

Langasite (LGS) Crystals and Substrates

Langasite crystal ($\text{La}_3\text{Ga}_5\text{SiO}_{14}$, LGS), belonging to the space group P321, point group 32, has been reported to be promising new piezoelectric materials for fabrication of surface acoustic wave (SAW) and bulk acoustic wave (BAW) devices. The devices made of langasite crystal could be used at a high temperature up to 900°C because of its high thermal stability.

Hangzhou Shalom EO offers the LGS crystals blanks, polished substrates and wafers upon customer's request.



SPECIFICATIONS

LGS crystals blanks or blocks	
X Direction	5~40mm
Y Direction	5~40mm
Z Direction	~80mm
Direction Precision	±20'

Langasite slices	
Diameter	5~14mm
Frequency	2.7~21MHz
Direction Precision	±20'
Surface Roughness(Lapped)	Ra=0.3~0.5μm

Sensor, SAW Wafers	
Diameter	6~76.2mm
Thickness	0.13~0.5mm
Reference Flat	2~15MM
Surface Roughness (CMP single or double sides)	Ra≤1nm
Qrientation	Following customer specifications

Inches boules and CMP wafers.

Langasite crystal possesses some great properties, such as higher electromechanical coupling factor than quartz, no phase transition from room temperature to melt point. Some properties of langgasite crystal are shown in Table 1.

Table 1 Dielectric, elastic stiffness constants and their first order temperature coefficients of langasite crystal

Constant	Relative Dielectric Constant		Piezoelectric Constant (pC/N)		Elastic Stiffness (10^{11} Pa)					
	ϵ_{11}	ϵ_{33}	d11	d14	c11	c12	c13	c14	c33	c44
Value	18.96	50.19	5.66	-5.48	1.898	1.058	1.022	0.144	2.626	0.535
First Order Temp.Coeff. ($10^{-6} \cdot K^{-1}$)	150	-760	329	-342	-66	204	-75	-335	-94	-63

Table 2 Comparative properties of piezoelectric crystals

PropertiesCrystal	Quartz SiO_2	Langasite $La_3Ga_5SiO_{14}$	Lithium tetraborate $Li_2B_4O_7$	Lithium tantalite $LiTa_3$
Electromechanical Coupling Factor K,%(BAW)	7.0	15.8	24.0	47.0
Frequency Spacing Δf ,%	0.25	0.90	4.00	7.00
Q-Factor Q , $\times 10^3$	100	50	10	2
Temperature Frequency Coefficient TFC, $\times 10^{-6}/^\circ C$	0.5	1.6	6.0	4.0

With the rapid development of the communication technology, the new generation communication system enables people not only to talk, but also to transmit image, data and video. Langasite crystal possesses high SAW properties compared with quartz, which make it to be the most competitive material in this field. SAW properties of langasite and quartz are listed in the Table 3.

Table 3 SAW properties of langasite and Quartz

PropertiesCrystal	Quartz(SiO_2)	Langasite($La_3Ga_5SiO_{14}$)
Density, g/cm^3	2.65	5.746
SAW Velocity V_{ef} , m/s	($0^\circ, 132.75^\circ, 0^\circ$)3157	($0^\circ, 140^\circ, 25^\circ$)2756
Electromechanical coupling factor K^2 , % (SAW)	0.14	0.36
Second order temp. coef. $a_2, \times 10^{-8}/^\circ C^2$	-3.2	-6.8
Temp. Coef. TTO, $^\circ C$	25	23
Dielectric Constant ϵ	4.92	27
Power flow angle Φ , $^\circ$	0	0.5