

Single Crystal Products

Crystals for a bright future
SHINKOSHA



The Feature of SHINKOSHA

- A world's leading company that possesses technologies to grow large-size sapphire crystals in possession of our own furnaces and process crystals to make our final products.
- Accumulation of our massive technical data and information on sapphire crystals in our more than 65 years' history.
- Close and quick correspondence to our customers from an order of only one piece.

Web Site

- SHINKOSHA

<https://www.shinkosha.com//english/>

- World's Finest Quality
Sapphire Product
Challenged by our Master-hands' Workshop

https://www.shinkosha.com/scube_e/

□ Sapphire Window Materials for High-class watches :

「 Apply sapphire to wristwatches 」
Sapphire is scaled at Mohs hardness 9, the hardest next to diamond. It has excellent endurance and eternal brilliance and transparency. This is why it has become intimate as the window materials of wristwatches with so many customers all over the world. Shinkosha is an only one maker in Japan of such sapphire window materials.

➔ Features of SHINKOSHA's Sapphire :

Growth method	the Verneuil method
Hardness	〈 Mohs hardness 〉 9, 〈 Vickers hardness 〉 1,400~2,300
Bending strength	320~950MPa
Transparency	〈 Transmission range 〉 0.2~4.5μm

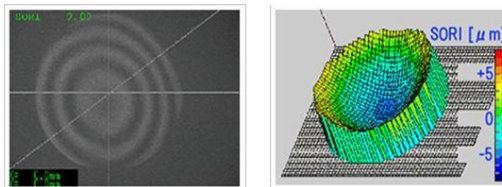
【 High Endurance against Ultraviolet Rays 】

Owing to our original technology, you cannot see such coloring in the sapphire crystals that has been caused by ultraviolet rays so far.

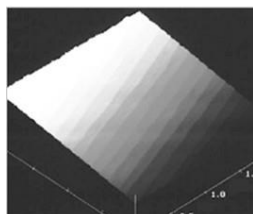


□ Sapphire Substrates for Blue and White LEDs :

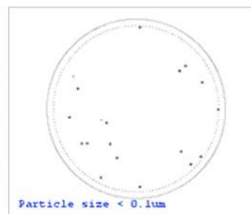
Sapphire substrates are very suitable for thin-film growth of such nitride semiconductors as blue and white LEDs. SHINKOSHA's sapphire substrates are made of those high-quality crystals which are quite flawless. We can respond to any of your request for various kinds of orientation, off-axis substrates, step surface treatment, etc.



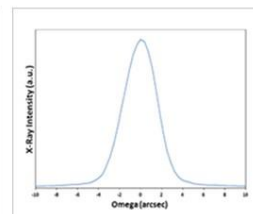
Excellent processing precision
(excellent warp and parallelism)



Excellent surface precision
(subnano order)



High degree of cleanliness
(distribution of particles)



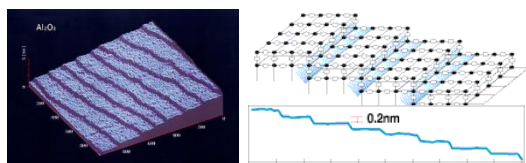
Excellent crystallinity
(X-ray rocking curve)

□ Substrates for Epitaxial Growth :

We can offer you such substrates of single oxides that are the most suitable for epitaxial growth for R&D. You can choose any of substrates that best fit for your needs of the crystal system, lattice constant, dielectric, etc. We can provide you excellent substrates which have such high-quality surface that has flaw-less and strain-less. So, please do not hesitate to consult with us regarding such orientation, form, off-axis substrates, especially specified substrates, etc. We can also offer you such STEP substrates that have extremely high precision surface, composed of STEPs and a terrace flat at the atomic level. These STEP substrates are made by our original technology which we have developed jointly with the Tokyo Institute of Technology. They are definitely indispensable for adequate growth of epitaxial films.

Crystal	System	Lattice constant (nm)
Al ₂ O ₃	Trigonal (Rhombohedral phase)	a=0.47588 c=1.2992
SrTiO ₃	Cubic	a=0.3905
TiO ₂	Tetragonal	a=0.4594 c=0.2958
NdGaO ₃	Orthorhombic	a=0.5431 b=0.5499 c=0.7710
LaAlO ₃	Hexagonal	a=0.5365 c=1.311
MgO	Cubic	a=0.4213
YSZ	Cubic	a=0.5139
LSAT	Cubic	a=0.7736
MgAl ₂ O ₄	Cubic	a=0.8083

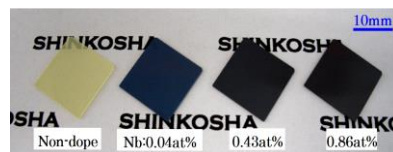
YSZ: Yttria Stabilized Zirconia LSAT: (La_{0.3}Sr_{0.7})(Al_{0.65}Ta_{0.35})O₃



STEP treatment



SrTiO₃ crystals and substrates



TiO₂ substrates



LaAlO₃ crystals and substrates



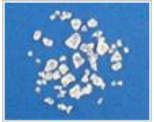


□ Vapor Deposition Sources for Alumina Coating :

We can also offer you vapor deposition sources for thin films of alumina (Al₂O₃) of high purity.

- ➔ Features of Our Products :
 - Single crystals of high purity (Purity: 99.99%)
 - Medium refractive index (1.63@550nm)

As we use single sapphire crystals, our outstanding feature is that gas does not break out at the time of vaporization.



Item					
Item	ES-0510	ES-1020	ES-1035	CS-1030	D13H700T60
Form	Crush type	Crush type	Crush type	Cutting type	Semidisc type
Size	0.5~1.0mm	1.0~2.0mm	1.0~3.5	1.0~3.0mm	D=13, 15, 18, 20mm

□ Features and Applications of Sapphire

■ Windows for Transmitting IR and UV ranges:

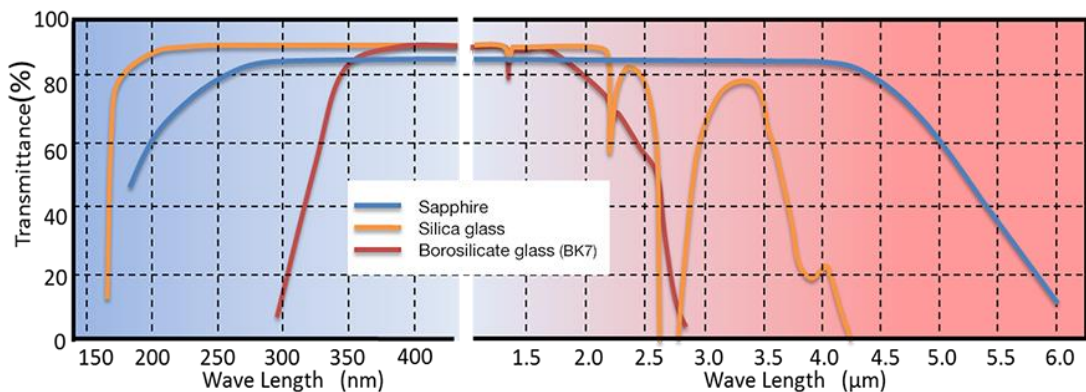
Sapphire windows can transmit a wide range of light ranging from infrared rays (IR) to ultraviolet rays (UV). So, they are widely used for a variety of applications.

【IR range】

Silica glass starts its internal absorption from IR of $2\mu\text{m}$ and then attenuates its transmittance. In contrast, sapphire is stable in transmitting light, so that it is quite suitable for the window materials for various types of IR sensors.

【UV range】

Sapphire is excellent in thermostability and corrosion resistance as compared with silica glass, so that it is the most suitable for applications against UV in the environment under severe conditions. At the same time, it does not deteriorate like silica glass with long-hour lighting of an excimer lamp (172nm).



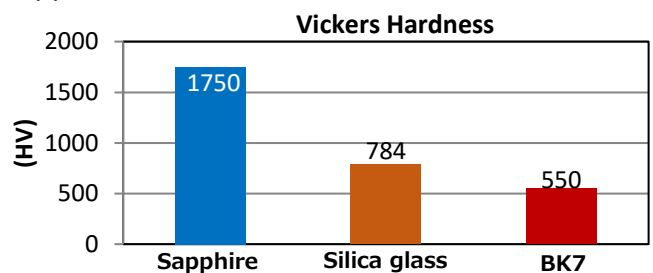
■ Window Materials for Preventing Scratches :

As sapphire is used for the window materials of wristwatches, it is an excellent material that has a property of high abrasion resistance

【Mohs hardness: Diamond=10, Sapphire=9】

〈Examples of applications〉

- Bar code readers
- Card readers
- Coin sensors
- Smart phones
- Cameras for industrial etc.



■ Large Windows and Tubes:

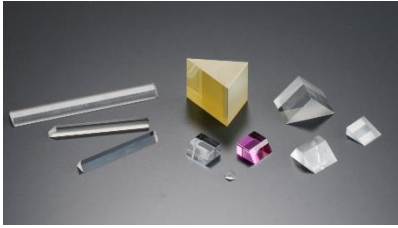
SHINKOSHA grows large size sapphire ingots by the TSMG (Top Seeded Melt Growth) method that is SHINKOSHA's original method. Large ingots are used for windows and tubes.

- TSMG ingots ($\approx \phi 300 \times 350\text{mmL}$)
- The size of products that we can cut out :
 - Round : $\sim \phi 270 \times 270\text{mmL}$
 - Rectangle : $\sim 300 \times 200 \times 30\text{mm}$



■ Prism shape & R shape

We also process various kinds of prisms by molding and optically polishing our sapphire materials. We finish the polished surface to the highest quality of flatness $\lambda / 4 - \lambda / 10$.



■ Sapphire Laser Cap

Utilizing the properties of high strength and no deterioration (devitrification), it is also used as a highly reliable cap application. We also coat of metal (Au) for high strength and airtight sealing.



■ for Semiconductor & Medical instruments

Sapphire has excellent chemical resistance and is resistant to industrial chemicals such as acids and alkalis used in semiconductor processes. For this reason, it is widely used as a window for medical equipment such as etching equipment, ashing equipment, and diffusion furnaces, and as a medical material. It is also used as a tube to flow activated plasma gas used for etching. Sapphire has high purity (99.99% or more) and low toxicity, so it is widely used as a jig and parts for semiconductor lines and medical parts.

Results of chemical resistance test of sapphire

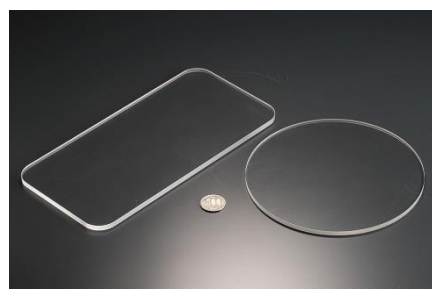
Weight Change of Sapphire Specimens (□25 x 0.5 mmt) Dipped for 6 Days

Acid or Alkali	Condition	Weight Change
HCl	35% , 20°C	No change
HNO3	50% , 20°C	No change
H3PO4	60% , 100°C	No change
H2SO4	95% , 100°C	No change
NaOH	30% , 100°C	No change
HF	46% , 60°C	$\Delta = 0.0038\text{g/day}$ (Very little)

Results of Analyzing Impurities in Sapphire (ICP-AES ; ppmw)

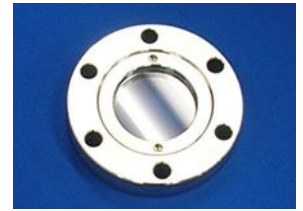
Ba < 0.1 Ca < 0.1 Cd ※ < 3 Cr ※ < 2 Cu < 2
 Fe < 1 Hg ※ < 2 K < 1 Mg < 0.1 Mn < 0.5
 Mo < 5 Na < 1 Pd ※ < 10 Si < 10 Sr < 0.1
 Ti = 1.8 W < 5 Zn < 1 Zr < 1

※ RoHS designated elements

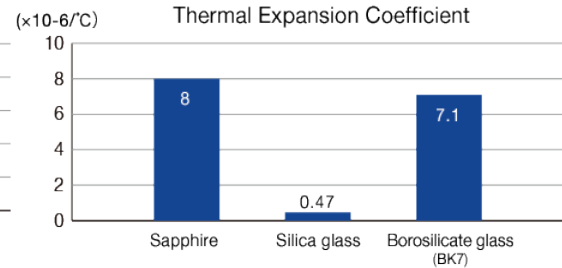
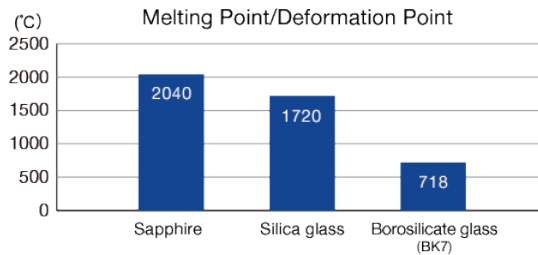
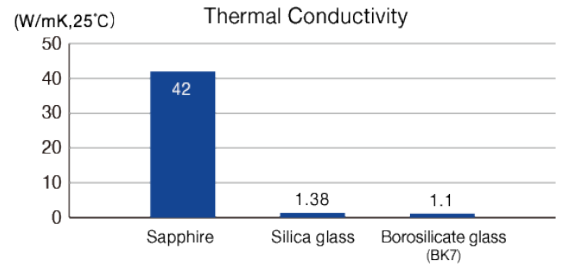
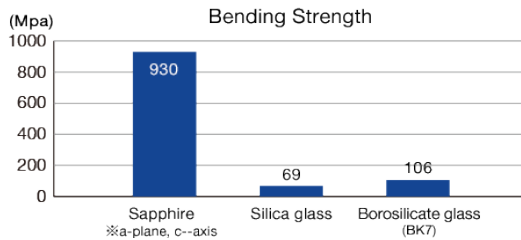


High Temperature and High Pressure :

Since sapphire is stable under high temperature and high pressure, it is also used as an observation window in harsh environments such as combustion chambers. The melting point is 2040 ° C and the strength is about 10 times that of glass. Thermal conductivity at room temperature is equivalent to stainless steel.



Sapphire window with a flange



Unique Products

Unique products for non-industrial applications using sapphire and ruby are also available. We are constantly creating new novelty products.

