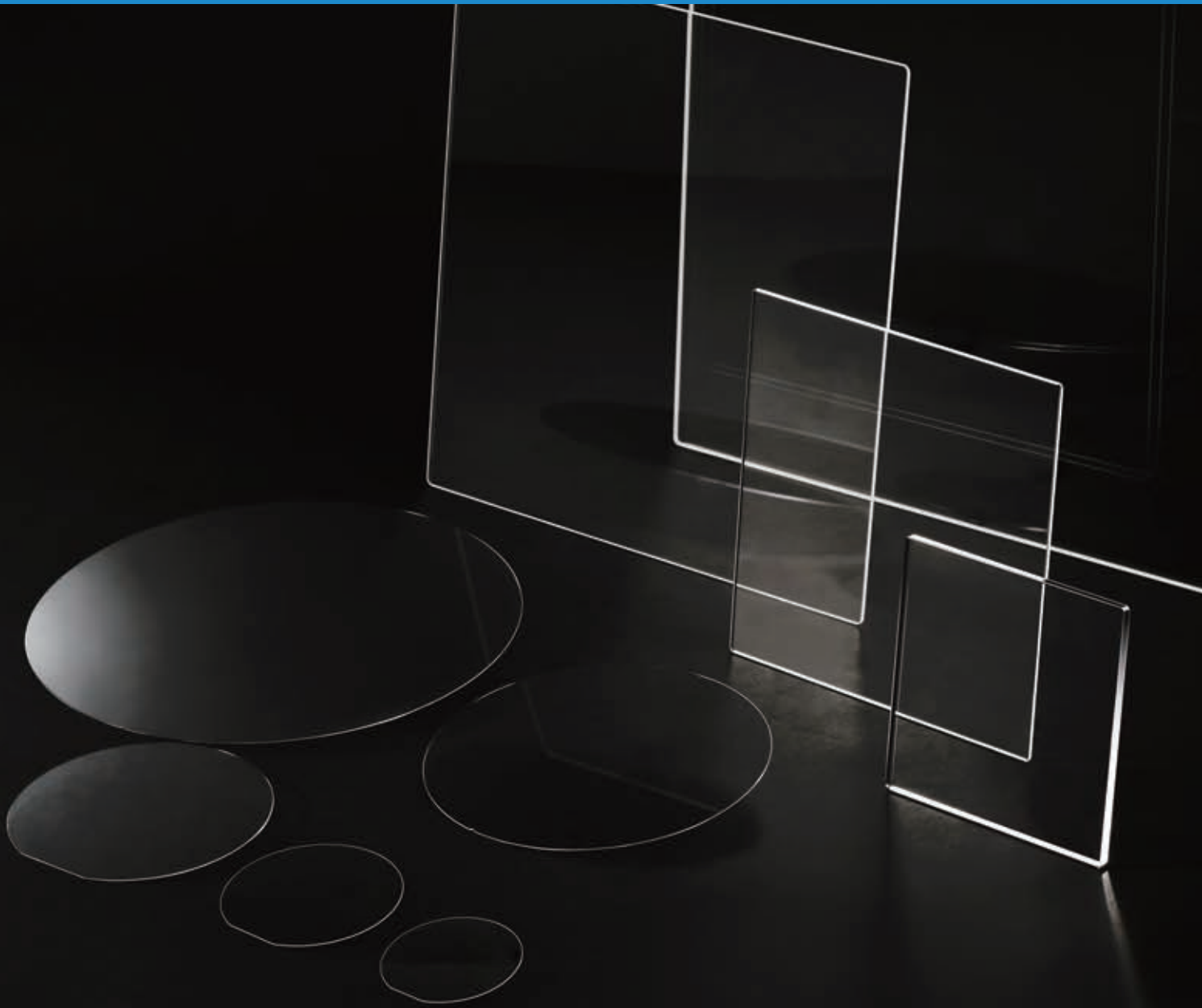


Synthetic Quartz Glass Substrate

VIOSIL-SQ/VIOSIL-SX/VIOSIL-LSX

Technical Data



Synthetic Quartz Glass Substrate

Synthetic Quartz Glass Substrate (VIOSIL) from Shin-Etsu Chemical has the following characteristics.

- High Purity
- High Chemical Resistance
- High Transmission

VIOSIL is used as a photomask substrate in the semiconductor and flat panel display fields.

VIOSIL is also used in a variety of fields, such as LCD projector elements, high frequency device substrates, optical element substrates like DOE, support substrates for wafer thinning processes, and microchannel substrates.

Purity

High-purity SiO₂ with no metal impurities.

Chemical resistance

Extremely resistant to almost all chemicals while maintaining high shape stability.

Heat resistance

Extremely high shape stability under high temperatures.

Transmission

Extremely high transmission over a wide range of wavelengths from infrared to ultraviolet light.

Fluorescence properties

Almost no autofluorescence over a wide range of wavelengths from infrared to ultraviolet light.

Dielectric properties

Extremely low dielectric loss at high frequencies in the GHz range.



We offer three types of materials, SQ, SX, and LSX.

SQ (OH : 300-1,000 ppm)

General use type

SX (OH : <100 ppm)

High heat-resistant type

LSX (OH : <15 ppm)

High heat resistance and reduced absorption type in the IR wavelength range

Physical Property Data (*This data is for reference only and is not a guaranteed value.)

■ Impurity

Element	Impurity conc. [ppb]	Element	Impurity conc. [ppb]	Element	Impurity conc. [ppb]
Li	<1	Cr	<1	Zr	<1
Na	<1	Mn	<1	Mo	<1
Mg	<1	Fe	<1	Cd	<1
Al	<1	Co	<1	Sn	<1
K	<1	Cu	<1	Sb	<1
Ca	<1	Zn	<1	Pb	<1
Ti	<1	Ni	<1	P	<1
V	<1	As	<0.1	U	<0.1

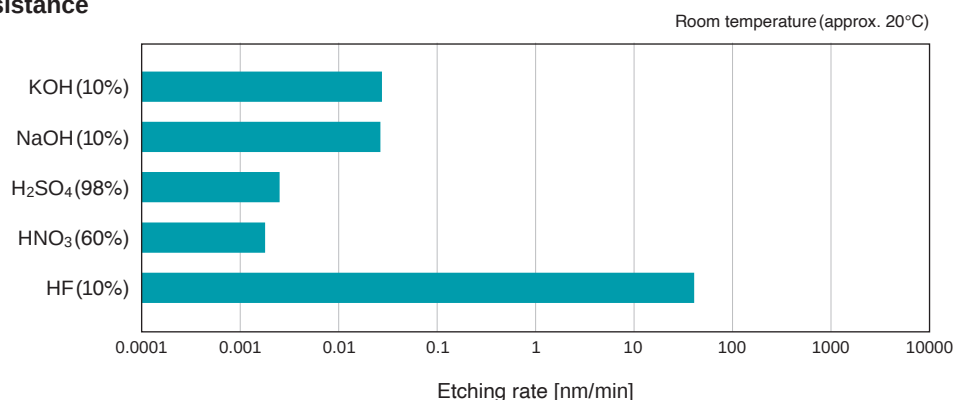
■ Mechanical Properties

Mechanical Properties	Unit	VIOSIL-SQ	VIOSIL-SX, LSX
Specific Gravity (ρ)	—	2.2	2.2
Poisson's Ratio (ν)	—	0.18	0.19
Young's Modulus (E)	GPa	72.5	72.8
Rigidity (G)	GPa	30.6	30.7
Vickers Hardness (HV)	kg/mm ²	599	602
Mohs Hardness	—	6 to 7	6 to 7

■ Thermal Properties

Thermal Properties	Unit	Condition	VIOSIL-SQ	VIOSIL-SX, LSX
Softening Point	°C	$\log \eta=7.6$	1600	1630
Annealing Point	°C	$\log \eta=13.0$	1090	1190
Strain Point	°C	$\log \eta=14.5$	985	1090
Thermal Expansion (α)	ppm/°C	0 to 100°C	0.53	0.52
		0 to 200°C	0.56	0.56
		-100 to 200°C	0.50	0.49
		0 to 700°C	0.58	0.59
Specific Heat	J/g·K	—	0.78	0.78
Thermal Diffusivity	$\times 1.0^{-7}$ m ² /sec	—	8.15	8.10
Thermal Conductivity	W/m·K	—	1.33	1.32

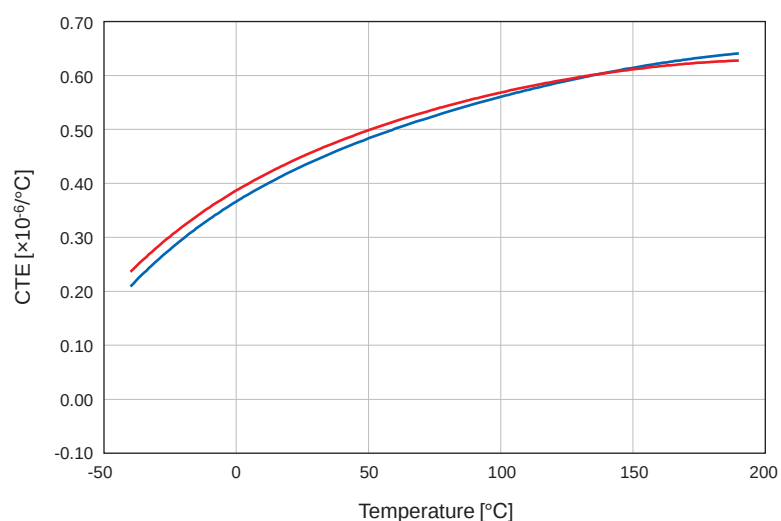
■ Chemical Resistance



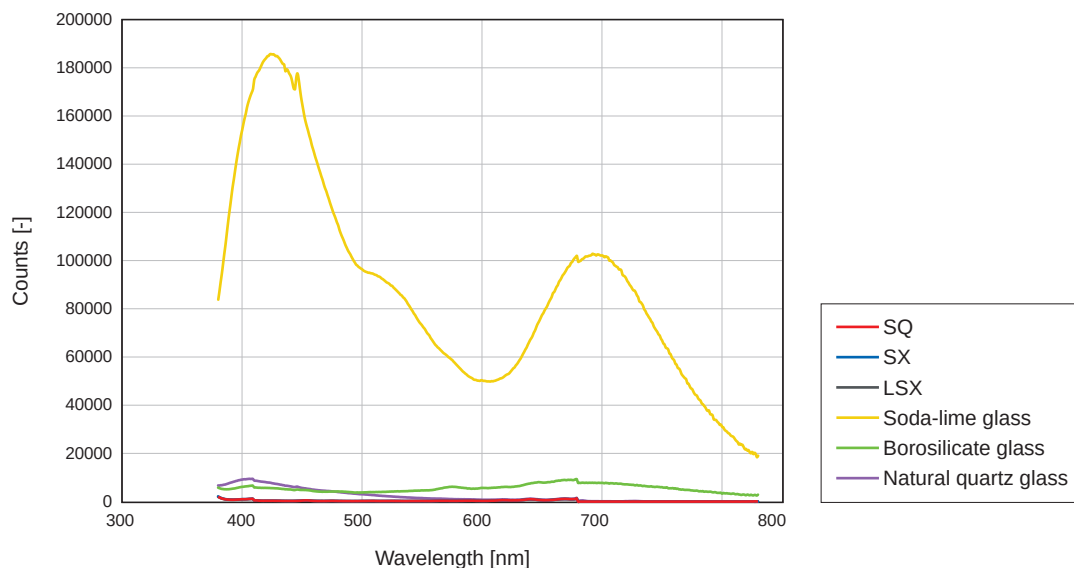
Electrical Properties

Electrical Properties	Unit	Condition	VIOSIL-SQ	VIOSIL-SX, LSX
Relative Permittivity (ϵ_r)		1 MHz	3.8	3.8
		3 GHz	3.8	3.8
		10 GHz	3.8	3.8
		80 GHz	3.8	3.8
Loss Tangent ($\tan\delta$)		1 MHz	<1.0E-4	<1.0E-4
		3 GHz	1.0E-4	1.0E-4
		10 GHz	4.0E-4	4.0E-4
		80 GHz	5.0E-4	5.0E-4
Electrical Resistivity	$\Omega\cdot\text{m}$	—	>1.0E+16	>1.0E+16
Dielectric Breakdown (DC)	kV/mm	0.3 mmt	35.8	
		1 mmt	17.5	

Coefficient of Thermal Expansion



Fluorescence Intensity



■ Optical Properties (SQ)

Wavelength [nm]		Refractive Index (n)	$\Delta n/\Delta T$ (ppm/°C)					
			-40 to -20 (°C)	-20 to 0 (°C)	0 to 20 (°C)	20 to 40 (°C)	40 to 60 (°C)	60 to 80 (°C)
1529.58	—	1.44432						
1064.00	—	1.44968						
1013.98	t	1.45029	7.2	7.7	8.1	8.6	9.0	9.5
852.11	s	1.45251	7.3	7.7	8.2	8.7	9.1	9.6
706.52	r	1.45519	7.4	7.9	8.3	8.8	9.3	9.7
656.27	C	1.45641	7.4	7.9	8.4	8.9	9.3	9.8
643.85	C'	1.45675	7.5	7.9	8.4	8.9	9.4	9.8
632.90	He-Ne	1.45706	7.5	8.0	8.4	8.9	9.4	9.9
589.30	D	1.45845						
587.56	d	1.45851						
546.07	e	1.46012	7.6	8.1	8.6	9.1	9.6	10.1
486.13	F	1.46317	7.8	8.3	8.8	9.3	9.8	10.3
479.99	F'	1.46335	7.8	8.3	8.8	9.3	9.8	10.3
435.83	g	1.46674	8.0	8.5	9.0	9.5	10.0	10.5
404.66	h	1.46966	8.1	8.6	9.2	9.7	10.2	10.7
365.01	I	1.47458						
248.40	KrF	1.50838						
194.16	ArF	1.55896						

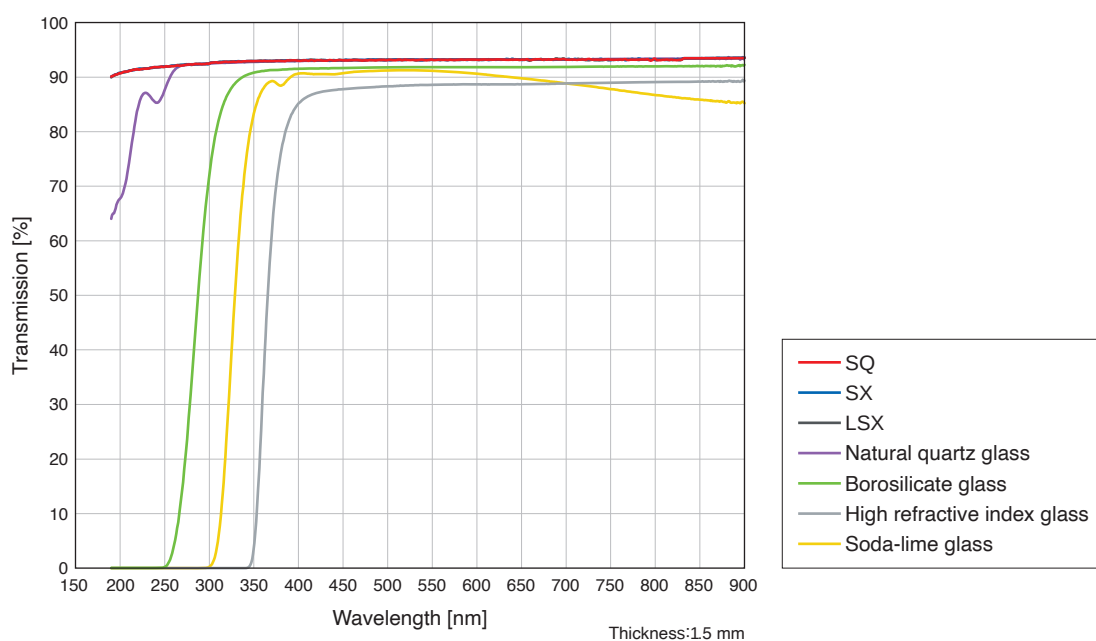
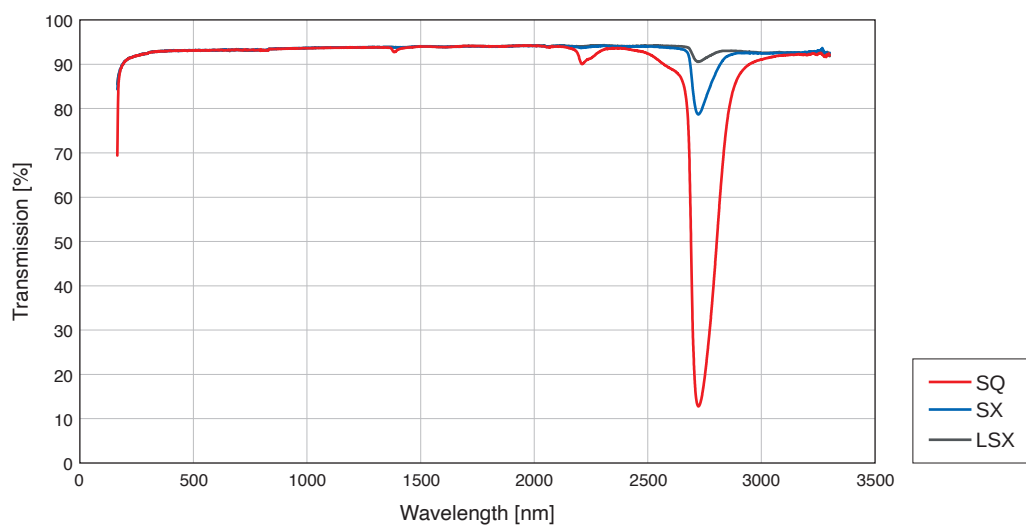
Refractive index measurement conditions...Temperature: 22.5°C, Atmospheric pressure: 1013.25 hPa, Humidity: 50%RH

■ Optical Properties (SX, LSX)

Wavelength [nm]		Refractive Index (n)	$\Delta n/\Delta T$ (ppm/°C)					
			-40 to -20 (°C)	-20 to 0 (°C)	0 to 20 (°C)	20 to 40 (°C)	40 to 60 (°C)	60 to 80 (°C)
1529.58	—	1.44436						
1064.00	—	1.44972						
1013.98	t	1.45033	7.2	7.7	8.1	8.6	9.0	9.4
852.11	s	1.45255	7.3	7.8	8.2	8.6	9.1	9.5
706.52	r	1.45523	7.4	7.9	8.3	8.8	9.2	9.7
656.27	C	1.45645	7.5	7.9	8.4	8.8	9.3	9.8
643.85	C'	1.45679	7.5	7.9	8.4	8.9	9.3	9.8
632.90	He-Ne	1.45710	7.5	8.0	8.4	8.9	9.3	9.8
589.30	D	1.45849						
587.56	d	1.45855						
546.07	e	1.46016	7.6	8.1	8.6	9.1	9.5	10.0
486.13	F	1.46321	7.8	8.3	8.8	9.3	9.7	10.2
479.99	F'	1.46359	7.8	8.3	8.8	9.3	9.8	10.2
435.83	g	1.46678	8.0	8.5	9.0	9.5	10.0	10.5
404.66	h	1.46970	8.2	8.7	9.2	9.7	10.2	10.7
365.01	I	1.47462						
248.40	KrF	1.50842						
194.16	ArF	1.55901						

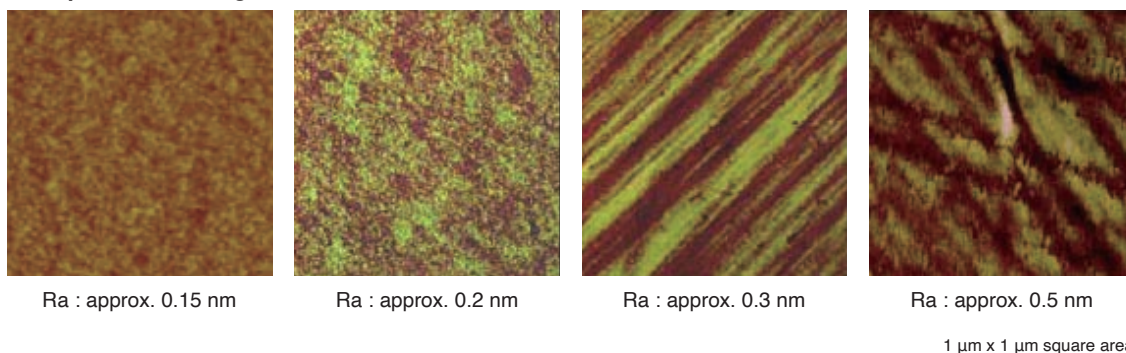
Refractive index measurement conditions...Temperature: 22.5°C, Atmospheric pressure: 1013.25 hPa, Humidity: 50%RH

- **Transmission** VIOSIL has excellent transmission over a wide range of wavelengths.
We can manufacture suitable materials to meet the customer's needs.



- **Surface Roughness** We can propose substrates with suitable surface roughness, according to the customer's request.

Example of AFM images

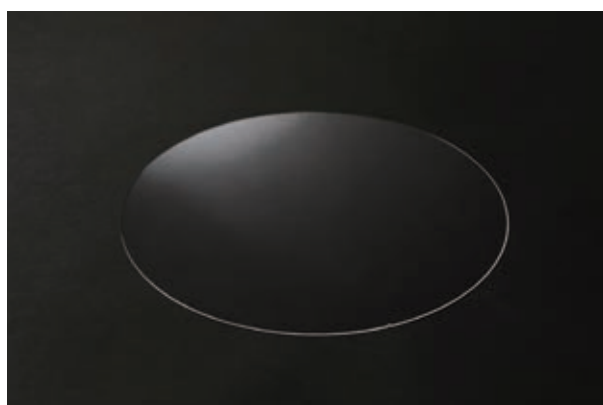


Size

Standard Wafer

■ Wafer Substrate Size

Size	Outside diameter (mm)		Thickness (mm)	
	Standard	Tolerance	Standard	Tolerance
3 inch wafer	φ76.20	± 0.25	0.525	± 0.020
			1.000	± 0.020
4 inch wafer	φ100.00	± 0.25	0.525	± 0.020
			1.000	± 0.020
5 inch wafer	φ125.00	± 0.25	0.550	± 0.020
6 inch wafer	φ150.00	± 0.25	0.625	± 0.020
			0.675	± 0.020
			1.000	± 0.020
			1.100	± 0.020
8 inch wafer	φ200.00	± 0.25	0.725	± 0.020
12 inch wafer	φ300.00	± 0.25	0.775	± 0.020
			1.200	± 0.020

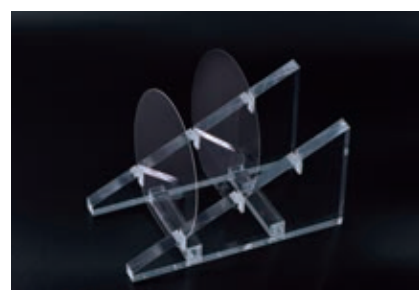
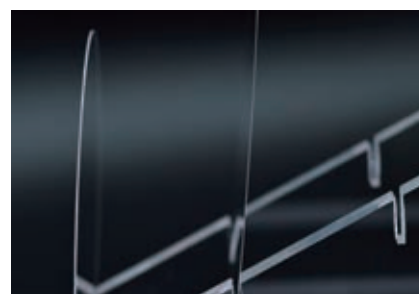


Thin Wafer

We can provide thin and highly flat wafers within the thickness range of 0.15 mm to 0.50 mm.

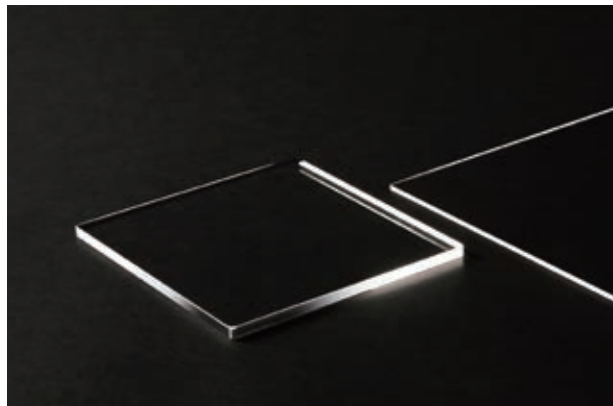
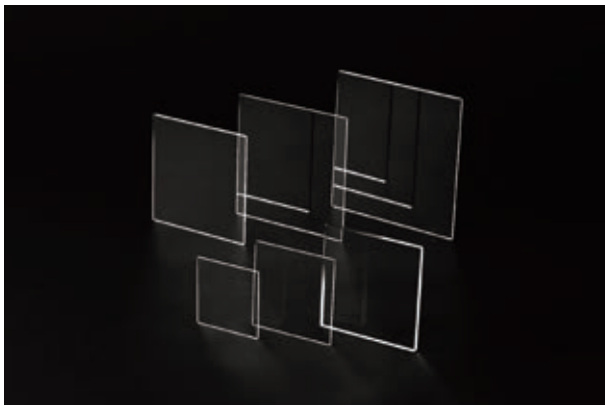
■ Wafer Substrate Size

Size	Thickness (mm)	
	Standard	Tolerance
3 inch wafer	0.150	± 0.020
	0.200	
4 inch wafer	0.150	± 0.020
	0.200	
5 inch wafer	0.200	± 0.020
	0.300	
6 inch wafer	0.200	± 0.020
	0.300	
8 inch wafer	0.300	± 0.020
	0.400	
12 inch wafer	0.500	± 0.020



■ Substrate Size for IC Photomask

Product name (abbreviation)	External shape (mm)		Thickness (mm)	
	Standard	Tolerance	Standard	Tolerance
4009	101.2 × 101.2	± 0.20	2.30	± 0.10
5009	126.6 × 126.6	± 0.20	2.30	± 0.10
5012	126.6 × 126.6	± 0.20	3.00	± 0.10
6009	152.0 × 152.0	± 0.20	2.30	± 0.10
6012	152.0 × 152.0	± 0.20	3.05	± 0.10
6025	152.0 × 152.0	± 0.20	6.35	± 0.10
7012	177.4 × 177.4	± 0.20	3.05	± 0.10
8009	200.0 × 200.0	± 0.20	2.30	± 0.10
9012	228.6 × 228.6	± 0.30	3.00	± 0.20



■ Substrate Size for FPD Photomask

Product name (abbreviation)	External shape (mm)		Thickness (mm)	
	Standard	Tolerance	Standard	Tolerance
3035	300 × 350	± 0.30	5	± 0.20
3535	350 × 350	± 0.30	3	± 0.20
5280	520 × 800	± 0.30	10	± 0.20
7080	700 × 800	± 0.30	8	± 0.20
8092	800 × 920	± 0.30	8 or 10	± 0.20
8096	800 × 960	± 0.30	8 or 10	± 0.20
80945	800 × 945	± 0.30	10	± 0.20
85120	850 × 1200	± 0.30	10	± 0.20
85140	850 × 1400	± 0.30	10	± 0.20
98115	980 × 1150	± 0.30	13	± 0.10
98155	980 × 1550	± 0.30	10	± 0.20
122140	1220 × 1400	± 0.30	13	± 0.20
122165	1220 × 1650	± 0.20	15	± 0.20
162178	1620 × 1780	± 0.30	17	± 0.20

Fine Processing Technology

Microchannel Processing Technology

We can manufacture a microchannel as a flow path to a very tight tolerance down to the nanometer range. This can be formed on a substrate made of glass, resin, silicon, etc.

Microchanneling is used to improve chemical operations such as mixing, reaction, separation, detection, and synthesis in a microspace. We utilize micro-machining and bonding processes to provide custom-made microchannel substrates with high purity, chemical resistance and micro-meter precision.

Wet etching

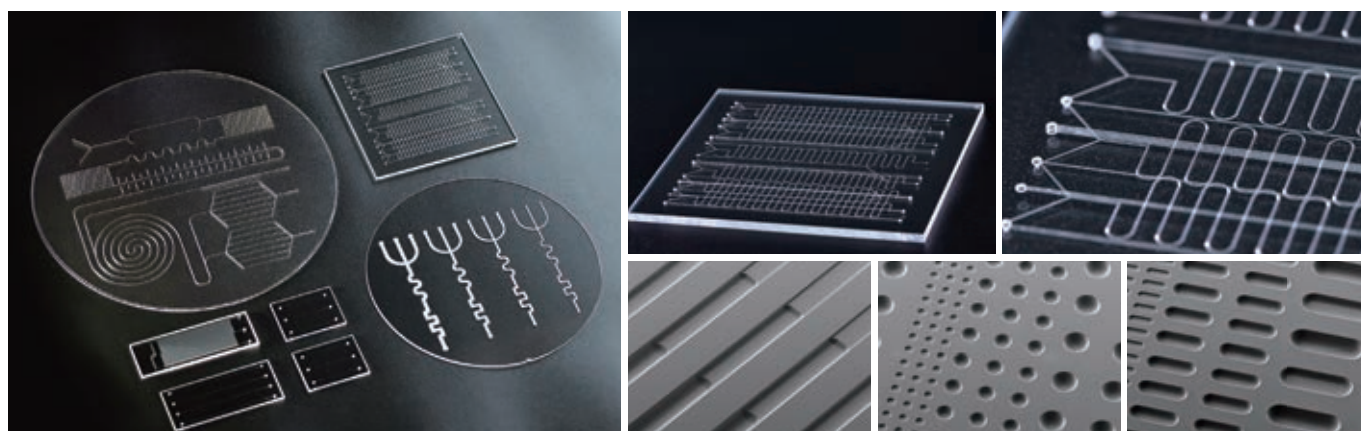
Dimensional accuracy	± 10%
Aspect ratio	Approx. 2:1 (width:depth)
Available range	Depth: 1 to 1,000 μm
Microchannel cross-section	Round
Microchannel bottom	Smooth
Microchannel side	Smooth

Grinding process

Dimensional accuracy	± 20%
Aspect ratio	Not specified
Available range	Depth ≥ 200 μm
Microchannel cross-section	Rectangle
Microchannel bottom	Grinding surface (rough surface) or smooth
Microchannel side	Grinding surface (rough surface)

Substrate bonding, stacking

Bonding	Thermal fusion bonding
Stacking layers	Pieces ≤ 6 (including cover glass)



Hole Machining Technology

We can provide precision hole processing with a high aspect ratio.

We can also provide disk substrates with high roundness and concentricity.

Small diameter hole machining (inlet, outlet)

Dimensional accuracy		± 20%
Machining surface	Hole diameter < 1.2 mm	Grinding surface (rough surface)
	Hole diameter ≥ 1.2 mm	Grinding surface (rough surface) or mirror surface

