

OHARA QUARTZ

VAD-process Synthetic Fused Silica SK-1300

Our Company successfully developed synthetic fused silica SK-1300 as a result of significant improvements made to the conventional VAD (vapor-phase axial deposition) method of optical fiber manufacturing technology.

SK-1300 is extremely high in purity and much lower in OH content than the traditional direct method, thus making it the first synthetic fused silica usable in the semiconductor and liquid crystal display industries.

SK-1300 is the state-of-the-art technology in optical characteristics because it provides a high ultraviolet transmission, no micro inclusion and a solarization resistance, in addition to heat resistance, mechanical strength, and chemical resistance.

These products can be used in a wide variety of industrial applications for semiconductors, optical and all physical or chemical related research featuring these applications:

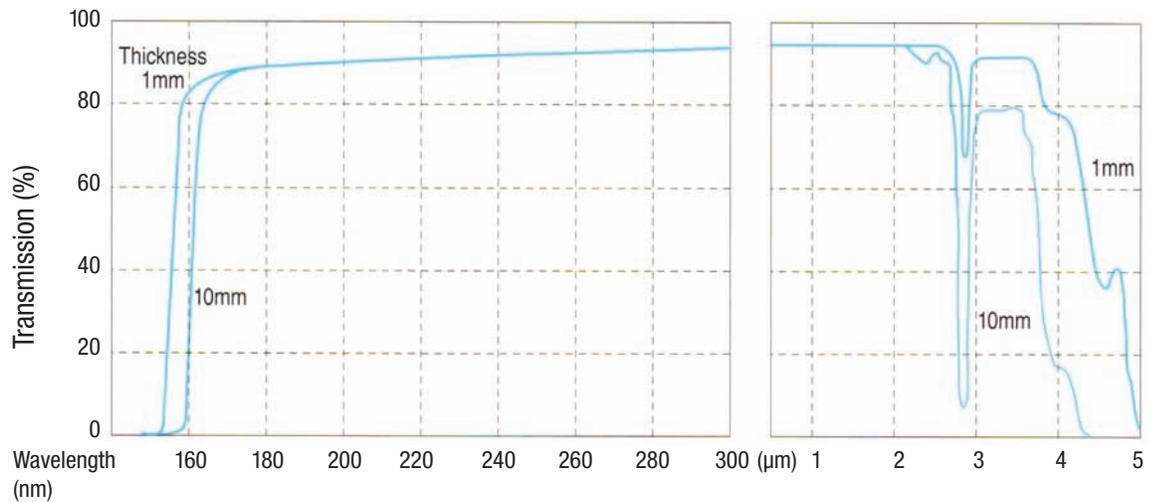
1. Wafers for various types of devices such TFT (poly-Si thin-film transistor LCD), SOI (Silicon on Insulator), etc.
2. Photomask substrates for ultra-LSI and LCD.
3. Reactor furnace tubes, jigs and tools for ULSI manufacturing processes.
4. Electrical-discharge lamp tubes.
5. Optical elements, lenses, mirrors and windows, for ultraviolet and vacuum ultraviolet.

Typical Characteristics

Typical Impurity Analysis	Element		Analytical value	
	Element	Analytical value	Element	Analytical value
ppb	Al	<0.2	Co	<0.01
	Fe	<0.5	Ni	<1.0
	Ti	<0.1	P	<1.0
	Ca	<0.5	B	<0.01
	Mg	<0.1	Na	<0.5
	Mn	<0.1	K	<0.2
	Cr	<0.2	Li	<0.1
	Cu	<0.2	Zr	<0.1
	OH		<200 (ppm)	

Chemical Resistance	Solution	Treatment temperatures (°C)	& hours (H)	Weight loss (mg/cm ²)
	H ₂ O	95	45	0.0001~0.0002
1/100 N HNO ₃	115	24	0.005~0.01	
5% NaOH	100	10	1.35	

Transmission



Refractive Index

Wavelength (nm, in air)	25°C in air	Wavelength (nm, in air)	20~25°C in air dn/dt
365.015(i)	1.47465	1013.98(t)	9.6
404.656(h)	1.46972	643.85(C')	9.8
435.835(g)	1.46680	632.80(He-Ne)	10.0
486.133(F)	1.46323	589.29(D)	10.0
546.075(e)	1.46018	546.07(e)	10.1
587.562(d)	1.45857	479.99(F')	10.4
656.273(C)	1.45647	435.835(g)	10.6

Measuring accuracy $\pm 1 \times 10^{-6}$

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Optical Qualities

Item	Grade
Bubbles	0~0.03mm ² /100cm ³
Striae	Grade A in one direction (As per Mil-G-174)
Birefringence (Strain)	10nm/cm and under
Fluorescence	Not permitted (Excited wavelength 254nm)

Physical Properties

Item	Unit	Value	Item	Unit	Value
Density	g/cm ³	2.201	Coefficient of thermal expansion	cm/cm°C	5.5X10 ⁻⁷
Young's module	10 ⁹ N/m ²	724			
Poisson's ratio		0.17	Softening point	°C	1600
Compression strength	kg/mm ²	115	Annealing point	°C	1160
Bending strength	kg/mm ²	7.0	Strain point	°C	1060
Tensile strength	kg/mm ²	5.6			
Torsional rigidity	kg/mm ²	3150	Specific heat (26°C)	cal/g • °C	0.176
Vickers hardness	kg/mm ²	900~1030	(26°C) cal/cm • sec • °C		2.65X10 ⁻³
Knoop hardness	kg/mm ²	650~710	Thermal conductivity ratio (100°C) cal/cm • sec • °C		3.27X10 ⁻³

SK-1300 Series Glass Data Sheet

Code(d) **459678**

Code(e) **460677**

Refractive Index n_d	1.45857 1.458567	Abbe Number v_d	67.8 67.84	Dispersion n_F-n_C	0.00676 0.006760
Refractive Index n_e	1.460181	Abbe Number v_e	67.68	Dispersion $n_F-n_{C'}$	0.006799

Refractive Indices(at 25°C,Air,1013hPa)		
$\lambda(\mu\text{m})$		
n_{2325}	2.32542	1.43307
n_{1970}	1.97009	1.43864
n_{1530}	1.52958	1.44438
n_{1129}	1.12864	1.44898
n_t	1.01398	1.45035
n_s	0.85211	1.45257
$n_{A'}$	0.76819	1.45399
n_r	0.70652	1.45525
n_C	0.65627	1.45647
$n_{C'}$	0.64385	1.45681
n_{He-Ne}	0.63280	1.45712
n_D	0.58929	1.45851
n_d	0.58756	1.45857
n_e	0.54607	1.46018
n_F	0.48613	1.46323
$n_{F'}$	0.47999	1.46361
n_{He-Cd}	0.44157	1.46633
n_g	0.435835	1.46680
n_h	0.404656	1.46972
n_i	0.365015	1.47465
n_{KrF^*}	0.24850	1.50840
n_{ArF^*}	0.19330	1.56041

Deviation of Relative Dispersions $\Delta\theta$ from "Normal"	
$\Delta\theta_{C,t}$	0.0406
$\Delta\theta_{C,A'}$	0.0085
$\Delta\theta_{g,d}$	-0.0063
$\Delta\theta_{g,F}$	-0.0040
$\Delta\theta_{i,g}$	0.0042

Constants of Dispersion Formula	
A_1	7.92122197E-01
A_2	3.12281689E-01
A_3	9.14368121E-01
B_1	5.26428733E-03
B_2	1.47301780E-02
B_3	9.98720100E+01

Other Properties	
Bubble Quality Group	1
Specific Gravity	2.20
Remarks	

Temperature Coefficients of Refractive Index							
Range of Temperature (°C)	dn/dt relative (10 ⁻⁶ /°C)						
	t	C'	He-Ne	D	e	F'	g
-40~0	-	-	-	-	-	-	-
0~20	-	-	-	-	-	-	-
20~25	9.6	9.8	10.0	10.0	10.1	10.4	10.6
20~40	-	-	-	-	-	-	-
40~60	-	-	-	-	-	-	-

Partial Dispersions	
n_C-n_t	0.006122
$n_C-n_{A'}$	0.002478
n_d-n_C	0.002097
n_e-n_C	0.003711
n_g-n_d	0.008230
n_g-n_F	0.003567
n_h-n_g	0.002925
n_i-n_g	0.007850
n_C-n_t	0.006459
$n_e-n_{C'}$	0.003374
n_F-n_e	0.003425
$n_i-n_{F'}$	0.011041

Thermal Properties	
Strain Point StP (°C)	1060
Annealing Point AP (°C)	1160
Softening Point SP (°C)	1600
Expansion Coefficients (+0~+200°C)	5.5
α (10 ⁻⁷ /°C) (+100~+300°C)	-
Thermal Conductivity k (W/m·K)	1.3
Specific heat capacity c (J/kg·K)	734
Thermal diffusivity (10 ⁻⁷ m ² /s)	8.05

Mechanical Properties	
Young's Modulus E (10 ⁸ N/m ²)	724
Rigidiv Modulus G (10 ⁸ N/m ²)	309
Poisson's Ratio σ	0.17
Knoop Hardness Hk[Class]	650 7
Abrasion Aa	-
Photoelastic Constant β (nm/cm/10 ⁵ Pa)	3.5

Chemical Properties	
Water Resistance(Powder) Group RW(P)	1
Acid Resistance(Powder) Group RA(P)	1
Weathering Resistance(Surface) Group W(S)	-
Acid Resistance(Surface) Group SR	1
Phosphate Resistance PR	-

Electrical Properties	
Dielectric constant ϵ	4.0
Dielectric tangent $\tan\delta$	0.0004
Volume resistivity($\Omega\cdot\text{cm}$)	>1E+16

Impurities	
OH content (ppm)	<200
Cl content (ppm)	<1

Relative Partial Dispersions	
$\theta_{C,t}$	0.9056
$\theta_{C,A'}$	0.3666
$\theta_{d,C}$	0.3102
$\theta_{e,C}$	0.5490
$\theta_{g,d}$	1.2175
$\theta_{g,F}$	0.5277
$\theta_{h,g}$	0.4327
$\theta_{i,g}$	1.1612
$\theta'_{C,t}$	0.9500
$\theta'_{e,C'}$	0.4962
$\theta'_{F,e}$	0.5038
$\theta'_{i,F}$	1.6239

Coloring			
λ_{80}	~165	λ_5	~165
λ_{70}	~165		

~165:Less than 165nm

Internal Transmittance	
$\lambda(\text{nm})$	$\tau_{10\text{mm}}$
172*	0.983
193*	0.997
248*	0.999~
250	0.999~
260	0.999~
270	0.999~
280	0.999~
290	0.999~
300	0.999~
320	0.999~
340	0.999~
360	0.999~
365*	0.999~
380	0.999~
400	0.999~
450	0.999~
500	0.999~
550	0.999~
587*	0.999~
600	0.999~
650	0.999~
700	0.999~
800	0.999~
900	0.999~
1000	0.999~
1129*	0.999~
1200	0.999~
1400	0.998
1530*	0.999~
1600	0.999~
1800	0.999~
1970*	0.999~
2000	0.999~
2326*	0.994
2400	0.991
2500	0.982

0.999~:better than 0.999

*Precision Measurements

Rev.F DATE 2018/10/24