

OPTICS

OPTICAL MATERIALS

JAYBAO is capable of fabricating a wide variety of optical components with various optical materials. The most important material properties to consider for an optical element are transmission versus wavelength, index of refraction, thermal characteristics, mechanical and chemical characteristics and cost.

There are two instances in which you might need to know more about optical materials. First, you may need to determine the performance of a catalog component in a particular application. Second, you may need specific information when selecting the material for a custom component. The data in the following is intended to assist in these situations.

To select the right materials seems overwhelming. The simplest way is to let JAYBAO sales or engineers know your application, and we can select them for you.

SOME OF THE MATERIALS THAT JAYBAO USES INCLUDE AS FOLLOWS.

Special glass: Fused silica, Dynasil fused silica, Color glass, Float glass, Zerodur...

Optical crystal: Sapphire, CaF₂, BaF₂, MgF₂, NaCl, MgO...

Quartz, Silicon, Ge, ZnSe, ZnS...

Calcite, YVO₄, LiNbO₃, TeO₂, KTP, YAG...

Materials	Refractive Index	Transmission Range(μm)	Thermal Expansion Coefficient (10 ⁻⁶ /K)
BK7	1.5168 (588 nm)	0.330 - 2.1	7.1
SF11	1.78472(588nm)	0.370 - 2.5	6.1
SF14	1.76182(588 nm)	0.420 - 2.0	6.6
Fused Silica	1.45846 (588 nm)	0.185 - 2.5	0.50
CaF ₂	1.399 (5.0 μm)	0.170 - 7.8	18.85
Sapphire	1.755 (1.0 μm)	0.180 - 4.5	8.4
Silicon	3.4179 (10 μm)	1.200 - 7.0	2.23
Ge	4.003 (10 μm)	1.900 - 16	5.7
ZnSe	2.40 (10 μm)	0.630 - 18	7.1
ZnS	2.2 (10 μm)	0.380 - 14	6.5
MgF ₂	no=1.3836 ne=1.3957 (405nm)	0.130 - 7.0	8.8 c; 13.1 a
YVO ₄	no=1.9500 ne=2.1554 (1.3 μm)	0.400 - 5.0	11.37 c; 4.43 a
CaCO ₃ (Calcite)	no=1.6557 ne=1.4852 (633 nm)	0.210 - 2.3	24.39 c; 5.68 a
Quartz	no=1.5427 ne=1.5518 (633 nm)	0.200 - 2.3	6.88 c; 12.38 a
α-BBO	no=1.6749 ne=1.5555 (532 nm)	0.190 - 3.5	33.3 c; 0.5 a
LiNbO ₃	no=2.2863 ne=2.2027 (633 nm)	0.370 - 4.5	4.1 c; 14.8 a

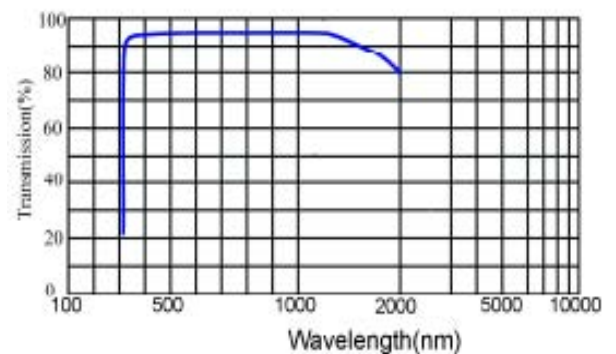


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BK7

BK7 is a borosilicate crown optical glass with high homogeneity and low bubble and inclusion content. Its good physical and chemical properties make it widely used in visible and NIR windows, lenses and prisms.

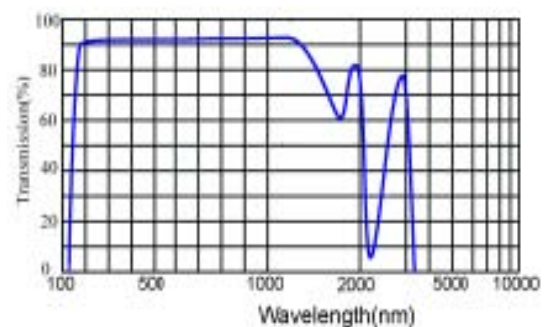
- **Transmission range:** 330 nm ~ 2100 nm
- **Thermal Expansion Coefficient:** $7.5 \times 10^{-6} / \text{K}$
- **Density:** 2.51 g/cm^3



Fused Silica

Fused silica is formed by chemical combination of silicon and oxygen. Advantages of fused silica material include good UV and IR transmission, low thermal expansion, providing stability and resistance to thermal shock over large temperature excursions, wider thermal operating range and high laser damage threshold. Used for windows, lenses, prisms and mirror substrates.

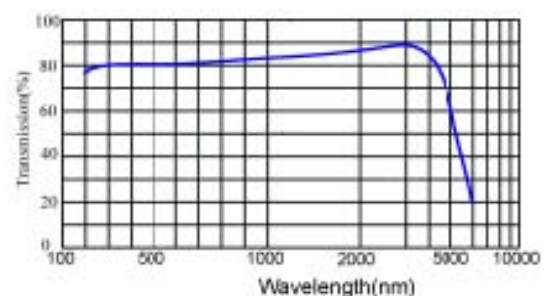
- **Transmission Range:** 185 nm ~ 2500 nm
- **Thermal Expansion Coefficient:** $0.54 \times 10^{-6} / \text{k}$
- **Density:** 2.20 g/cm^3



Sapphire

Sapphire is a single crystal aluminum oxide or Al_2O_3 and is one of the hardest materials. It has good transmission characteristics over the visible, and near IR spectrum. Sapphire exhibits high mechanical strength, chemical resistance and thermal stability. It is often used in environment where scratch resistance is importance.

- **Transmission range:** 180 nm ~ 4500 nm
- **Thermal expansion coefficient:** $8.4 \times 10^{-6} / \text{k}$
- **Density:** 3.98 g/cm^3

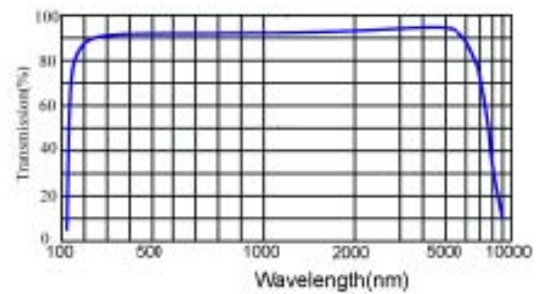


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CaF₂

CaF₂ is a crystal which has good transmission from 170 nm to 7800nm. It is slightly soluble in water and is susceptible to thermal shock. Common uses of CaF₂ include IR components such as windows, lenses and prisms.

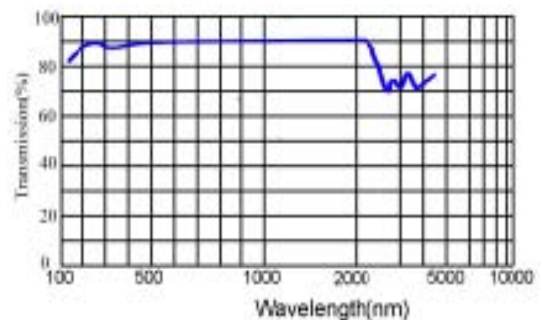
- **Transmission range: 170 nm ~ 7800 nm**
- **Thermal expansion coefficient: $18.85 \times 10^{-6} / \text{K}$**
- **Density: 3.18 g/cm^3**



Crystal Quartz

Crystal quartz is a positive uniaxial birefringent single crystal. CASIX's crystal quartz is selected to minimize inclusions and refractive index variation. Crystal quartz is most commonly used for high damage threshold waveplates.

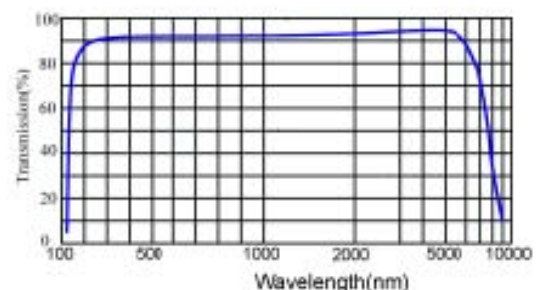
- **Transmission range: 200 nm ~ 2300 nm**
- **Thermal expansion coefficient: $7.07 \times 10^{-6} / \text{K}$**
- **Density: 2.65 g/cm^3**



YVO₄ Crystal

YVO₄ (yttrium orthovanadate) is a positive uniaxial crystal grown by Czochralski method. It has good mechanical and physical properties and is ideal as optical polarizing components because of its wide transparency range in IR and large birefringence. It is an excellent crystal in many applications including fiber optic isolators, circulators, beam displacers and Glan polarizers.

- **Transmission range: 400 nm ~ 5000 nm**
- **Walk off angle @ 45° : 5.72° (1310nm), 5.69° (1550nm)**
- **Density: 4.22 g/cm^3**

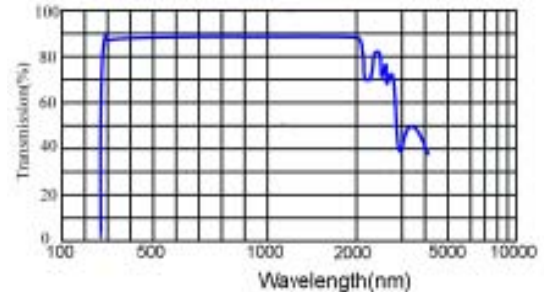


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α -BBO Crystal

α -BBO (high temperature Barium Borate) is a negative uniaxial crystal with successfully growing into large size under both of Czochralski and Top seeded flux methods by CASIX. It has a large birefringence, unique UV transparency, high optical homogeneity, good mechanical properties and high damage threshold. It is an excellent material for UV polarizing components.

- **Transmission range: 190 nm ~ 3500 nm**
- **Walk off angle @ 45°: 5.3° (351nm), 5.0° (633nm)**
- **Density: 3.85 g/cm³**



Calcite (CaCO₃)

Calcite is a negative uniaxial crystal that has high birefringence, wide spectral transmission and availability in reasonably-sized rhombs. Although it is a soft crystal and is easily scratched, it is an ideal material for use in visible & IR polarizers, such as Glan Taylor, Glan Thompson and Glan laser.

- **Transmission range: 210 nm ~ 2300 nm**
- **Walk off angle @ 45°: 6.2° (633nm)**
- **Density: 2.7 g/cm³**

