Single Crystal Substrates

SAPPHIRE Al_2O_3 SUBSTRATE

Sapphire (single crystal of Al_2O_3) is being used extensively as a substrate for III-V nitrides and for many other epitaxial films. Single crystal sapphire wafer plays an increasingly important role as a material for blue LED, high Tc superconductor and microwave applications, due to its high strength, high anti-corrosion, high anti-abrasion, low dielectric loss and good electrical insulation.

NEYCO provides sapphire substrates with complete orientation options including C plane, A plane, R plane and M plane, in diameter range from 1" to 4", square substrate is also available as well, size from 10 x 10 mm to 100 x 100 mm. NEYCO can offer EPI ready grade sapphire wafer for your epitaxial growth.

FEATURES

- High working temperature
- Good thermal conductivity
- Superior mechanical properties
- High anti corrosion
- Stable dielectric constant & low dielectric loss
- Excellent light transmission

APPLICATIONS

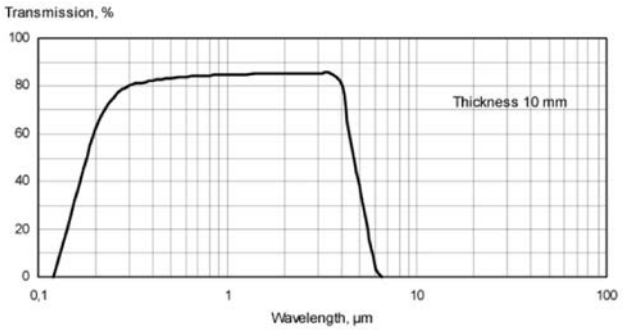
- Blue LED substrate
- Superconductor substrate
- Electronics and optoelectronics
- UV and IR optics

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 4"
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Hexagonal a = 0.477 nm c = 1.304 nm
Color	Colourless
PHYSICAL PROPERTIES	
Density	3.98 $g.cm^{-3}$
Melting point	2052°C
Hardness	9 Mohs
Thermal expansion	Vertical c-axis: $6.2.10^{-6}$ K^{-1} Parallel c-axis: $5.4.10^{-6}$ K^{-1}
Thermal conductivity	Vertical c-axis: 23.1 $W.m^{-1}.K^{-1}$ Parallel c-axis: 25.2 $W.m^{-1}.K^{-1}$
Heat capacity	761 $J.kg^{-1}.K^{-1}$
Dielectric constant	Vertical c-axis: 9.4 Parallel c-axis: 11.5
Loss Tangent at 10 GHz	Vertical c-axis: $8.6.10^{-8}$ Parallel c-axis: 3.10^{-8}
CHEMICAL PROPERTIES	
Solubility in water	98.10^{-6} g/100 cm^3
Solubility in acids	Insoluble
Solubility in organic solvents	Not declarate

OPTICAL PROPERTIES				
Absorption coefficient	0.2 cm^{-1} at 0.2 µm 0.02 cm^{-1} at 0.4 µm 0.46 cm^{-1} at 5 µm			
Transmission range (thickness 10 mm)	0.17 - 5.0 µm			
Refractive index n	1 µm	2 µm	3 µm	4 µm
	1.7545	1.7374	1.7015	1.6748

TRANSMISSION SPECTRUM



BARIUM FLUORIDE BaF_2 SUBSTRATE

APPLICATIONS

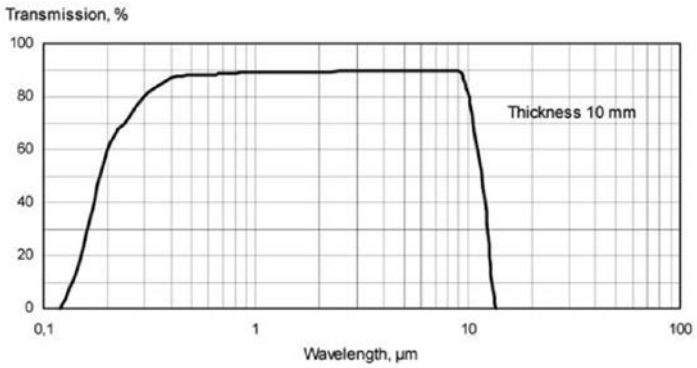
IR and UV window, prism, substrate.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Stockbarger technique
Maximum size	Ø 150 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 0.6196 nm
Cleavage plane	<111>
PHYSICAL PROPERTIES	
Density	4.83 $g.cm^{-3}$
Melting point	1354°C
PHYSICAL PROPERTIES	
Hardness	3 Mohs
Thermal expansion	16.5 - 19.2 x 10^{-6} K^{-1}

PHYSICAL PROPERTIES						
Thermal conductivity	7.1 $W.m^{-1}.K^{-1}$					
Specific heat capacity	456 $J.kg^{-1}.K^{-1}$					
CHEMICAL PROPERTIES						
Solubility in water	0.17 g/100 cm^3					
Solubility in acids	Soluble					
Solubility in organic solvents	Not declarate					
OPTICAL PROPERTIES						
Absorption coefficient	0.20 cm^{-1} at 0.2 µm 0.08 cm^{-1} at 0.4 µm 0.13 cm^{-1} at 10.6 µm					
Refractive index n	0.2 µm	0.5 µm	1.0 µm	5.0 µm	10.0 µm	12.0 µm
	1.5573	1.4779	1.4686	1.4511	1.4014	1.3696

TRANSMISSION SPECTRUM



BARIUM TITANATE $BaTiO_3$ SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	10 x 10 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Tetragonal a = 0.3992 nm c = 0.4036 nm
PHYSICAL PROPERTIES	
Density	8.82 $g.cm^{-3}$
Melting point	1600°C
Hardness	5 Mohs

CALCIUM FLUORIDE CaF_2 SUBSTRATE

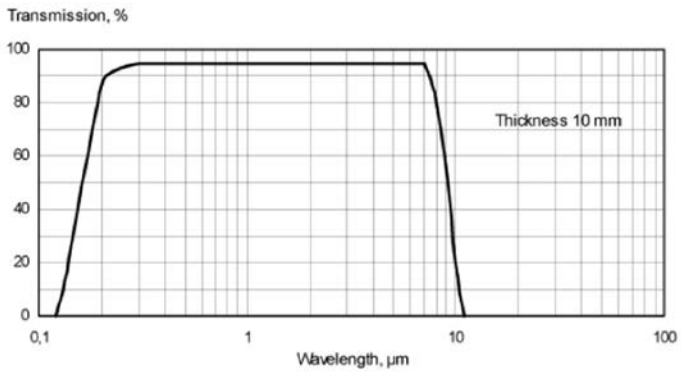
APPLICATIONS

IR windows and lens, prism.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH						
Growth method	Stockbarger technique					
Maximum size	Ø 200 mm					
CRYSTALLOGRAPHIC PROPERTIES						
Crystal structure	Cubic a = 0.5462 nm					
Cleavage plane	<111>					
PHYSICAL PROPERTIES						
Density	3.18 $g.cm^{-3}$					
Melting point	1418°C					
Hardness	4 Mohs					
Thermal expansion	16.2 - 19.4 x 10^{-6} K^{-1}					
Thermal conductivity	9.17 $W.m^{-1}.K^{-1}$					
Specific heat capacity	888 $J.kg^{-1}.K^{-1}$					
CHEMICAL PROPERTIES						
Solubility in water	0.0016 g/ 100 cm^3					
Solubility in acids	Unessential					
Solubility in organic solvents	Insoluble in acetone					
OPTICAL PROPERTIES						
Transmission range (Thickness 10 mm)	0.15 - 9.0 µm					
OPTICAL PROPERTIES						
Refractive index	0.2 µm	0.5 µm	1.0 µm	5.0 µm	10.0 µm	12.0 µm
	1.4951	1.4365	1.4289	1.3990	1.3002	1.2299
Absorption coefficient	0.10 cm^{-1} at 0.2 µm 0.01 cm^{-1} at 0.4 µm 0.03 cm^{-1} at 2.6-2.9 µm					

TRANSMISSION SPECTRUM



CALCIUM NEODYMIUM ALUMINATE $CaNdAlO_4$ (CNAO) SUBSTRATE

MATERIAL CHARACTERISTICS

High quality YBaCuo, BiSrCaCuO, Bi(Pb)CaCuO and TlBaCaCuO thin films have been grown on $CaNdAlO_4$ substrates by different techniques.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 18 - 20 mm
Standard thickness	0.5 to 1 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Tetragonal a = 0.369 nm c = 2.215 nm
Color	Violet
Twin structure	No
PHYSICAL PROPERTIES	
Density	5.527 $g.cm^{-3}$
Melting point	1860°C
Thermal expansion	Along a-axis: $8.67.10^{-6}$ K^{-1} Along c-axis: $1.57.10^{-5}$ K^{-1}
Dielectric constant	20
Loss tangent (at 10 GHz)	2.10^{-3}
OPTICAL PROPERTIES	
Transmission range	220 to 6670 nm (excluding Nd range)
Refractive index n	1.941

CADMIUM SULFIDE CdS SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Seeded vapour phase growth
Maximum size	Ø 50 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Hexagonal a = 0.4135 nm c = 0.6749 nm
PHYSICAL PROPERTIES	
Density	4.82 $g.cm^{-3}$
Melting point	1475°C
Hardness	4 Mohs
Thermal expansion	$4.2.10^{-6}$ K^{-1}
Resistivity range	> 10^{8} Ω.cm (high resistivity) < 10^{1} Ω.cm (low resistivity)
Band gap at 300 K	2.53 eV
Thermal conductivity	15.9 $W.m^{-1}.K^{-1}$
Conductivity type	N-type
Carrier concentration	10^{9} - 10^{18} cm^{-3}
Dielectric constant	Vertical c-axis: 8.28 Parallel c-axis: 8.64

CADMIUM SELENIDE CdSe SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Seeded vapour phase growth
Maximum size	Ø 50 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Hexagonal a = 0.431 nm c = 0.7021nm
PHYSICAL PROPERTIES	
Density	5.816 $g.cm^{-3}$
Melting point	1268°C
Hardness	4 Mohs
Thermal expansion	$2.9.10^{-6}$ K^{-1}
Resistivity range	> 10^{7} Ω.cm (high resistivity) < 10^{1} Ω.cm (low resistivity)
Thermal conductivity	3.49 $W.m^{-1}.K^{-1}$
Band gap at 300 K	1.74 eV
Conductivity type	N-type

CADMIUM TELLURIDE CdTe SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH						
Growth method	Modified Bridgman (with Cd-reservoir)					
Maximum size	Ø 60 mm					
CRYSTALLOGRAPHIC PROPERTIES						
Crystal structure	Cubic a = 0.6481 nm					
Cleavage	<110>					
PHYSICAL PROPERTIES						
Density	5.855 $g.cm^{-3}$					
Melting point	1092°C					
Hardness	3 Mohs					
Thermal expansion	$5.7.10^{-6}$ K^{-1}					
Thermal conductivity	6.28 $W.m^{-1}.K^{-1}$					
Resistivity range	> 10^{9} Ω.cm					
Band gap at 300 K	1.5 eV					
Conductivity type	N-type, P-type					
CHEMICAL PROPERTIES						
Solubility in water	Insoluble					
Solubility in acids	Insoluble					
Solubility in organic solvents	Insoluble					
OPTICAL PROPERTIES						
Absorption coefficient	0.001 cm^{-1} at 10.6 µm					
Transmission range (thickness 2 mm)	0.9 µm to 24 µm					
Refractive index n	1 µm	5 µm	10 µm	15 µm	20 µm	30 µm
	2.831	2.692	2.679	2.659	2.632	2.559

COBALT OXIDE CoO SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Verneuil
Maximum size	Ø 15mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 0.4267 nm
Color	Black
PHYSICAL PROPERTIES	
Density	6.4 $g.cm^{-3}$
Melting point	1935°C
Hardness (Knoop test)	310 to 345

CHROMIUM OXIDE Cr_2O_3 SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Verneuil
Maximum size	Ø 15 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Hexagonal a = 0.496 nm c = 1.3599 nm
Color	Black
PHYSICAL PROPERTIES	
Density	5.2 $g.cm^{-3}$
Melting point	2275°C

GALLIUM ARSENIDE GaAs SUBSTRATE

Gallium Arsenide used for lenses and beam splitters provides an alternative to ZnSe in medium and high power CW CO2 laser systems. It is most useful in applications where toughness and durability are important. Its hardness and strength make it a good choice where dust or abrasive particles tend to build up on or bombard the optical surfaces. When frequent cleaning by wiping is required, GaAs is excellent. The material is nonhygroscopic, safe to use in laboratory and field conditions and is chemically stable except when in contact with strong acids.

FEATURES

- High mobility
- High frequency
- Low power consumption

APPLICATIONS

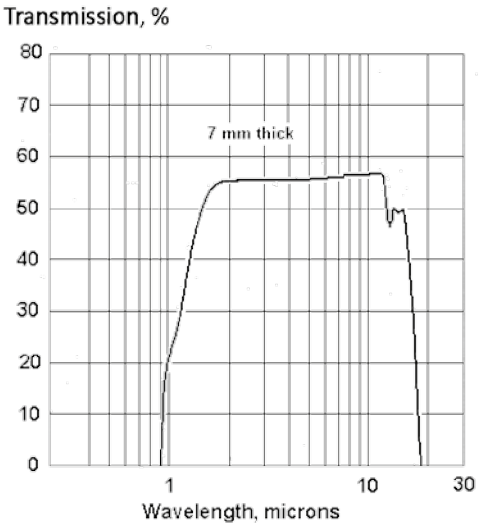
- Visible and infrared LED
- Light emitting diodes
- Laser diodes

STANDARD SPECIFICATIONS

CRYSTAL GROWTH										
Growth method	Czochralski (CZ) or Vertical Gradient Freeze									
Maximum size	Ø 4"									
Standard thickness	350 - 625 µm									
CRYSTALLOGRAPHIC PROPERTIES										
Crystal structure	Cubic a = 0.565 nm									
Dopant available	Silicon, Tellurium, Zinc, Chromium									
PHYSICAL PROPERTIES										
Density	5.32 $g.cm^{-3}$									
Melting point	1238°C									
Hardness (Knoop test)	750									
Thermal expansion	$5.8.10^{-6}$ K^{-1}									
Dielectric constant	12.85									
Band gap	1.42 eV									
Thermal conductivity	0.55 $W.cm^{-1}.K^{-1}$									
Specific heat capacity	0.327 $J.g^{-1}.K^{-1}$									
Conductivity	Semi-conducting or semi-insulating									
Conductivity type	P-type or N-type									
OPTICAL PROPERTIES										
Absorption coefficient	< 0.02 cm^{-1} at 10.6 µm									
Transmission range (thickness 7 µm)	1.0 to 22 µm									
Solubility in water	None									
Refractive index n	8 µm	10 µm	11 µm	13 µm	13.7 µm	14.5 µm	15 µm	17 µm	19 µm	21.9 µm
	3.34	3.13	3.04	2.97	2.89	2.82	2.73	2.59	2.41	2.12

Parameters	Undoped GaAs	Si Doped GaAs	Zn Doped GaAs	Cr Doped GaAs	Te Doped GaAs
Doping	Undoped	Si	Zn	Cr	Te
Conductor type	N, (SI)	N	P	SI	N
Carrier concentration (cm^{-3})	-	$(5 - 15).10^{17}$	$> 5.10^{18}$	-	$5 - 20.10^{17}$
Resistivity (Ω.cm)	$> 1.10^{-7}$	-	-	$> 5.10^{7}$	-
Mobility ($cm^2.V^{-1}.s^{-1}$)	> 4500	3000 - 1800	> 50	> 3000	> 1500
E.P.D. (cm^{-2})	$< 5.10^{4}$	$1.10^{4} - 3.10^{3}$	$< 5.10^{4}$	$> 8.10^{4}$	< 3000

TRANSMISSION SPECTRUM



GALLIUM PHOSPHIDE GaP SUBSTRATE

GaP single crystals are grown by the Czochralski technique and are widely used for red, yellow and green LED substrates. NEYCO provides high quality as-cut GaP wafers for LPE in mass production, and also supplies EPI polished wafers for CVD and MBE applications.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 2"
Standard thickness	500 µm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 0.545 nm
PHYSICAL PROPERTIES	
Conductivity	Semi-conducting (SI)
Conductivity type	N-type
Dopant available	Silicon

Dopant	Si doped	Undoped
Carrier concentration	2 - 8.10^{17} cm^{-3}	4 - 6.10^{16} cm^{-3}
EPD	< 3.10^{5} cm^{-2}	< 3.10^{5} cm^{-2}
Resistivity range	~ 0.03 Ω.cm	~ 0.3 Ω.cm
Density	4.13 $g.cm^{-3}$	
Melting point	1480°C	
Thermal expansion	5.3.10^{-6} K^{-1}	
Band gap	2.26 eV	
Thermal conductivity	1.1 $W.cm^{-1}.K^{-1}$ at 300 K	

GADOLINIUM GALLIUM GARNET $Gd_3Ga_5O_{12}$ (GGG) SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 3"
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 1.2382 nm
Color	Pale yellow
PHYSICAL PROPERTIES	
Density	7.02 $g.cm^{-3}$
Melting point	1730°C
Thermal expansion	9.7.10^{-6} K^{-1}

GERMANIUM Ge SUBSTRATE

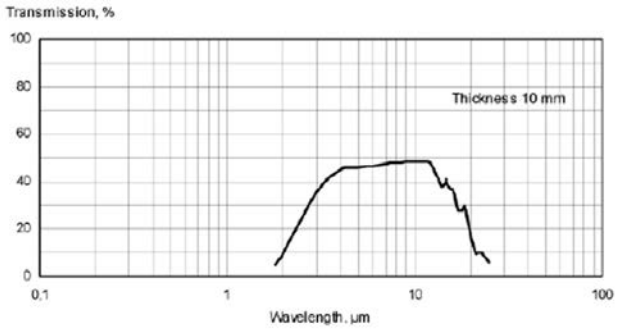
APPLICATIONS

- IR optics
- Solar cell application
- Optical fiber production
- Semiconductor and electronics device

STANDARD SPECIFICATIONS

CRYSTAL GROWTH						
Growth method	Czochralski (CZ)					
Maximum size	Ø 3"					
CRYSTALLOGRAPHIC PROPERTIES						
Crystal structure	Cubic a = 0.565 nm					
Dopant available	Antimony (N), Gallium (P)					
Cleavage	<111>					
PHYSICAL PROPERTIES						
Density	5.32 $g.cm^{-3}$					
Melting point	937°C					
Hardness	6 Mohs					
Thermal expansion	$5.75.10^{-6}\ K^{-1}$					
PHYSICAL PROPERTIES						
Resistivity range	N-type: < 0.4 Ω.cm P-type: 0.005 - 30 Ω.cm Undoped: > 30 Ω.cm					
Specificity heat capacity	310 $J.kg^{-1}.K^{-1}$					
Band gap at 273 K	0.67 eV					
Thermal conductivity	58.6 $W.m^{-1}.K^{-1}$					
Carrier mobility	μ_e = 3900 $cm^2.V^{-1}.s^{-1}$ μ_h = 1900 $cm^2.V^{-1}.s^{-1}$					
Conductivity type	P-type or N-type					
CHEMICAL PROPERTIES						
Solubility in water	Insoluble					
Solubility in acids	Soluble in mixture of HCl and HNO_3 and H_2O_2					
Solubility in organic solvents	Insoluble					
OPTICAL PROPERTIES						
Absorption coefficient	0.02 cm^{-1} at 10.6 µm					
Transmission range (thickness 10 mm)	2 to 18 µm					
Refractive index n	2.0 µm	5.0 µm	8.0 µm	10.0 µm	11.0 µm	15.0 µm
	4.1079	4.0153	4.0053	4.0040	4.0031	4.0017

TRANSMISSION SPECTRUM



INDIUM ARSENIDE InAs SUBSTRATE

NEYCO provides InAs wafers (Indium Arsenide) to optoelectronics in diameter up to 2 inch. InAs crystal has high uniformity of electrical parameters and low defect density, suitable for MBE or MOCVD epitaxial growth.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 2"
Standard thickness	500 µm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic
PHYSICAL PROPERTIES	
Band gap	0.4 eV
Conductivity	Semi-conducting (SI)
Conductivity type	P-type or N-type
Dopant available	Silicon, Zinc

DOPANT AVAILABLE	TYPE	CARRIER CONCENTRATION (cm^{-3})	MOBILITY ($cm^2.V^{-1}.s^{-1}$)
Undoped	N	-	> 20000
Si	N	1.10^{17} - 3.10^{18} cm^{-3}	10000 - 25000
Zn	P	1.10^{17} - 5.10^{18} cm^{-3}	100 - 500

INDIUM PHOSPHIDE InP SUBSTRATE

NEYCO supplies high quality InP single crystal substrates for semiconductor industries. The wafers are cut along precise orientation and highly EPI polished.

APPLICATIONS

InP has been a focus of development since the early 1980s, and today the material is being used as a platform for a wide variety of fiber communications components, including lasers, LEDs, semiconductor optical amplifiers, modulators and photo-detectors.

InP applications for discrete active devices are widespread in communications networking, making it the natural starting place for wholesale integration of passive devices for a complete system on a chip. As a semiconductor material, InP can provide all-in-one integrated functionality that includes light generation, detection, amplification, high-speed modulation and switching, as well as passive splitting, combining and routing. The same material can be used to make high-speed modulators, switches, amplifiers and detectors, or just passive wave guides for interconnecting these diverse devices.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Standard thickness	500 µm
Maximum size	Ø 2"
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Face-centered cubic (Zinc blende)
PHYSICAL PROPERTIES	
Band gap	1.344 eV
Conductivity	Semi-conducting or semi-insulating (SI)
Conductivity type	P-type or N-type
Dopant available	Silicon, Tin, Zinc, Iron
Density	4.81 $g.cm^{-3}$
Melting point	1082°C
Thermal conductivity	0.68 $W.cm^{-1}.K^{-1}$ at 300 K

DOPANT AVAILABLE	TYPE	CARRIER CONCENTRATION (cm^{-3})	MOBILITY ($cm^2 .V^{-1}.s^{-1}$)	RESISTIVITY (Ω.cm)	EPD (cm^{-2})
Undoped	N	0.8 - 2.0 $.10^{15}$	3600 - 4000	0.03 - 0.2	5-6.10^4
Sn, Si	N	0.5 - 1.0 $.10^{18}$	200 - 2400	0.001 - 0.002	3-5.10^4
		0.5 - 1.0 $.10^{18}$	1500 - 2000	0.0025 - 0.007	
Zn	P	0.8 - 2.0 $.10^{18}$	2500 - 3500	0.0025 - 0.006	1-3.10^4
		2.5 - 4.0 $.10^{18}$	1300 - 1600		
Fe	SI	0.1 - 1.0	2000	10^7 - 10^8	4-5.10^4

LANTANUM ALUMINATE $LaAlO_3$ SUBSTRATE

$LaAlO_3$ single crystal provides a good lattice match to many materials with perovskite structure. It is an excellent substrate for epitaxial growth of high Tc superconductors, magnetic and ferro-electric thin films. The dielectric properties of $LaAlO_3$ crystal are well suitable for low loss microwave and dielectric resonance applications.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Max. size	Ø 3"
Standard thickness	0.5 to 1 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Rhombohedral at 25°C a = 0.5357 nm
	Cubic at > 435°C a = 0.379 nm
Twin structure	Twins // to the <100>-planes of the pseudocubic cell
Color	Tan to brown based on annealing condition
PHYSICAL PROPERTIES	
Density	6.52 $g.cm^{-3}$
Melting point	2180°C
Thermal expansion	$9.2.10^{-6}$ K^{-1}
Dielectric constant	24.5
Loss tangent (at 10 GHz)	~ 3.10^{-4} at 300 K ~ 6.10^{-5} at 77 K
CHEMICAL PROPERTIES	
Chemical stability	Insoluble in mineral acids at 25°C and soluble in H_3PO_3 at > 150°C

LITHIUM ALUMINATE $LiAlO_2$ SUBSTRATE

$LiAlO_2$ is a potential substrate for III-V nitride thin films due to its excellent lattice mismatch to GaN (<0.2% at <100>), chemical stability at high temperature and cost effective.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 2"
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Tetragonal a = 0.517 nm c = 0.626 nm
Color	Transparent
PHYSICAL PROPERTIES	
Density	2.2 $g.cm^{-3}$
Melting point	1900°C
Hardness	7.5 Mohs

LITHIUM FLUORIDE LiF SUBSTRATE

APPLICATION

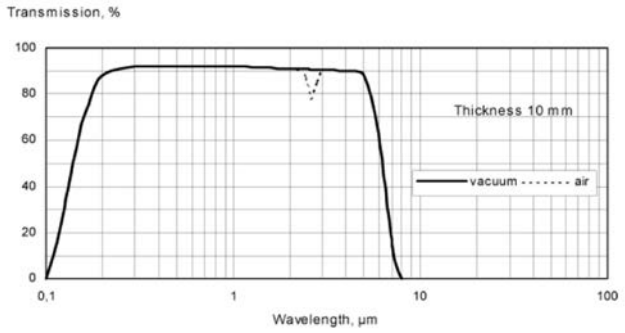
UV window and prism, without deliquescence.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Stockbarger technique
Maximum size	Ø 150 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 0.4026 nm
Cleavage plane	<100>
PHYSICAL PROPERTIES	
Density	2.60 $g.cm^{-3}$
Melting point	870°C

PHYSICAL PROPERTIES						
Hardness	4 Mohs					
Thermal expansion	28.1 - 34.8.10^{-6} K^{-1}					
Thermal conductivity	14.2 W.m^{-1}.K^{-1}					
Specific heat capacity	1562 J.kg^{-1}.K^{-1}					
CHEMICAL PROPERTIES						
Solubility in water	0.27 g/100 cm^3					
Solubility in acids	Soluble					
Solubility in organic solvents	Insoluble in acetone and ethylalcohol					
OPTICAL PROPERTIES						
Absorption coefficient	0.05 cm^{-1} at 0.2 µm 0.02 cm^{-1} at 0.4 µm 0.03 cm^{-1} at 2.6-2.9 µm					
Transmission range (thickness 10 mm)	0.12 - 6.5 µm					
Refractive index n	0.2 µm	0.5 µm	1.0 µm	3.0 µm	5.0 µm	6.0 µm
	1.4390	1.3943	1.3871	1.3666	1.3266	1.2975

TRANSMISSION SPECTRUM



LITHIUM GALLATE $LiGaO_2$ SUBSTRATE

$LiGaO_2$ single crystal was grown in 1960's for laser application. However, it is found out that $LiGaO_2$ is a potential substrate for III-V nitride thin films due to its excellent lattice mismatch to GaN (<0.2%), chemical stability at high temperature and cost effective.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 20 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Orthorhombic a = 0.54 nm b = 0.6379 nm c = 0.5012 nm
Color	White to brown
Twin structure	No twins and inclusion
PHYSICAL PROPERTIES	
Density	4.18 $g.cm^{-3}$
Melting Point	1600°C

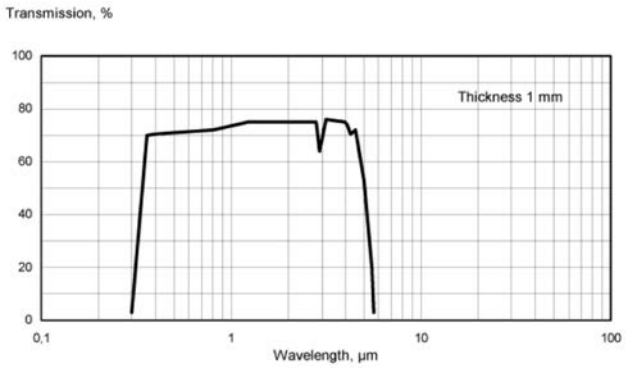
LITHIUM NIOBATE $LiNbO_3$ SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Hexagonal a = 0.5148 nm c = 1.3863 nm
PHYSICAL PROPERTIES	
Density	4.64 $g.cm^{-3}$
Melting point	1250°C
Hardness	5 Mohs
Thermal expansion	Vertical c-axis: $15.4.10^{-6}$ K^{-1} Parallel c-axis: $7.5.10^{-6}$ K^{-1}

OPTICAL PROPERTIES			
Transmission range	0.4 - 2.90 µm		
Refractive index:	0.633 µm	1.064 µm	1.30 µm
n_o	2.286	2.232	2.220
n_e	2.203	2.156	2.146

TRANSMISSION SPECTRUM



LANTHANUM-STRONTIUM-ALUMINUM-TANTALUM-OXIDE (LSAT) SUBSTRATE

LSAT $(LaAlO_3)_{0.3}$ $(Sr_2AlTaO_6)_{0.7}$ is a newly developing crystal with peroviskite structure and twin-free. LSAT has excellent lattice match with high Tc superconductors and many oxide materials. LSAT has lower melting point and can be grown by CZ technology at lower cost, therefore, it is expected to replace $LaAlO_3$ and $SrTiO_3$ as a common single crystal substrate for epitaxial oxide thin films for gain magnetic ferro-electronic and superconductive devices.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 2"
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 0.7737 nm
Twin structure	No twin and domain visible
Color	Colorless to light brown based on annealing condition
PHYSICAL PROPERTIES	
Density	6.74 $g.cm^{-3}$
Melting point	1840°C

PHYSICAL PROPERTIES	
Thermal expansion	10.10^{-6} K^{-1}
Dielectric constant	~ 22
Loss tangent (at 8.8 GHz)	2.10^{-4} at 77 K

MAGNESIUM ALUMINUM OXIDE $MgAl_2O_4$ SUBSTRATE

$MgAl_2O_4$ (spinel) single crystals are widely used for bulk acoustic wave and microwave devices and fast IC epitaxial substrates. It is also found that $MgAl_2O_4$ is a good substrate for III-V nitrides device. $MgAl_2O_4$ crystal is very difficult to grow, due to the difficulty in maintaining a single phase structure.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 30 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 0.8083 nm
Color	Colourless
PHYSICAL PROPERTIES	
Density	3.64 $g.cm^{-3}$
Melting Point	2130°C
Hardness	8.0 Mohs
Thermal expansion	7.10^{-6} K^{-1}

MAGNESIUM FLUORIDE MgF_2 SUBSTRATE

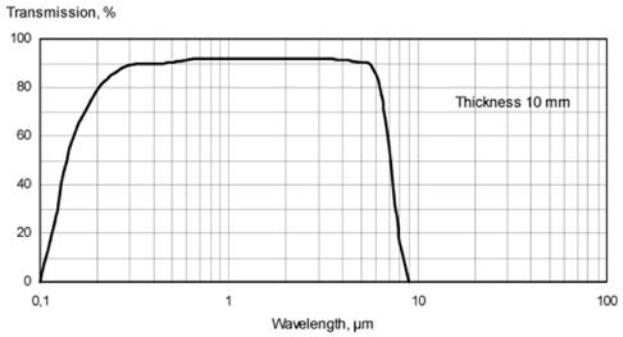
APPLICATIONS

VUV window and mirror, lens.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH						
Growth method	Stockbarger technique					
Cleavage	<100>, <110>					
Maximum size	Ø 90 mm					
CRYSTALLOGRAPHIC PROPERTIES						
Crystal structure	Tetragonal a = 0.464 nm c = 0.306 nm					
PHYSICAL PROPERTIES						
Density	3.18 $g.cm^{-3}$					
Melting point	1255°C					
Hardness	6 Mohs					
Thermal expansion	Parallel c-axis: 10.86 - 14.54.10^{-6} K^{-1} Vertical c-axis: 6.23 - 9.25.10^{-6} K^{-1}					
Specific heat capacity	920 $J.kg^{-1}.K^{-1}$					
CHEMICAL PROPERTIES						
Solubility in water	0.0076 g/100 cm^3					
Solubility in acids	Soluble					
Solubility in organic solvents	Insoluble in alcohol					
OPTICAL PROPERTIES						
Absorption coefficient (cm^{-1})	0.07 cm^{-1} at 0.2 µm 0.02 cm^{-1} at 5.0 µm					
Refractive index:	0.2 µm	0.5 µm	1.0 µm	3.0 µm	5.0 µm	7.0 µm
n_o	1.4231	1.3797	1.3736	1.3618	1.3400	1.3044
n_e	1.4367	1.3916	1.3852	1.3724	1.3487	1.3101

TRANSMISSION SPECTRUM



MAGNESIUM OXIDE MgO SUBSTRATE

MgO is an excellent single crystal substrate for thin films of ferro-magnetic, photo-electronic and high Tc superconductor materials.

FEATURES

- Low dielectric loss
- Cleavage plane on the <100>

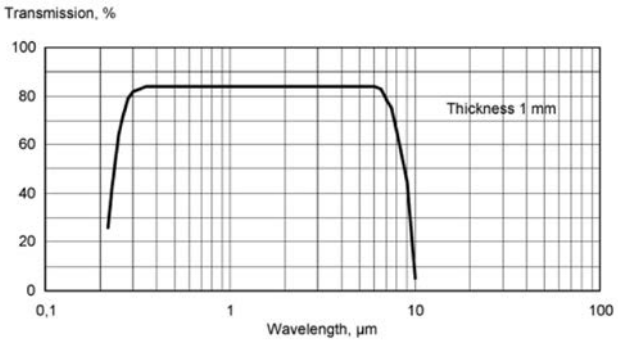
APPLICATIONS

- High Tc Superconductor
- Electronics and optoelectronics
- Microwave device

STANDARD SPECIFICATIONS

CRYSTAL GROWTH				
Growth method	Flux melt			
Standard thickness	0.5 to 1 mm			
Maximum size	Ø 2"			
CRYSTALLOGRAPHIC PROPERTIES				
Crystal structure	Cubic a = 0.4216 nm			
Cleavage	<100>			
Twin structure	Without twins			
Color	Colorless			
PHYSICAL PROPERTIES				
Density	3.58 $g.cm^{-3}$			
Melting point	2800°C			
Hardness	5.8 Mohs			
Thermal expansion	8.10^{-6} K^{-1}			
Thermal conductivity	40.6 $W.m^{-1}$ K^{-1}			
Specific heat capacity	837 $J.kg^{-1}.K^{-1}$			
Dielectric constant	8.1			
Loss tangent (at 10 GHz)	~ 9.10^{-3} at 77 K			
CHEMICAL PROPERTIES				
Chemical stability	Insoluble in mineral acids at 25 °C and soluble in H_3PO_3 at > 150 °C			
Solubility in water	0.00062 g/100 cm^3			
OPTICAL PROPERTIES				
Transmission range (thickness 1 mm)	0.3 - 7.0 µm			
Refractive index n	0.5 µm	1 µm	3 µm	5 µm
	1.74	1.72	1.68	1.63

TRANSMISSION SPECTRUM



MANGANESE OXIDE MnO SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Verneuil
Maximum size	Ø 15 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 0.4445 nm
Color	Black
PHYSICAL PROPERTIES	
Density	5.4 $g.cm^{-3}$
Melting point	1650°C
Hardness (Knoop test)	300

SODIUM CHLORIDE NaCl SUBSTRATE

Use only these crystals for fine research work requiring minimum 10 mm square uninterrupted areas.

- Formula: NaCl
- Appearance: Cubic clear (nearly transparent) crystals
- Density: 2.165 $g.cm^{-3}$
- Solubility in water: a thin "wafer" that is 0.05" (1.27 mm) will dissolve in water at room temperature in roughly 30 seconds

GROW EPITAXIAL FILMS

These high quality research grade sodium chloride single crystal substrates offer a major advantage: the ability to grow epitaxial films on a featureless substrate.

The orientation of the film is related to the orientation of the substrate, producing areas of single crystal film.

This feature is ideal for boundary diffusion studies and applications where a single crystal thin film is required. The film is easily removed by floating it off on water or by dissolving away the underlying substrate.

SIZES	PACKAGING	P/N
25 mm cubes	1	01817-AB
10 mm cubes	5	01807-AF
25 mm cubes	5	01817-AF

OFF-CUTS

- Use for class experiments and for the teaching of cleaving techniques
- Approximate size range: 20 mm to 45 mm
- Note: Some "fines" will be present as well

PACKAGING	P/N
100 g	01779-AB

NEODYMIUM GALLATE $NdGAO_3$ (NGO) SUBSTRATE

MATERIAL CHARACTERISTICS

- Excellent lattice matches to the typical HTSC composition
- Low dielectric constant and low dielectric loss tangent, which makes it attractive for microwave applications
- Good thermal properties
- No destructive phase transformations

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 2"
Standard thickness	0.5 to 1 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Orthorhombic to > 1000°C a = 0.5426 nm b = 0.5496 nm c = 0.7707 nm Second order phase transformation at 950°C
Twin structure	Without twins
Color	Deep red to green
PHYSICAL PROPERTIES	
Density	7.56 $g.cm^{-3}$
Melting point	1750°C
Hardness	5.9 Mohs
Thermal expansion	11.10^{-6} K^{-1}
Dielectric constant (1 MHz)	20 at 300 K

NICKEL OXIDE NiO SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Verneuil
Maximum size	Ø 15 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 0.419 nm
Color	Black
PHYSICAL PROPERTIES	
Density	6.96 $g.cm^{-3}$
Melting point	1998°C
Hardness (Knoop test)	560 - 590

QUARTZ SiO_2 SUBSTRATE

FEATURES

- High working temperature
- Good thermal conductivity
- High stability
- High anti corrosion
- Superior mechanical properties
- Stable dielectric constant & low dielectric loss
- High optical transmission

APPLICATIONS

- Photo mask blank
- Sensors
- High frequency circuit (Microwave circuit)
- Biotech arrays
- Laser Optics
- Optical windows and lenses

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Hydrothermal synthesis
Maximum size	100 x 100 mm
Standard thickness	0.5 mm to 4 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Hexagonal a = 0.490 nm c = 0.539 nm
Color	Colourless
PHYSICAL PROPERTIES	
Density	2.65 $g.cm^{-3}$
Melting Point	1700°C
Hardness	5.5 - 6.5 Mohs
Thermal expansion	Vertical c-axis: $13.37.10^{-6}$ K^{-1} Parallel c-axis: $7.97.10^{-6}$ K^{-1}
Resistivity	7.10^{7} Ω.cm
Dielectric constant	3.7 - 3.9

STRONTIUM LANTHANUM ALUMINATE $SrLaAlO_4$ SUBSTRATE

SrLaAlO4 crystal is a promising substrate material for high Tc superconductor film and other oxide films. It has similar lattice constant to $SrTiO_3$, but better quality and lower cost because of CZ growth and lower melting point.

APPLICATIONS

High quality YBaCu, BiSrCaCuO, Bi(Pb)CaCuO and TlBaCaCuO thin films have been grown on $SrLaAlO_4$ substrates by different techniques.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 18 - 20 mm
Standard thickness	0.5 to 1 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Tetragonal a = 0.3754 nm c = 1.2630 nm
Twin structure	No
Color	Light yellow
PHYSICAL PROPERTIES	
Density	5.924 $g.cm^{-3}$
Melting point	1650°C
Hardness	7 Mohs
Thermal expansion	Along a-axis: $7.55.10^{-6}$ K^{-1} Along c-axis: $1.71.10^{-6}$ K^{-1}
Dielectric constant	17
Thermal conductivity	At 12 K: 360 $W.m^{-1}.K^{-1}$ At 300 K: 8.82 $W.m^{-1}.K^{-1}$ At 450 K: 7.50 $W.m^{-1}.K^{-1}$
Dielectric loss tangent (at 10 GHz)	8.10^{-4} at 77 K
OPTICAL PROPERTIES	
Transmission range	240 to 6670 nm

STRONTIUM LANTHANUM GALLATE $SrLaGA_3O_7$ SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 18 - 20 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Tetragonal a = 0.806 nm c = 0.534 nm

CRYSTALLOGRAPHIC PROPERTIES	
Color	Orange
PHYSICAL PROPERTIES	
Density	5.2 $g.cm^{-3}$
Melting point	1760°C
Dielectric constant	22
Loss tangent (at 1 MHz)	$5.7.10^{-5}$ at 300 K

STRONTIUM LANTHANUM GALLATE $SrLaGaO_4$ SUBSTRATE

APPLICATIONS

High quality YBaCuO, BiSrCaCuO, Bi(Pb)CaCuO and TlBaCaCuO thin films have been grown on $SrLaGaO_4$ substrates by different techniques.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 18 - 20 mm
Standard thickness	0.5 to 1 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Tetragonal a = 0.3843 nm c = 1.2680 nm
Twin structure	No
Color	Colorless to yellow
PHYSICAL PROPERTIES	
Density	6.389 $g.cm^{-3}$
Melting point	1520°C
Thermal expansion	Along a-axis: $10.1.10^{-6}$ K^{-1} Along c-axis: 1890.10^{-5} K^{-1}
Dielectric constant	22
Loss tangent (at 10 GHz)	$5.7.10^{-3}$ at 77 K

STRONTIUM TITANATE $SrTiO_3$ SUBSTRATE

$SrTiO_3$ single crystal provides a good lattice match to most materials with Perovskite structure. It is an excellent substrate for epitaxial growth of HTS and many oxide thin films. $SrTiO_3$ single crystal has also been used widely for special optical windows and as high quality sputtering target.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Verneuil
Maximum size	Ø 2"
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 0.3905 nm
Twin structure	Without twins
Color	Colorless to pale yellow
PHYSICAL PROPERTIES	
Density	5.175 $g.cm^{-3}$
Melting point	2080°C
Hardness	6 Mohs
Thermal expansion	9.10^{-6} K^{-1}
Dielectric constant	~ 300
Loss Tangent (at 10 GHz)	2.10^{-2} at 77 K
CHEMICAL PROPERTIES	
Chemical stability	Insoluble in water

Doped $SrTiO_3$ is used in the basic research and is applied as conducting material [e.g. back side contacting, application of certain surface sensitive measurements (STM)].

DOPANDS	Nb		La	
CONCENTRATION AT %	AVAILABLE	RESISTIVITY (Ω.cm)	AVAILABLE	RESISTIVITY (Ω.cm)
0.02	X	-	-	-
0.05	X	0.08	X	0.12
0.1	X	0.03	X	-
0.2	X	-	-	-
0.5	X	0.005	X	0.006
1.0	X	0.003	X	-
2.0	X	-	-	-
5.0	-	-	X	0.0007

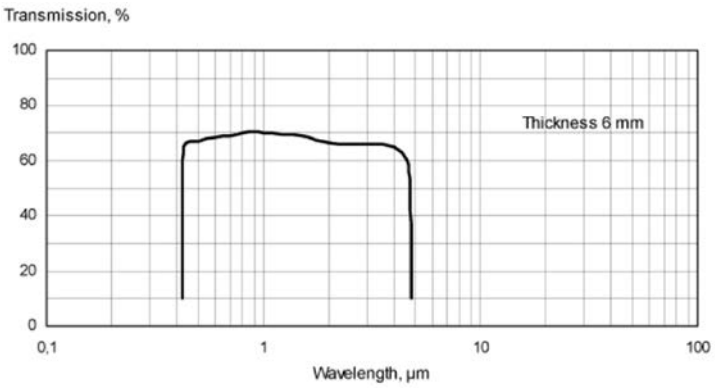
TITANIUM OXIDE (RUTILE) TiO_2 SUBSTRATE

Rutile (TiO_2) single crystal is one of the most suitable materials for spectral prisms and polarizing devices such as optical isolators and beam displacers because it has a large birefringence with a high refractive index. Compared to YVO_4, TiO_2 crystal is more stable chemically and physically.

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Floating zone (FZ)
Maximum size	Ø 1"
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Tetragonal a = 0.459 nm c = 0.296 nm
Color	Pal
PHYSICAL PROPERTIES	
Density	4.26 $g.cm^{-3}$
Melting point	1825°C
Hardness	7 Mohs
Thermal expansion	Vertical c-axis: $7.2.10^{-6}$ K^{-1} Parallel c-axis: $9.19.10^{-6}$ K^{-1}
Specific heat capacity	710 $J.kg^{-1}.K^{-1}$
Thermal conductivity	12.56 $W.m^{-1}.K^{-1}$
Resistivity	7.10^7 Ω.cm
Dielectric constant	Vertical c-axis: 170 Parallel c-axis: 88
OPTICAL PROPERTIES	
Transmission range (thickness 6 mm)	0.43 - 6.0 µm
Refractive index:	0.6 µm
n_o	2.61
n_e	2.90

TRANSMISSION SPECTRUM

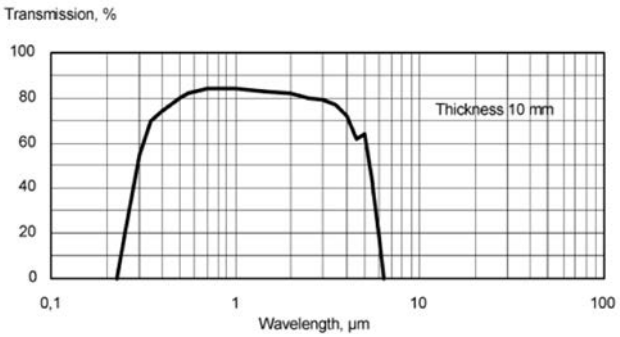


YTTRIUM ALUMINIUM GARNET $Y_3AL_5O_{12}$ (YAG) SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH					
Growth method	Czochralski (CZ)				
Maximum size	Ø 2"				
CRYSTALLOGRAPHIC PROPERTIES					
Crystal structure	Cubic a = 1.2005 nm				
Color	Colorless				
PHYSICAL PROPERTIES					
Density	4.55 $g.cm^{-3}$				
Melting point	1940°C				
Hardness	8.5 Mohs				
Thermal expansion	$6.9.10^{-6}$ K^{-1}				
Transmission range (thickness 1 mm)	0.3 - 0.5 µm				
Solubility in water	Insoluble				
Solubility in acids	Unessential				
Refractive index n	0.5 µm	1.0 µm	2.0 µm	3.0 µm	4.0 µm
	1.845	1.8197	1.8035	1.7855	1.7602

TRANSMISSION SPECTRUM



YTTRIUM ALUMINATE $YAlO_3$ (YAP) SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Czochralski (CZ)
Maximum size	Ø 1.5"
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Orthorombic a = 0.517 nm b = 0.5307 nm c = 0.7355 nm
Twin structure	No
Color	Colorless
PHYSICAL PROPERTIES	
Density	4.88 $g.cm^{-3}$
Melting point	1870°C
Thermal expansion	2 - 10.10^{-6} K^{-1}
Dielectric constant	16 - 20

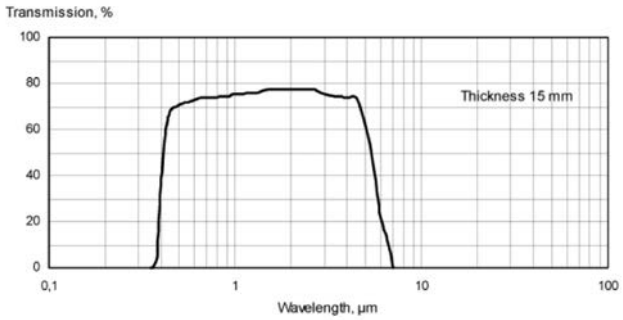
YTTRIA STABILIZED ZIRCONIA (YSZ) SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Skull melting (ZrO_2/Y_2O_3 92-8 % wt)
Maximum size	Ø 2"
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 0.5125 nm
Color	Colourless
PHYSICAL PROPERTIES	
Density	5.92 $g.cm^{-3}$
Melting point	2780°C
Hardness	7.5 - 8 Mohs
Thermal expansion	8.10^{-6} K^{-1}
Dielectric constant	27
Thermal conductivity	31.8 $W.m^{-1}.K^{-1}$
CHEMICAL PROPERTIES	
Solubility in water (g/100 cm^3)	Not declarate
Solubility in acids	Not declarate
Solubility in organic solvents	Not declarate

OPTICAL PROPERTIES	
Refractive index n	4 µm
	2.24

TRANSMISSION SPECTRUM



ZINC OXIDE ZnO SUBSTRATE

STANDARD SPECIFICATIONS

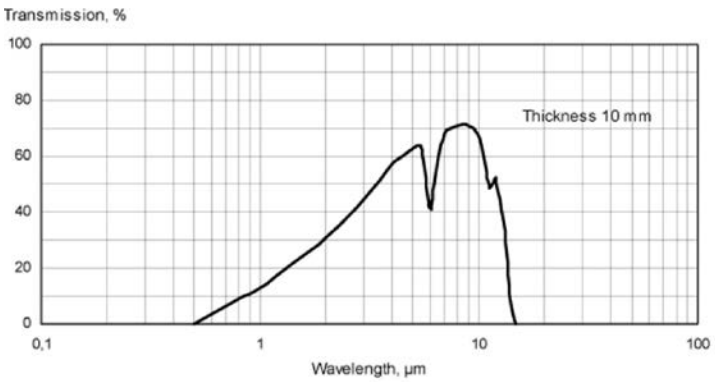
CRYSTAL GROWTH	
Growth method	Hydrothermal, seeded vapor phase growth
Maximum size	Ø 35 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Hexagonal a = 0.3252 nm c = 0.5213 nm
PHYSICAL PROPERTIES	
Density	5.7 $g.cm^{-3}$
Melting point	1975°C
Hardness	4 Mohs
Thermal expansion	$3.16.10^{-6}$ K^{-1}
Resistivity range	> 10^{2} - 10^{4} Ω.cm
Band gap at 300 K	3.2 eV
Thermal conductivity	2.5 $W.m^{-1}.K^{-1}$
Conductivity type	N-type
Carrier concentration	10^{10} to 10^{18} cm^{-3}
Dielectric constant	8.5
OPTICAL PROPERTIES	
Refractive index n	n_0 = 2.026, n_e = 2.041

ZINC SULFIDE ZnS SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH						
Growth method	Seeded vapour phase growth					
Maximum size	Ø 40 mm					
CRYSTALLOGRAPHIC PROPERTIES						
Crystal structure	Cubic a = 0.5411 nm					
PHYSICAL PROPERTIES						
Density	4.09 $g.cm^{-3}$					
Melting point	1830°C					
Hardness	3 Mohs					
Thermal expansion	$7.9.10^{-6}$ K^{-1}					
Resistivity range	> 10^{2}-10^{4} Ω.cm					
Band Gap (at 300 K)	3.66 eV					
Thermal conductivity	1.73 W $m^{-1}.K^{-1}$					
Conductivity type	N-type					
Carrier concentration	10^{5} to 10^{16} cm^{-3}					
Dielectric constant	9.67 5.13					
Specific heat capacity	530 $J.kg^{-1}.K^{-1}$					
CHEMICAL PROPERTIES						
Solubility in water	Insoluble					
Solubility in acids	Unessential					
Solubility in organic solvents	Insoluble					
OPTICAL PROPERTIES						
Absorption coefficient	0.001 cm^{-1} at 2.7 µm 0.2 cm^{-1} at 10 µm					
Transmission range (thickness 10 mm)	0.4 - 12.5 µm					
Refractive index n	0.5 µm	0.7 µm	1.0 µm	10.0 µm	11.0 µm	12.0 µm
	2.419	2.332	2.292	2.201	2.186	2.161

TRANSMISSION SPECTRUM

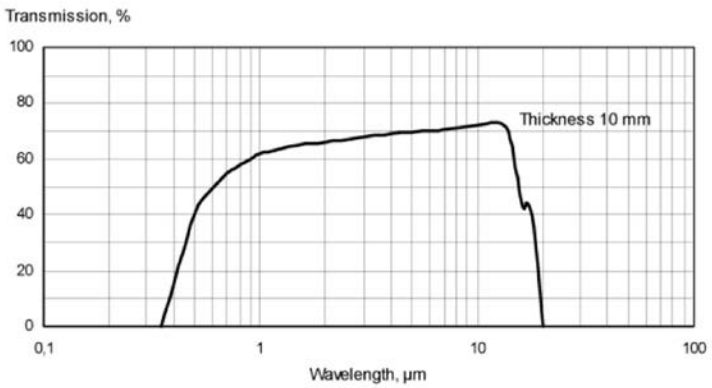


ZINC SELENIDE ZnSe SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH						
Growth method	Seeded vapour phase growth					
Maximum size	Ø 40 mm					
CRYSTALLOGRAPHIC PROPERTIES						
Crystal structure	Cubic a = 0.5668 nm					
Cleavage	<110>					
PHYSICAL PROPERTIES						
Density	5.26 $g.cm^{-3}$					
Melting point	1520°C					
Hardness	4 Mohs					
Thermal expansion	$7.6.10^{-6}$ K^{-1}					
Thermal conductivity	12.97 $W.m^{-1}.K^{-1}$					
Specific heat capacity	355 $J.kg^{-1}.K^{-1}$					
Resistivity range	> 10^{8} Ω.cm					
Band Gap (at 300 K)	3.66 eV					
Conductivity type	N-type					
Carrier concentration	10^{5} to 10^{17} cm^{-3}					
CHEMICAL PROPERTIES						
Solubility in water	Insoluble					
Solubility in acids	Soluble					
Solubility in organic solvents	Insoluble					
OPTICAL PROPERTIES						
Absorption coefficient	0.005 cm^{-1} at 10.6 µm					
Transmission range (thickness 10mm)	0.55 - 18.0 µm					
Refractive index n	1.0 µm	3.0 µm	5.0 µm	10.0 µm	12.0 µm	15.0 µm
	2.4894	2.4376	2.4296	2.4067	2.3936	2.3662

TRANSMISSION SPECTRUM



ZINC TELLURIDE ZnTe SUBSTRATE

STANDARD SPECIFICATIONS

CRYSTAL GROWTH	
Growth method	Seeded vapour phase growth
Maximum size	Ø 40 mm
CRYSTALLOGRAPHIC PROPERTIES	
Crystal structure	Cubic a = 0.6089 nm
PHYSICAL PROPERTIES	
Density	5.636 $g.cm^{-3}$
Melting point	1290°C
Hardness	4 Mohs
Thermal expansion	$8.36.10^{-6}$ K^{-1}
Resistivity range	> 10^{5} Ω.cm
Band gap (at 300 K)	2.28 eV
Thermal conductivity	12.39 $W.m^{-1}.K^{-1}$
Conductivity type	P-type
Carrier concentration	10^{10} to 10^{17} cm^{-3}
Dielectric constant	8.1 7.28
OPTICAL PROPERTIES	
Refractive index n	2.68