, QD diamond slurries offers consistent and high precision finishes that easily meet and exceed requirements set by the advanced ceramics industry. All the diamond slurries in the Hydroqual series can be used in each stage of lapping and precision polishing of components for the advanced ceramics industry.

APPLICATION:

Industries	Materials	Hydroqual Mono Diamond Slurry	Hydroqual Poly D Diamond Slurry
Advanced Ceramic	Mercury Cadmium telluride	✓	✓
	Boron Carbide	✓	✓
	Aluminum Nitride	✓	✓
	Silicon Carbide	✓	✓
	Silicon Nitride	✓	✓
	Tungsten Carbide	✓	✓
	Zirconia	✓	✓
	Alumina	✓	✓
	Silicates	✓	✓

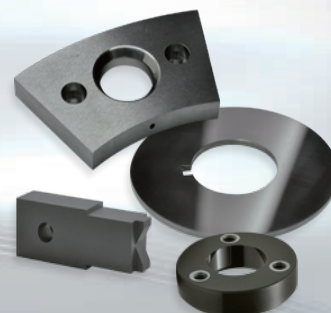
SOLUTIONS:



The listed sizes are for guidance only. Specific material results may vary. Please consult our technical team.

ADVANTAGES:

- * Higher material removal rate.
- * Reduced number of process steps.
- * Uniform edge-to-edge thickness.
- * Fine finishes with high precision.
- * Lower slurry consumption.
- * Environmentally friendly.
- * Ease of cleaning due to aqueous matrix



SOLUTIONS FOR THE METALLOGRAPHIC INDUSTRY

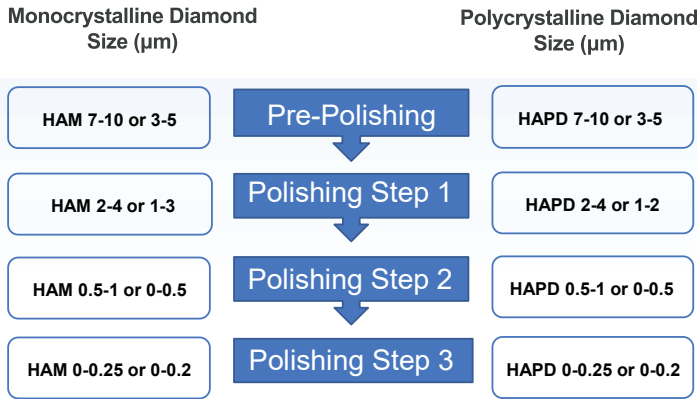
OVERVIEW:

Metallography is often performed with the aid of sophisticated instruments such as optical microscope, electron microscope, and x-ray diffraction machine to detect critical material properties that are not visible to the naked eye. Polishing and lapping are the necessary steps in metallographic inspection. Defect-free surfaces of metallographic samples are necessary to provide accurate metallographic analyses. Diamond abrasives can be used in the entire lapping and polishing process but are commonly used in the final polishing steps to produce a mirror-like finish. Chemical or electrochemical etching of the defect-free surfaces of the metallographic samples is then performed and subjected to microscopy,

x-ray diffraction, and other characterization techniques.

Qual Diamond (QD) diamond slurries are manufactured with diamond particles treated with a proprietary surface modification method. The treatment results in the deagglomeration of fine diamond particles, prolonged suspension in a hydro-based or glycol-based matrix, and narrow size distribution. As a result, QD diamond slurries offers consistent and high precision finishes that easily meet and exceed requirements set by the metallography industry. All the diamond slurries in the Hydroqual series can be used in each stage of lapping and precision polishing of metallographic samples.

SOLUTIONS:



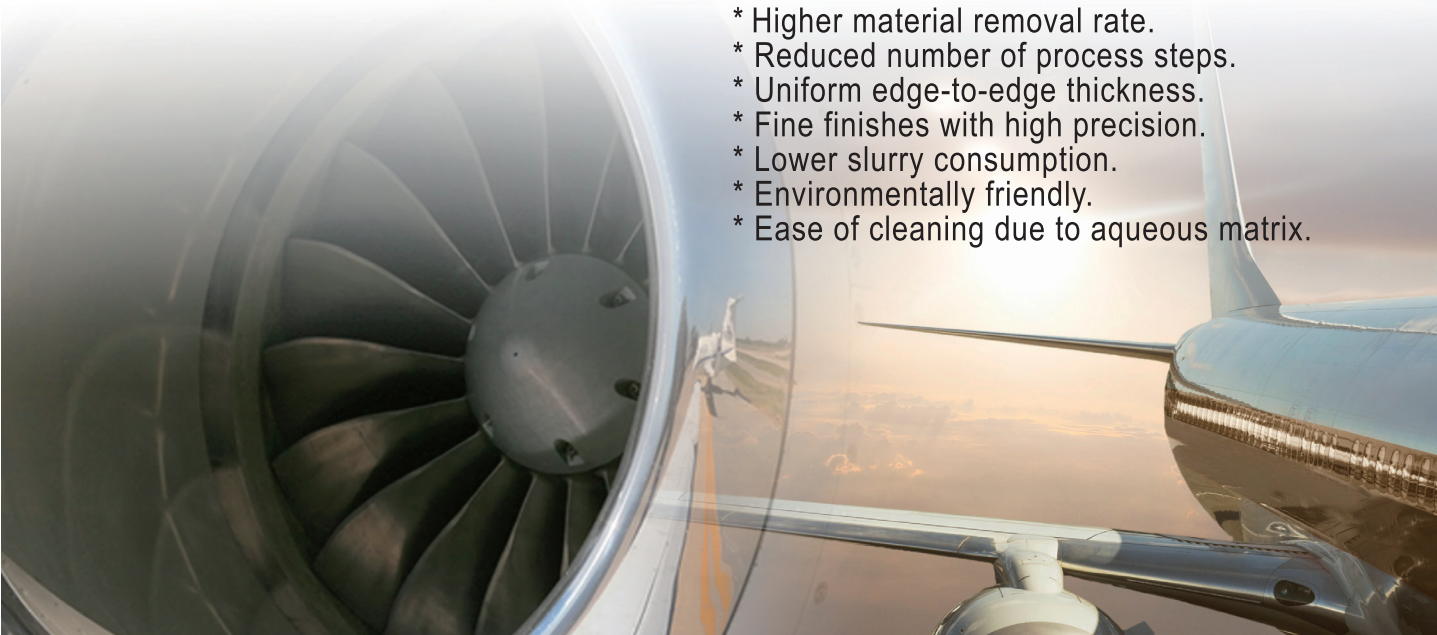
The listed sizes are for guidance only. Specific material results may vary. Please consult our technical team.

APPLICATION:

Industries	Materials	Hydroqual Mono Diamond Slurry	Hydroqual Poly D Diamond Slurry
Metal	Cast Iron	✓	✓
	Titanium Alloys	✓	✓
	Steel	✓	✓
	Nickle-based Superalloys	✓	✓
	Bronze	✓	✓
	Brass	✓	✓
	Cermets	✓	✓

ADVANTAGES:

- * Higher material removal rate.
- * Reduced number of process steps.
- * Uniform edge-to-edge thickness.
- * Fine finishes with high precision.
- * Lower slurry consumption.
- * Environmentally friendly.
- * Ease of cleaning due to aqueous matrix.





OUR DIAMOND SLURRY SPECIFICATION:

Slurry Types	Diamond Size (µm)	Concentration (g/l)	Viscosity (cpm)	PH	Stability				
MONO	0-0.2	1	A	6-7	High				
HAM HSM	0-0.25		2			B			
	0-0.5					30~100			
	0.5-1					C			
POLY	1-2		5			100~180	8-9		
	1-3					25		D	
	2-3							200~300	
	3-5							50	E
	5-7								>500
HAPD	4-6		50				Very High		
HSPD	6-12								
HAPH	7-10								
HSPH	10-20								
	20-30								
	30-40								
	40-50								

At Qual Diamond, we understand that each project is unique. We provide customization solutions based on customers' specific requirements. We can also customize based on our available diamond types, sizes, concentrations, viscosity, and pH. Please see the chart Above for more information.



Qual Diamond

Hi-tech Corporation



(858)263-4358
www.qualifiediamond.com
info@qualifiediamond.com

