TDG 天通控股股份有限公司
TDG HOLDING CO.,LTD.

$LiTaO_3$ / $LiNbO_3$ CRYSTAL MATERIAL

钽酸锂 / 铌酸锂晶体材料

TDG 天通控股股份有限公司
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天通智造　凯巨科技　线上商城

天通控股股份有限公司
TDG HOLDING CO., LTD

天通控股股份有限公司(股票代码：600330)创建于1984年，于2001年在上海证券交易所挂牌上市，是国内首家由自然人直接控股的上市公司，经过近四十年的艰苦创业，天通拥有多家控股和参股公司，目前已经形成电子材料、电子模组、绿色能源、智能装备四大业务板块,业务涵盖电子信息材料产业链上下游，是集科研、制造、销售于一体的国家高新技术企业。

TDG Holdings Co., Ltd. (stock code: 600330) was founded in 1984 and listed on the Shanghai Stock Exchange in 2001. It is the first listed company in China directly controlled by a natural person. After forty years of arduous entrepreneurship, TDG has multiple holding and participating companies, and has now formed four major business segments: electronic materials, electronic modules, green energy, and intelligent equipment. Its business covers the upstream and downstream of the electronic information materials industry chain, and it is a high-tech enterprise integrating scientific research, manufacturing, and sales.

天通凯巨科技有限公司
TDG KAIJU TECHNOLOGY CO., LTD

天通凯巨科技有限公司成立于2021年，是天通控股股份有限公司全资子公司，主营产品为压电晶体材料。公司聚集全球顶尖技术团队，实现关键核心技术自主可控，同时优化升级质量管理体系，产品质量得到国内外客户高度认可。

天通凯巨始终坚持以市场为导向，以客户为中心，依托智能化的研发设计、数字化的运营管理、精细化的成本控制、自动化的生产制造，以及专业、年轻并富有激情的管理团队，持续为客户提供优质的产品和服务，以数字赋能，创新驱动，绿色发展为引领，打造国际领先的压电晶体材料生产基地，不断引领行业的进步与发展。

TDG Kaiju Technology Co., Ltd. was established in 2021 and is a wholly-owned subsidiary of TDG Holding Co., Ltd. Our main products are piezoelectric crystal materials. We has gathered top international technical teams and developed a number of key core technologies to realize independent and controllable technology. By setting up a perfect quality management system, using advanced management methods and matching high-end testing equipment, the product quality has been highly recognized by domestic and foreign customers.

TDG Kaiju always adheres to the market-oriented and customer-centered, relying on intelligent research and development design, digital operation management, refined cost control, automated manufacturing, and a professional, young and passionate management team, and continues to provide customers with better products and services. Guided by digital empowerment, innovation drive and green development, TDG Kaiju has built an international leading piezoelectric crystal material production base and continuously led the progress and development of the industry.

声表面波级晶体
SAW Grade Crytal

应用领域:声表面波器件　Application:SAW Devices

声表面波级LT、LN晶体是天通的基础产品。SAW传播速度的一致性是SAW器件生产商对SAW材料的基本要求。LT、LN晶体的组份变化、极化的不完整和内部缺陷会引起SAW传播速度的变化。通过严格控制Ta_2O_5、Nb_2O_5和Li_2CO_3原料的批次质量变化和两者配置比例，并以成熟的晶体生长和单畴化工艺，居里温度测试和内部质量检查等措施来满足客户对产品越来越高的质量要求。

SAW grade LT, LN crystals are the featured products of TDG Holding Co., Ltd. Variation of SAW propagation velocity may arise from the fluctuation of crystal components, uncompleted crystal poling and crystal defects. So, to ensure the SAW propagation velocity consistent and to meet customer's increasing requirement on crystal quality, such strict measures as quality and precise component ratio control of Ta_2O_5、Nb_2O_5 and Li_2CO_3 raw materials, Curie temperature measurement, defects inspection as well as optimized crystal growth and poling process, are taken.

Crystal Categories	$LiTaO_3$ Crystal	$LiNbO_3$ Crystal
Crystal Orientation	Z, 36° Y, 42° Y, X-112° Y	X, Y, Z, 36°Y, 41°Y, 45°Y, 64°Y, 128°Y, 135°Y
Orientation Fluctuation	±0.1°	
Diameter	100.0±0.2mm,150±0.2mm,200±0.2mm	
Length	50~150mm	
Curie Temperature	603℃±2℃	1142℃±2℃
Orientation of First Reference Flat	±0.2°	
First Reference Flat	32±2mm(4”), 47.5±2mm(6”)	
Second Reference Flat	10±2mm, 12±2mm	
Quality	Free of Crack, bubbles and inclusions	

* 以上参数仅供参考
* 特殊规格按照客户要求定制
* The above index are for reference
* Other specifications are available on request

声表面波级钽酸锂晶片
SAW Grade $LiTaO_3$ (LT) Wafer

应用领域:声表面波器件　Application:SAW Devices

- 提供适用于SAW和BAW器件制作要求的各种LT晶片。
- 影响SAW器件成品成品率的关键指标会被逐项检查。
- 亦可供应我们的专利技术产品-低静电黑色或灰色LT晶片。

- Providing various LT wafers for SAW and BAW fabrications.
- Key properties influencing the yield of SAW devices are examined.
- And our patented product-low static black or gray LN wafers, are also available.

Orientation	42°rot. Y-cut±0.2°	X-cut±0.2°	42°rot. Y-cut±0.2°
Diameter	100.0±0.2mm	150.0±0.2mm	200.0±0.2mm
Orientation Flat (OF)	32±2mm, 47.5±2mm Perpendicular to X±0.2°	32±2mm, 47.5±2mm Perpendicular to 112.2°Y±0.2°	Notch
Second Refer Flat (RF)	10mm±2mm SOF:Cw270°±1° from OF	10mm±2mm SOF:Cw315°±1° from OF TOF:Cw270°±1° from OF	/
Thickness	200~250±20um, 350±20um, 500±20um		500±20um
Propagating Surface	“+”side Ra≤10Å		
wafer Backside	GC#1000 lapped/etched, GC#2000 lapped/etched		
TTV	≤5um		
LTV	≤0.5um within an area of 5*5mm		
PLTV	≥95%(3mm from edge excluded)		
BOW	-25um≤Bow≤+25um		
Curie Temperature	603℃±2℃(DTA method)		
Edge Beveling	Edge grinding		

* 以上参数仅供参考
* 特殊规格按照客户要求定制
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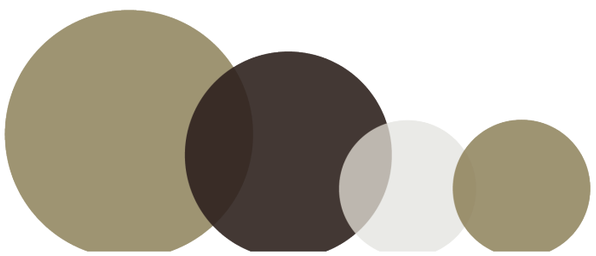


声表面波级铌酸锂晶片
SAW Grade $LiNbO_3$ (LN) Wafer

应用领域:声表面波器件　Application:SAW Devices

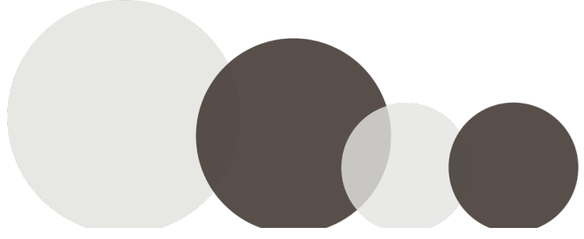
- 提供适用于SAW和BAW器件制作要求的各种LN晶片。
- 影响SAW器件成品率的关键指标会被逐项检查。
- 亦可供应我们的专利技术产品-低静电黑色或灰色LN晶片。

- Providing various LN wafers for SAW and BAW fabrications.
- Key properties influencing the yield of SAW devices are examined.
- And our patented product-low static black or gray LN wafers, are also available.

Orientation	127.86°rot. Y-cut±0.2°	Y-cut±0.2°	127.86°rot. Y-cut±0.2°
Diameter	100.0±0.2mm	150.0±0.2mm	200.0±0.2mm
Orientation Flat (OF)	32±2mm, 47.5±2mm Perpendicular to X±0.2°	32±2mm, 47.5±2mm Perpendicular to X±0.2°	Notch
Second Refer Flat (RF)	10mm±2mm SOF:Cw225°±1° from OF	10mm±2mm SOF:Cw270°±1° from OF TOF:Cw225°±1° from OF	/
Thickness	500±20um, 350±20um, 200~250±20um		500±20um
Propagating Surface	“+”side Ra≤10Å		
wafer Backside	GC#1000 lapped/ etched, GC#2000 lapped/ etched		
TTV	≤5um		
LTV	≤0.5um within an area of 5*5mm		
PLTV	≥95%(3mm from edge excluded)		
BOW	-25um≤Bow≤+25um		
Curie Temperature	1142℃±3℃(DTA method)		
Edge Beveling	Edge grinding		

* 以上参数仅供参考
* 特殊规格按照客户要求定制

* The above index are for reference
* Other specifications are available on request



黑色钽酸锂晶片/黑色铌酸锂晶片
Black-LT/Black-LN

特性　Special Features

- 中和电荷能力强。黑色LT和黑色LN可以中和任何迅速产生的瞬时电荷。
- 黑色LT和黑色LN的电压常数和普通LT和LN晶片没有区别。
- 从表面到内部的体电阻率均匀性一致。
- 体电阻率在每个等级都应被控制在(1.0E+10~9.0E+11 Ω*cm)的水平。

- High ability of electrical charge neutralization. Black-LT and Black-LN wafers shall neutralize the instantaneous electrical charge.
- Black-LT and Black-LN shall have no difference at piezoelectric properties from usual LT and LN wafers.
- High uniformity of Bulk resistivity throughout the surface and depth of wafers.
- Bulk resistivity shall be voluntarity controllable at each level (1.0E+10~9.0E+11 Ω*cm).

体积电阻/电导率规格 Specification of Bulk resistivity, Bulk conductivity

黑色钽酸锂 Black-LT

	Standard Black	Super Black
Bulk resistivity (Ω·cm)	0.9E+11~9.9E+11	1.0E+11~9.9E+10
Bulk conductivity ($\Omega^{-1}\cdot cm^{-1}$)	1.11E-11~1.11E-12	1.0E-10~1.11E-11

黑色铌酸锂 Black-LN

	Standard Black
Bulk resistivity (Ω·cm)	1.0E+10~9.9E+10
Bulk conductivity ($\Omega^{-1}\cdot cm^{-1}$)	1.00E-10~1.00E-11

典型规格 Typical Specifications

黑色钽酸锂晶片 Black-LT Wafers

Orientation	Diameter	Thickness	Surface Finish (+)plane (-)plane	
36° Y-cut 38.7° Y-cut 42° Y-cut 48° Y-cut X-112° Y-cut	100.0(mm) 150.0(mm) 200.0(mm)	0.20(mm) 0.25(mm) 0.35(mm) 0.50(mm)	Mirror Polished	GC#1000 GC#2000

黑色钽酸锂晶片 Black-LN Wafers

Orientation	Diameter	Thickness	Surface Finish (+)plane (-)plane	
Y-Zcut 41° Y-cut 64° Y-cut 127.86° Y-cut	100.0(mm) 150.0(mm) 200.0(mm)	0.20(mm) 0.25(mm) 0.35(mm) 0.50(mm)	Mirror Polished	GC#1000 GC#2000

体积电阻/电导率规格 Specification of Bulk resistivity, Bulk conductivity

Black-LT Wafers	Black-LT Wafers		Usual LT	Black-LN	Usual LN
	Standard Black	Super Black		Standard Black	
Bulk resistivity (Ω-cm)	2.22*E+11	3.54E+10	1.90E+14	2.40E+10	1.20E+15
Bulk conductivity (Ω^{-1}-cm^{-1})	4.50E-12	2.80E-11	5.30E-15	4.17E-11	8.30E-16
Surface electric Potential*1/100mϕ(kv)	< 0.40	< 0.10	4.12	< 0.05	3.05
Electrical charges neutralization(sec.)	3.7	1.5	∞	1.5	∞
Optical transmit ion(%)*2)	65	< 60	72	< 60	73
Color	gray	dark gray	colorless	dark gray	colorless

*1) 电荷发生在温度从室温上升到95℃的4英寸LT晶片（42' Y-cut, 厚度为0.35 mm)

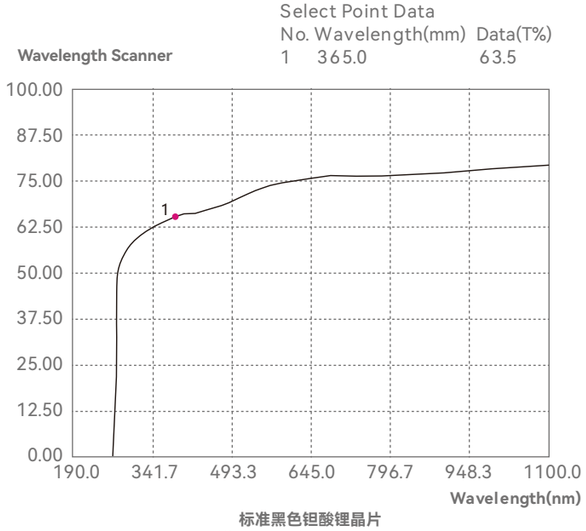
*2) 用365nm的波长测试0.35mm厚度的晶片透射率（双面镜面抛光)

*1) electrical charges occurring with temperature raising from room temperature to 95, at 4 inch LT wafer (42' Y-cut, 0.35 mm thickness)

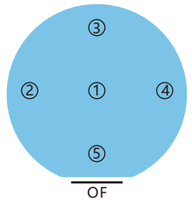
*2) transmissivity of 0.35 mm thickness wafer (with both side mirror polished) measured by 365 nm wavelength

SAW Properties	LT 42° Y-cut		LN 127.86° Y-cut	
	LT	Black-LT	LN	Black-LN
Curie temp., Tc (℃)	603±2	603±2	1142±2	1142±2
SAW velocity	4022	Unchanged	3980	Unchanged
Coupling coeffient k^2	7.6	Unchanged	5.5	Unchanged

光学透射谱 Optical Transmission Spectra



标准黑色钽酸锂晶片
Standard Black LT Wafer



透过率测量点
Transmission Measurement Points

Easurementpoint	B-LT T(%),365nm	B-LN T(%),365nm
1	63.5	51.3
2	63.8	52.6
3	64.6	52.5
4	64.9	51.7
5	63.6	51.8
最大	64.9	52.6
最小	63.5	51.3
R	1.4	1.3

钽酸锂晶体基本性能
LT Crystal Features

分子式：$LiTaO_3$/LT　分子量：235.8871

Molecular Formula: $LiTaO_3$/LT　Molecular Weight: 235.8871

性能表1 Properties Chart 1

Crystal System		Trigonal System	Density Crystallinity(g/cm³)	7.4564
Lattice Constant(nm)		a=0.515428, c=1.378351	Moh's Hardness	5.5
Point Group	High Temperature Phase	-3m	SAW Speed(m/s)	See Chart 2
	Low Temperature Phase	3m		
Cleavage Plane		(01T2)	Electromechanical Coupling Factor(K^2/%)	See Chart 2
Melting Point（℃）		1650	Temperature Coefficient10^{-6}/℃	See Chart 2
Pyroelectric Coefficient		23×10^{-5}C/(k·m2)	Relative Dielectric Constant	ε_{11}=53.6, ε_{33}=43.4
Curie Temperature（℃）		603	Insoluble in acid except HF and HNO_3	
Optical Transparency Range		350~5000 nm	Specific Heat（Cal/K·cm^3）	0.79
Refractive Index		n_o = 2.180，n_e=2.176 @632.8nm		
Electro-optic Coefficient		r_{13} =8.4pm/v，r_{33} =30.5pm/V		
Nonlinear Optical Coefficient		d_{33}=15.1pm/v@852nm	Piezoelectric Constant 10^{-11}C/N	D_{15}=2.67, d_{33}=0.57
Coefficient of Thermal Expansion (10^{-6}/℃(@25℃)		α_{11}=16.1, α33=4.1	Heat Conductivity(w/cm·k)	0.05

性能表2 Properties Chart 2

Cut Surface	X Plane	42°Y Plane	36°Y Plane
SAW Propagation Direction	112.2°Y-Direction	X-Direction	X-Direction
Electromechanical Coupling Coefficient K_s^2 (%)	0.75	7.6	5
Temperature Coefficient of Delay Time T_0t(ppm/℃)	-18	-40	-36
SAW Speed V_S(m/s)	3296	4022	4178

* 以上参数仅供参考　* The above index are for reference

铌酸锂晶体基本性能
LN Crystal Features

分子式： $LiNbO_3$/LN　分子量：147.85
Molecular Formula: $LiNbO_3$/LN　Molecular Weight: 147.85

性能表1 Properties Chart 1

Crystal System		Trigonal System	Density Crystallinity(g/cm³)	4.612
Lattice Constant(nm)		a=0.514829, c=1.38631	Moh's Hardness	5
Point Group	High Temperature Phase	-3m	SAW Speed(m/s)	See Chart 2
	Low Temperature Phase	3m		
Cleavage Plane		(01T2)	Electromechanical Coupling Factor(K^2/%)	See Chart 2
Melting Point（℃）		1260	Temperature Coefficient10^{-6}/℃	See Chart 2
Pyroelectric Coefficient		-4×10^{-5}C/(k·m2)	Relative Dielectric Constant	ε_{11}=85.2, ε_{33}=28.7
Curie Temperature（℃）		1142	Insoluble in acid except HF and HNO_3	
Optical Transparency Range		400~5000 nm	Specific Heat（Cal/K·cm³）	0.76
Refractive Index		n_o = 2.286，n_e=2.202 @632.8nm		
Electro-optic Coefficient		r_{13} =9.6pm/v, r_{33} =30.9pm/V		
Nonlinear Optical Coefficient		d_{33}=33pm/v@852nm	Piezoelectric Constant 10^{-11}C/N	D_{15}=6.8, d_{33}=0.6
Coefficient of Thermal Expansion (10^{-6}/℃(@25℃)		α_{11}=15.4, α33=7.5	Heat Conductivity(w/cm·k)	0.029

性能表2 Properties Chart 2

Items	Index	
SAW Speed V_S(m/s)	（Rotate128°Y-X）：3950/3990	（Y-Z）：3470/3510
SAW Electromechanical Coupling Coefficient K_s^2 (%)	（Rotate128°Y-X）：5.4 ~ 6.0	（Y-Z）：4.1 ~ 4.6
Temperature Coefficient of SAW Delay Time T_0t(ppm/℃)	（Rotate128°Y-X）：73 ~ 78	（Y-Z）：91 ~ 97
Temperature Coefficient of SAW Speed T_0V(ppm/℃)	（Rotate128°Y-X）：-57 ~ -61	（Y-Z）：-84 ~ -90

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