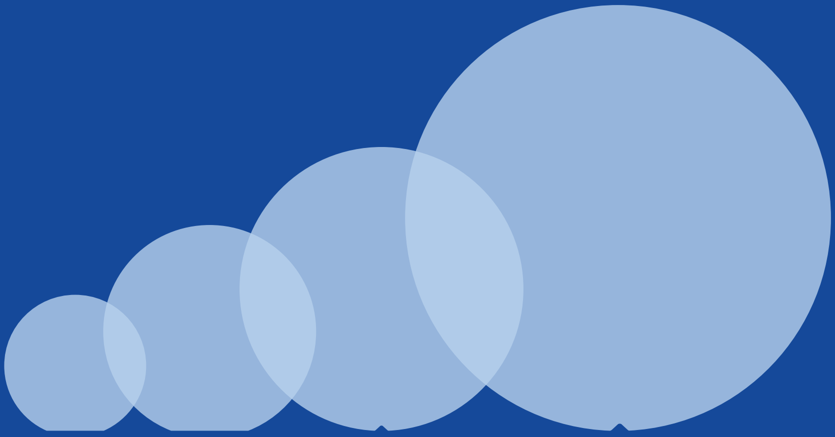
天通控股股份有限公司
TDG HOLDING CO.,LTD.

证券代码（Stock Code）:600330

SAPPHIRE SUBSTRATE PRODUCTS

蓝宝石衬底产品



天通控股股份有限公司
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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、智能装备、绿色能源四大业务板块，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 Holding Co., Ltd (stock code: 600330) was founded in 1984 and listed on the Shanghai Stock Exchange in 2001. TDG is the first listed company in China that is controlled by individual shareholders. After forty years of development, TDG possesses several holding and joint stock companies, and now has formed four major business segments: electronic materials, electronic modules, intelligent equipment and green energy. Its business covers the upstream and downstream of the electronic information material industry chain and it is a high-tech enterprise integrating scientific research, manufacturing and sales.

天通银厦新材料有限公司
TDG YINXIA NEW MATERIAL CO.,LTD

天通银厦新材料有限公司成立于2014年，是天通控股股份有限公司的全资子公司。公司是用改良泡生法制造大尺寸蓝宝石晶体的行业龙头企业，主营蓝宝石晶体、蓝宝石晶棒、蓝宝石衬底的研发、制造和销售，产品主要应用于工业、医药业、集成电路及智能手机终端、新一代Micro LED显示技术和5G通信等行业。

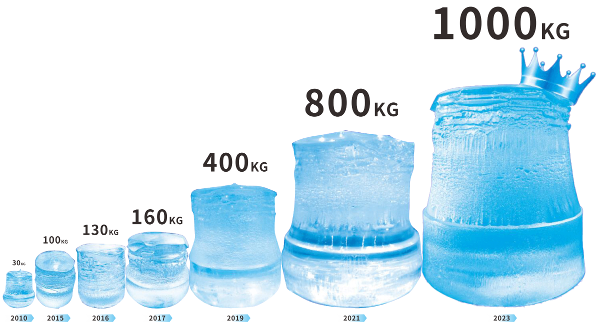
TDG Yinxia New Material Co., Ltd was established in 2014 and is a wholly-owned subsidiary of TDG Holding Co. Ltd. TDG Yinxia is a leading company in the industry that produces large-sized sapphire crystals using the improved KY crystal growth method. Its main business is research and development, manufacturing and sales of sapphire crystals, sapphire ingots and sapphire substrates. Its products are mainly used in industry, pharmaceuticals, integrated circuits, smartphone terminals, new generation Micro LED display technology and 5G communication.

蓝宝石晶体
Sapphire Crystal

1.企业已具备100kg-400kg级A向/C向蓝宝石晶体量产能力，其中C向400kg晶体是行业内首家达到量产能力的C向最大规格蓝宝石晶体。

2.目前已研发出1000kg级蓝宝石晶体。

1. TDG has possessed the mass production capacity of A-Direction/ C-Direction sapphire crystals from 100 KG to 400 KG, among which the C-Direction 400kg crystal from TDG is the first in the industry to reach mass production capacity.
2. At present, the 1000KG sapphire crystal has been successfully developed.



材料 Material	Al_2O_3
密度 Density	3.98g/cm^3
维氏硬度 Vickers Hardness	// C 16~17GPa ⊥A 18~20GPa
纯度 Purity	>99.996%
莫氏硬度 Mohs Hardness	9
杨氏模量 Young's Modulus	>420GPa
泊松比 Poisson Ratio	0.27~0.3
抗弯强度 Bending Strength	>350MPa
熔点 Melting Point	2050°C
线性热膨胀系数 Linear Coefficient Of Thermal Expansion	232~323K // C6.6 ⊥C 0.5 310~670K // C7.0 ⊥C 7.7
折射率 Refractivity	1.762-1.770
热导率 Thermal Conductivity	46.06@0°C 25.12@100°C 12.56@400°C (W/(m.k)
热容 Heat Capacity	0.10(cal/°C)
双折射 Birefringence	0.008~0.010
比热 Specific Heat	0.7788J/(g.K)@300K
位错密度（EPD） Etch Pit Density	<500 ea./ cm^2
半峰宽 FWHM	<15"
透过率 Transmittance	⩾85%@400-4000nm
光学均匀性 Optical Uniformity	$\Delta n \leqslant 4 \times 10^{-5}$
介电常数 Dielectric Constant	7.65@1575MHz/C axis 7.47@2450MHz/C axis 7.51@5000MHz/C axis

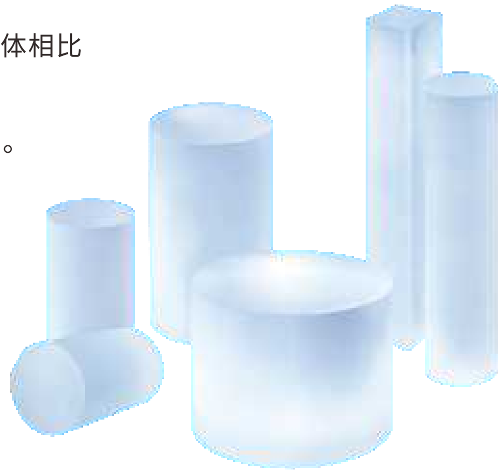
蓝宝石晶棒
Sapphire Ingot

1.企业已具备4-12英寸蓝宝石晶棒量产能力，加工C向晶体相比同行业加工A向晶体的得棒率高。

2.已实现超大尺寸(600mm-750mm)蓝宝石异形件加工。

1.TDG has possessed the mass production capacity of 4-12 inch sapphire crystal ingots. The ingot yield of processing C-Direction crystals is higher than A-Direction crystals in the industry.

2.TDG has realized the processing of ultra-large-sized (600mm-750mm) sapphire shaped products.



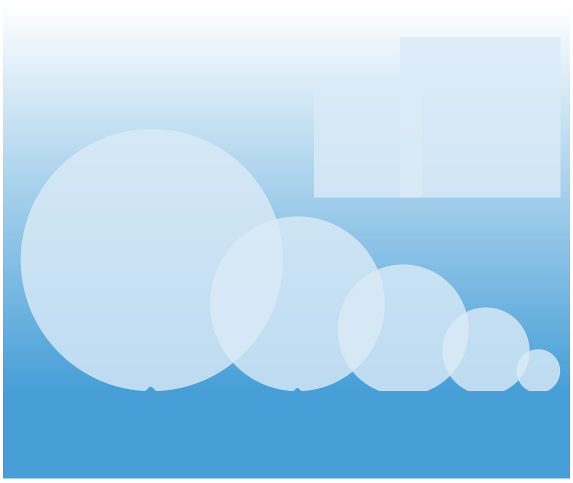
性能 Properties	规格 Specification			
	4英寸 4 Inch	6英寸 6 Inch	8英寸 8 Inch	12英寸 12 Inch
直径 Diameter	100.2±0.05mm	150.2±0.05mm	200.2±0.05mm	300.2±0.05mm
平边长度 Flat Length	30±1mm	47.5+1mm	/	/
材质 Material	高纯氧化铝/High Purity Al_2O_3			
端面晶向 Surface Crystal Orientation	C-Plane ±0.3			
平边晶向 Primary Flat Orientation	A-Plane ±0.2			
每一批次平均长度 Average Length Per Batch	>80mm			
有效长度率 Effective Length Ratio	>90%			
缺陷 Defect	无包裹物、孪晶、晶界 No Wrappage,Twin CrystalorCrystal Boundary			
崩边、裂纹、气泡 Edge chip, Crack, Bubble	崩边、裂纹、气泡所占长度不计入有效长度 Edge chip, Crack,Bubbles are not Counted Into Effective length			
位错密度 EPD	<500 ea./ cm^2			

备注:可根据客户要求定制　Remarks: customerizationis available.

蓝宝石衬底
Sapphire Substrate

企业具备2英寸至12英寸蓝宝石衬底的加工能力，产品应用于LED、功率器件、晶圆级封装以及键合等领域。

TDG has the processing capability of sapphire substrates from 2-12 inch. The products are applied to LED, power devices, wafer -level packaging and bonding.



性能 Properties	**规格** Specification			
	4英寸 4 Inch	**6英寸** 6 Inch	**8英寸** 8 Inch	**12英寸** 12 Inch
直径 Diameter	100.00mm±0.20mm	150.00mm±0.20mm	200.00mm±0.20mm	300.00mm±0.20mm
厚度 Thickness	650µm±10µm	1300µm±25µm	1600µm±25µm	1000µm±30µm
a面(11-20)取向 A-Plane	0°± 0 1°	0°± 0 1°	0°± 0.1°	0°± 0.1°
m面(1-100)取向 M-Plane	0.2°± 0.05°	0.2°±0.05°	0.2°± 0.03°	0.2°± 0.1°
定位面长度 Primary Flat Length	30.00mm±1.00mm	47.50mm±1.00mm	-	-
定位面方向 Primary Flat Orientation	A-plane±0.2°	A-plane±0.25°	-	-
Notch	-	-	SEMI	SEMI
正面粗糙度 Ra Frontside Ra	⩽0.3nm	⩽0.2nm	⩽0.2nm	⩽0.2nm
背面粗糙度 Ra Backside Ra	1.0µm±0.2µm	1.0µm+0.3µm	0.7~1.0µm	0.7µm-1.0µm
R-plane	R9	R9	R9	R9
衬底边缘 Wafer Edge	R-type	T-type	T-type	T-type
TTV	⩽10µm	⩽10µm	⩽15µm	⩽20µm
WARP	⩽15µm	⩽25µm	⩽20µm	⩽30µm
BOW	-10~0µm	-15~0µm	-20~10µm	-15~5µm
LTV	⩽2µm,7mm*7mm	⩽3µm,5mm*5mm	-	-
表面洁净度 Particle	Particle<50	Particle<150	＞0.3µm＜150	＞0.3µm Particle<200

备注：可根据客户要求定制单抛或双抛产品；针对不同应用可做部分指标优化。
Remarks: Products can be customized as single or double polished according to customer requirements; specific indicators can be optimized for different applications.

图形化蓝宝石衬底

Patterned Sapphire Substrate

通过差异化的图形化结构设计以及多材料组合应用，开发出适配外延技术特征的基板，满足LED芯片不同应用领域。图形化蓝宝石衬底（DPSS），图形化异质材料衬底（MMS）是其中两类重要的产品。

By designing differentiated graphical structures and combining multiple materials, we have developed substrates that are compatible with epitaxial technology features to meet the different application areas of LED chips. Graphic sapphire substrate (DPSS) and graphic heterogeneous material substrate (MMS) are two important types of products.

4英寸 | 4 Inch

NO	项目 Item	规格 Specification	
		4英寸DPSS 4 Inch DPSS	**4英寸MMS** 4 Inch MMS
1	材料 Material	Al_2O_3 99.996%	Al_2O_3 99.996%
2	直径 Diameter	100mm±0.1mm	100mm±0.1mm
3	厚度 Thickness	650-670um	650-670um
4	平边长度 Flat length	30mm±1mm	30mm±1mm
5	C偏M Off Angle toward M-axis	0.2°±0.05°	0.2°±0.05°
6	C偏A Off Angle toward A-axis	0°±0.1°	0°±0.1°
7	平边方向 Flat Orientation	0.°±0.2°(A-plane)	0.°±0.2°(A-plane)
8	弯曲度 BOW	-8~0um	-8~0um
9	翘曲度 WARP	⩽15um	⩽15um
10	总厚度差 TTV	⩽7um	⩽7um
11	背面粗糙度 Rouqhness(Ra)-Back side	0.8~1.2um	0.8~1.2um
12	R-Plane	R9	R9
13	LTV(5*5mm)	⩽1.5um	⩽1.5um
14	倒角方式 Wafer Edge Type	R-type	R-type
15	Laser mark position	Back side marking	Back side marking

NO	项目 Item	规格 Specification	
		4英寸DPSS 4 Inch DPSS	**4英寸MMS** 4 Inch MMS
1	底径 Diameter	2.70-2.90um	2.70-2.90um
2	深度 Height	1.70~1.90um	/
3	周期 Pitch	3.0±0.05um	3.0um±0.05um
4	弧度 Radian	＜0.18um	＜0.18um
5	图形排列方向 Pattern of mask	0°from primary flat	0° from primary flat
6	SiO_2深度 SiO_2 Height	/	1.50-1.60um
7	蓝宝石深度 Sapphire Height	/	200-300nm

产品外观
4&6 inch PSS&MMS

产品包装
Packaging

6英寸 | 6 Inch

NO	项目 Item	规格 Specification	
		6英寸DPSS 6 Inch DPSS	**6英寸MMS** 6 Inch MMS
1	材料 Material	Al_2O_3 99.996%	Al_2O_3 99.996%
2	直径 Diameter	150mm±0.2mm	150mm±0.2mm
3	厚度 Thickness	1300um±15um	1300um±15um
4	Notch Depth	1.0mm-1.25mm	1.0mm-1.25mm
5	Notch Radius	1mm±0.15mm	1mm±0.15mm
6	Notch Angle	92°±3°	92°±3°
7	Notch Axial	A-plane±0.3°	A-plane±0.3°
8	弯曲度 BOW	-10um~0um	-10um~0um
9	翘曲度 WARP	⩽30um	⩽30um
10	总厚度差 TTV	⩽10um	⩽10um
11	背面粗糙度 Rouqhness(Ra)-Back side	0.8~1.2um	0.8~1.2um
12	Plane R-Plane	R9	R9
13	LTV(5*5mm)	⩽3um	⩽3um
14	倒角方式 Wafer Edge Type	T-type	T-type
15	晶向 Surface Orientation	C-plane	C-plane

NO	项目 Item	规格 Specification	
		6英寸DPSS 6 Inch DPSS	**6英寸MMS** 6 Inch MMS
1	底径 Diameter	2.70-2.90um	2.70-2.90um
2	深度 Height	1.70~1.90um	/
3	周期 Pitch	3.0±0.05um	3.0±0.05um
4	弧度 Radian	＜0.18um	＜0.18um
5	图形排列方向 Pattern	0° from primary flat	0° from primary flat
6	SiO_2深度 SiO_2 Height	/	1.50-1.60um
7	蓝宝石深度 Sapphire Height	/	200-300nm

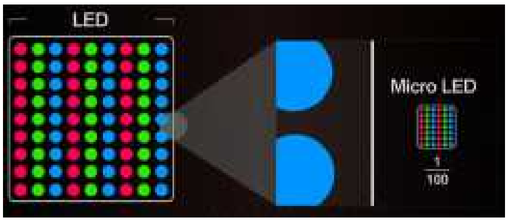
产品应用
Applications

LED蓝宝石衬底

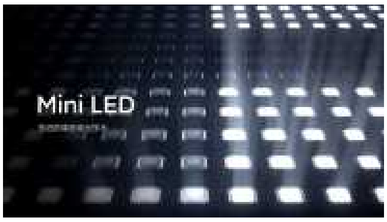
蓝宝石衬底具有高透光性、高稳定性、耐高温及良好的机械性能，是LED、micro LED以及mini LED芯片的优选材料。

LED Sapphire Substrate

Sapphire substrate has excellent light transmission, high stability, high heat resistance and good mechanical properties and is the primary material of LED, micro LED and mini LED chips.



Micro LED



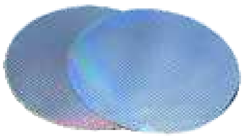
Mini LED

功率器件衬底

采用蓝宝石衬底可以大幅提升GaN器件的耐压，市场应用有望从消费类转向工业和汽车等领域，需求进一步打开，而随着8英寸蓝宝石衬底制备工艺的日趋成熟和大批量出货，氮化镓器件成本也有望进一步下降。

Power Device Substrate

The use of sapphire substrate can significantly improve the GaN devices' voltage resistance, the application has shifted from consumer to industrial and automotive fields. With the increasingly mature 8-inch sapphire substrate process and large-scale shipments, the cost of GaN devices is also expected to decline further.



蓝宝石基氮化镓晶圆
Sapphire based GaN wafer

蓝宝石晶圆键合

蓝宝石在键合领域的应用前景十分广阔，不仅限于已知领域，还包括传感器制造、生物医学应用、光学窗口与透镜、高频器件与微波集成电路、太阳能电池以及复合材料增强体等多个方面。随着科技的进步和市场的拓展，蓝宝石在键合领域的应用将会更加广泛和深入。

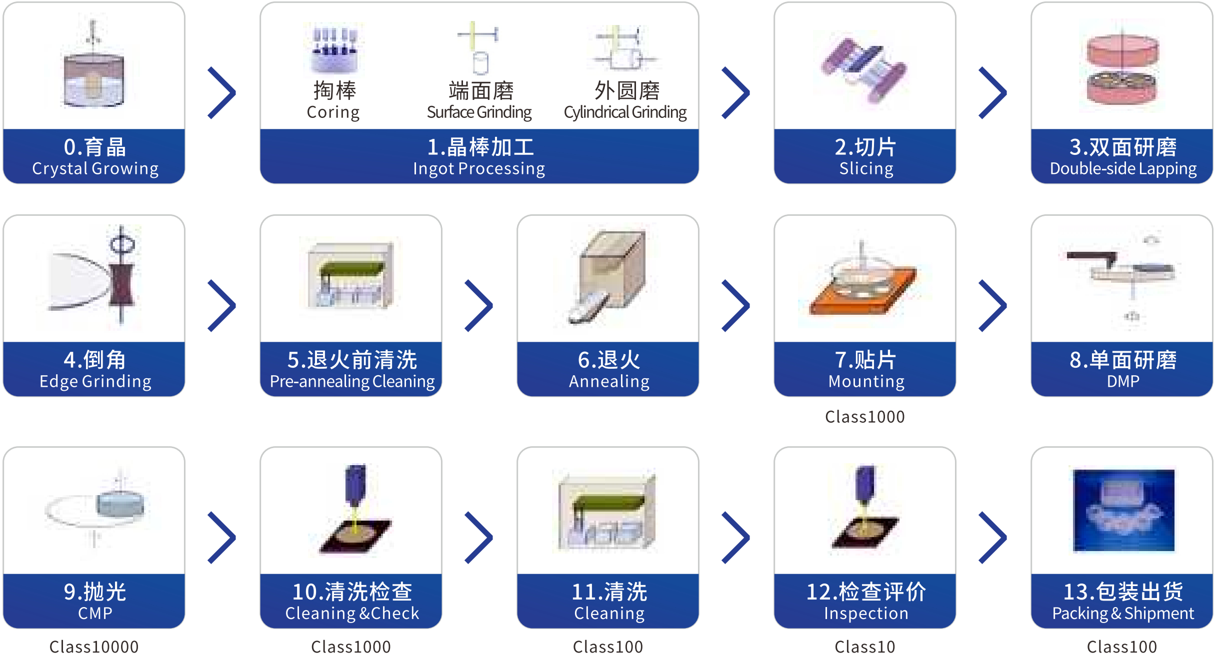
Sapphire Wafer Bonding

Sapphire has a broad application in the field of wafer bonding, not only limited to known fields, but also includes sensor manufacturing, biomedical applications, optical windows and lenses, high frequency devices and microwave integrated circuits, solar cells and composite reinforcement. With the progress of science and technology and the expansion of the market, the application will be more extensive and in-depth.

蓝宝石晶圆键合
Sapphire Wafer Bonding

工艺流程&生产设备

Process & Equipment



- 0.育晶 Crystal Growing
- 1.晶棒加工 Ingot Processing
  - 掏棒 Coring
  - 端面磨 Surface Grinding
  - 外圆磨 Cylindrical Grinding
- 2.切片 Slicing
- 3.双面研磨 Double-side Lapping
- 4.倒角 Edge Grinding
- 5.退火前清洗 Pre-annealing Cleaning
- 6.退火 Annealing
- 7.贴片 Mounting Class1000
- 8.单面研磨 DMP
- 9.抛光 CMP Class10000
- 10.清洗检查 Cleaning &Check Class1000
- 11.清洗 Cleaning Class100
- 12.检查评价 Inspection Class10
- 13.包装出货 Packing & Shipment Class100

蓝宝石衬底流程　Sapphire Substrate Process

长晶炉
Sapphire Crystal
Growing Furnance

双工位摇摆切割机
Double Station
Swing Cutting Machine

掏棒机
Ingot Coring Machine

切片机
Slicing Machine

双面研磨机
Double Sided
Lapping Machine

单面研磨机
Single-sided
Lapping Machine

抛光机
Polishing Machine

全反射荧光X射线
Total X-Ray Reflection
Fluorescence Analyzer

企业核心竞争力
Core Competence

技术优势 Technical Advantages

大尺寸晶体研发、量产能力 Large-size crystal R&D&MP capability

不同规格、形状晶棒可定制化能力 Customization capability for crystal ingots of different specifications and shapes

核心设备自制能力 Self-made core equipment

车间智能化 Intelligent Workshop

服务优势 Service Advantages

专属销售团队，确保送样快速、交付及时、沟通准确

产品可定制化，满足差异性需求

Exclusive sales team to ensure fast sample-delivery, product timely delivery and accurate communication.

Products can be customized to meet diverse requirements.

规模优势 Scale Advantages

完善的产业链布局(育晶-加工-衬底)

已形成较大规模的量产和扩产能力

Thorough industrial chain layout (crystal growth-ingot production-substrate production).

Large-scale mass production and expansion capability.

体系保障 System Guarantee

公司已先后通过：	Our qualifications
ISO9001质量管理体系认证	ISO9001 Quality Management System Certification
ISO14001环境管理体系认证	ISO14001 Environmental Management System Certification

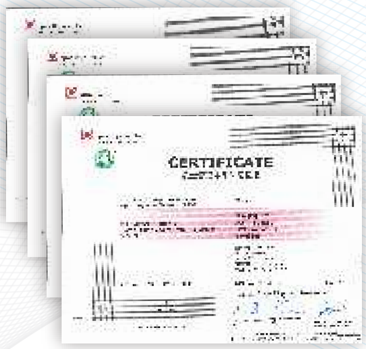
ISO45001职业健康安全管理体系认证

ISO45001 Occupational Health and Safety Management System Certification

ISO50001 能源管理体系认证 ISO5001 Energy Management System Certification

IATF16949汽车行业质量管理体系认证

IATF16949 Automotive Industry Quality Management System Certification



知识产权获得情况
Intellectual Property

合计 **84** 项
There are 84 in total

发明专利 21 项 “一种大尺寸蓝宝石晶体生长方法”等

21 invention patents, including "a method for growing large-sized sapphire crystals"

实用新型专利 32 项 “一种蓝宝石晶体的生长设备”等

32 utility model patents, including "a device for growing sapphire crystals"

外观设计 2 项 “蓝宝石导料管”、“蓝宝石光学棱镜”

2 design patents: "Sapphire Material Tube" and "Sapphire Optical Prism"

软件著作权 15 项 “蓝宝石自动化称重系统”等

15 software copyrights, including "Sapphire Automated Weighing System"

宁夏回族自治区科学技术成果登记证书

科技成果 14 项 100kg、110kg、130kg、160kg、400kg、720kg、直径600mm蓝宝石窗口材等

14 technological achievements, including 100kg, 110kg, 130kg, 160kg, 400kg, 720kg, 600mm diameter sapphire window materials, etc

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Yinchuan, Ningxia, China

天通智造　天通蓝宝石　线上商城