



# AIN Thin Film Substrate





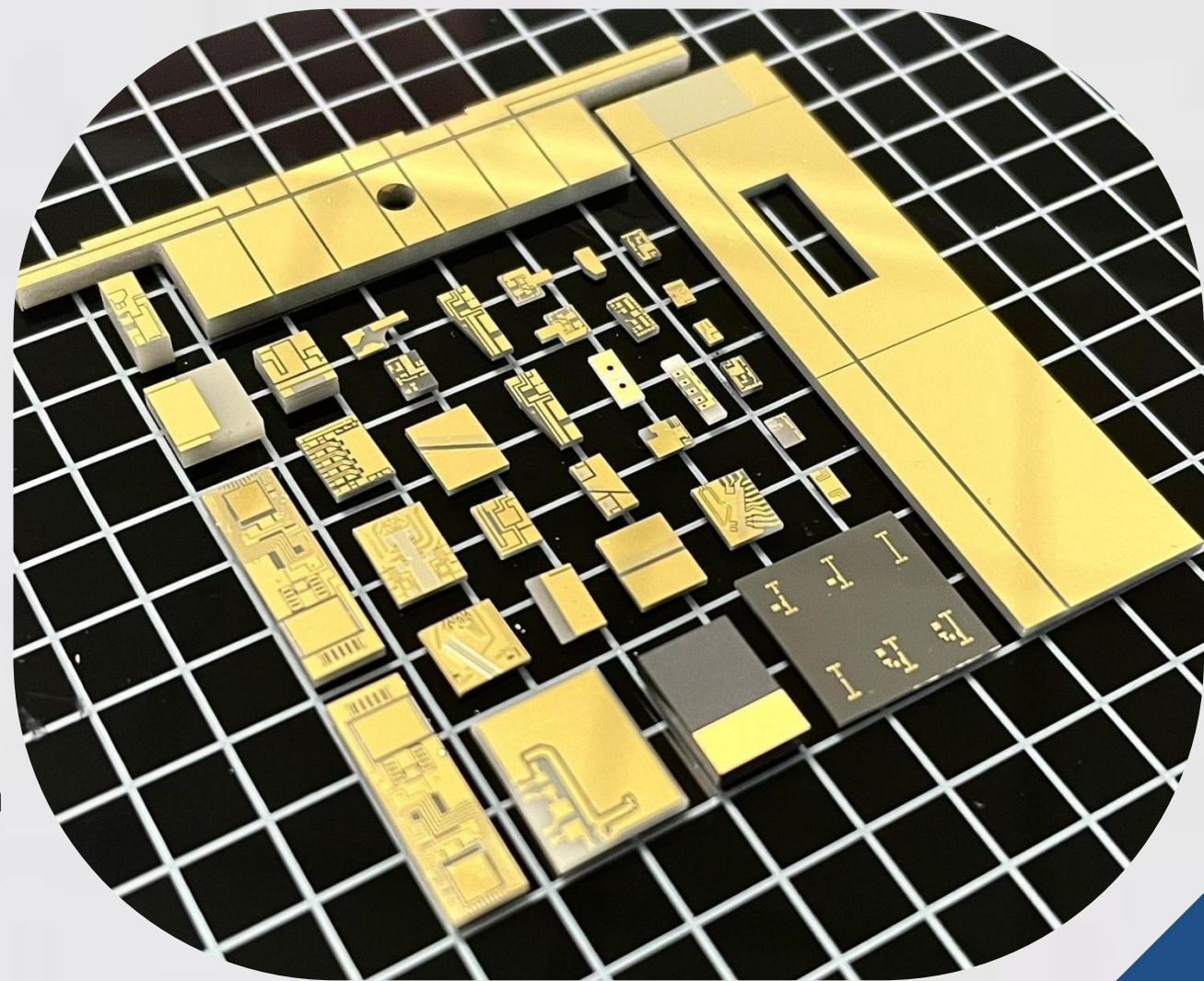
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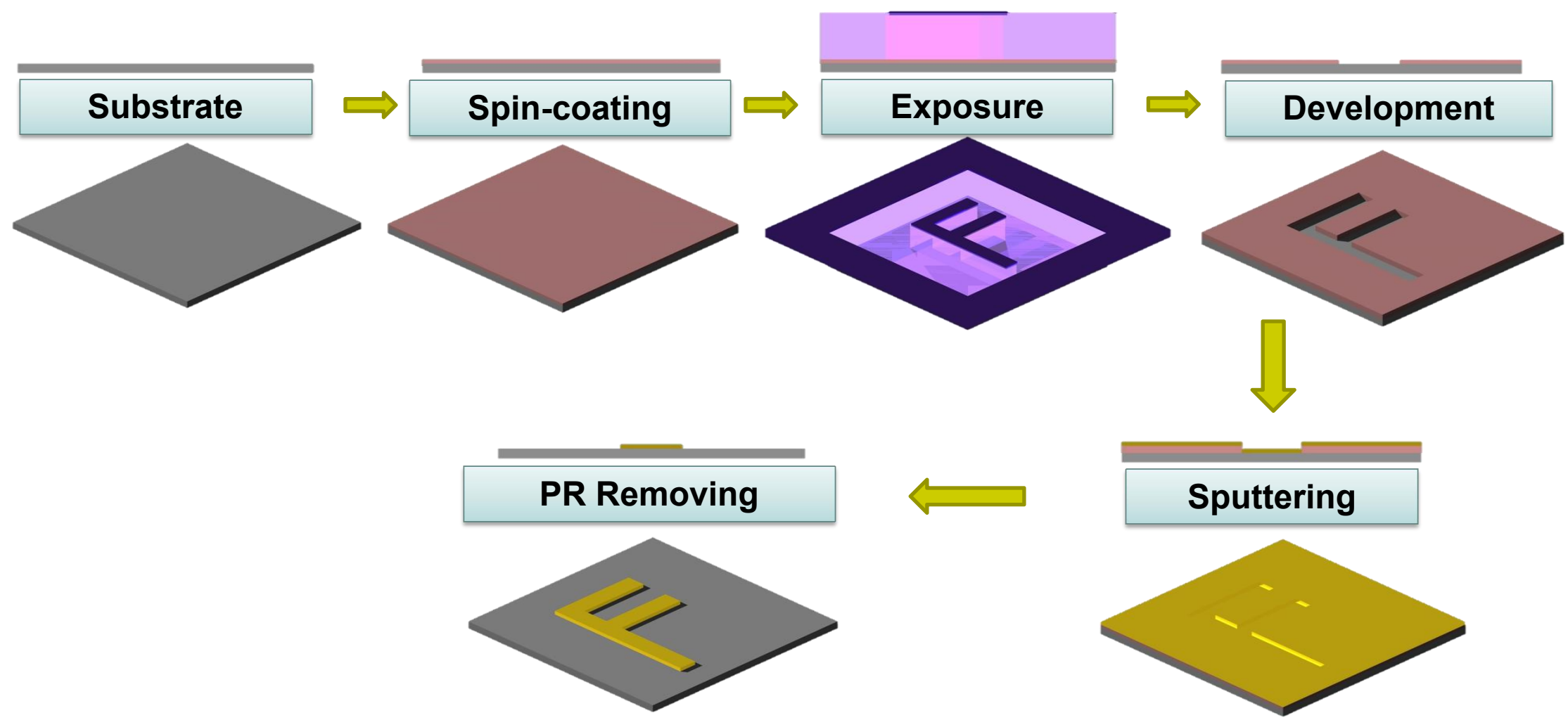
# 1. Introduction

★ ALN single-layer thin film substrates adopt Ti/Pt/Au metallization system, with prefabricated AuSn and TaN resistor, including through via metallization, side pattern metallization, special-shaped structure, etc.

★ ALN multi-layer ceramic substrate could realize thick film multi-layer wiring and three-dimensional interconnection structure, combining the advantages of thick film multi-layer wiring and thin film fine wiring.



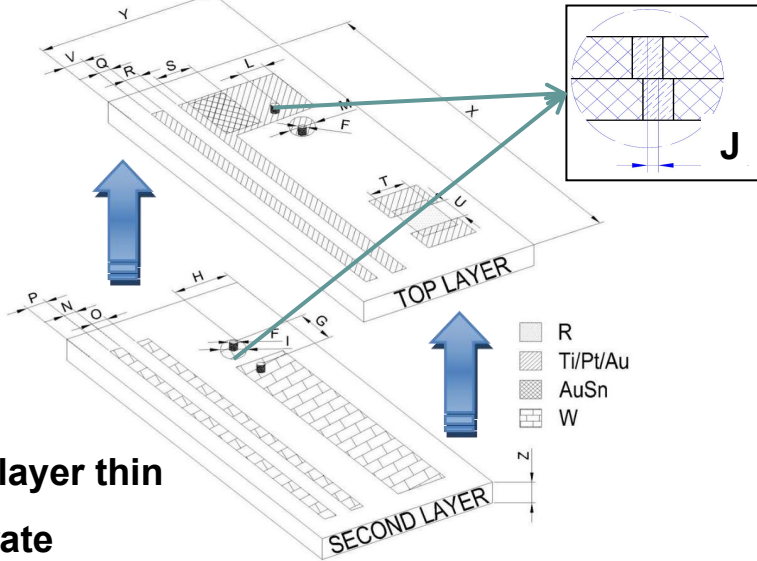
# Lift-off Process



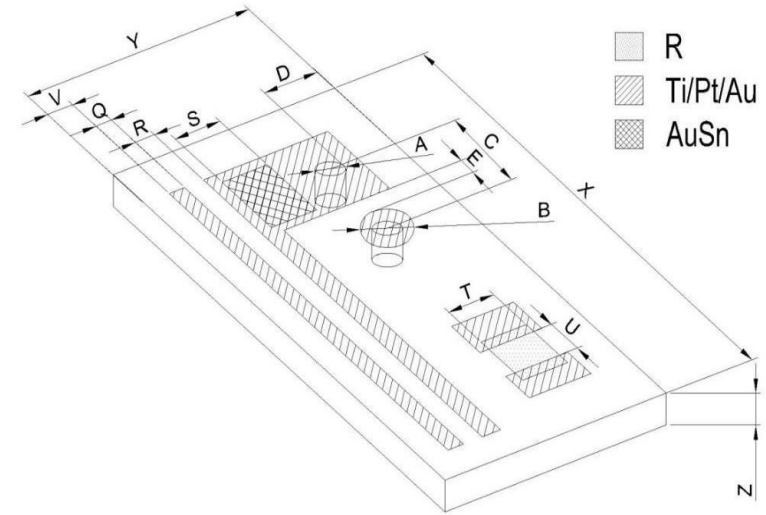
# Ceramic Material

PARAMETER		TEST CONDITION	UNIT	Al <sub>2</sub> O <sub>3</sub> 95% WHITE CERAMIC	Al <sub>2</sub> O <sub>3</sub> 99.6% WHITE CERAMIC	95% ALN
MECHANICAL	Volume Density	/	g/cm <sup>3</sup>	3.62	3.88	3.30
	Surface Roughness(Ra)	/	μm	≤0.60 (Grinding)	≤0.10(As-fired) ≤0.05(Polishing)	≤0.60(Grinding) ≤0.05(Polishing)
	Young's Modulus	/	GPa	≥279	≥372	≥280
	Bending Strength	/	MPa	≥430	≥592	≥400
THERMAL	CTE	RT-400°C	ppm/K	7.60	7.00	4.60
	Thermal Conductivity	20°C	W/m•K	21	26.9	170
ELECTRICAL	Dielectric Constant	f=1MHz	/	9.00	9.90	8.70
		f=10GHz	/	8.65	/	/
	Breakdown Strength	D.C.	KV/mm	≥28	≥18	≥15

# Design Rule



**ALN multi-layer thin film substrate**

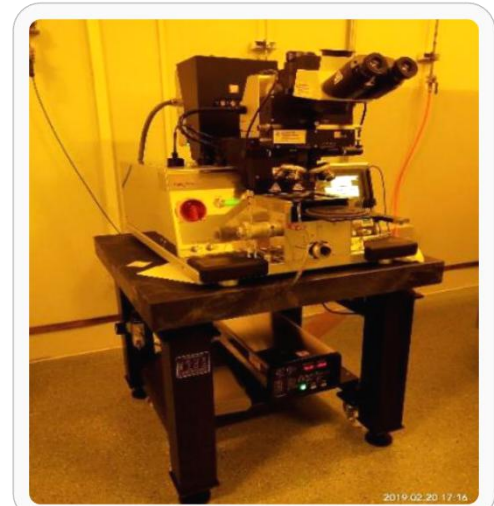


**Single-layer thin film substrate**

	Item	Mark	MP	R&D
W Filled Via	Via Diameter	F	0.10mm	0.075mm
	Via-to-Via Centerline	G	$\geq 3F$	/
	Via-to-Edge	H	$\geq 0.10\text{mm}$	/
	Position Error	J	$\pm 0.05$	$\pm 0.03$
	Space from Via Edge & Line Edge	L	$\geq 0.05\text{mm}$	/
Mid-Layer Metallization	Line Width	N	$\geq 0.15\text{mm}$	$\geq 0.10\text{mm}$
	Line Space	O	$\geq 0.15\text{mm}$	$\geq 0.10\text{mm}$
	Space from Edge (in mid-layer)	P	$\geq 0.05\text{mm}$	0


	Item	Item	MP	R&D	
Through Via	Via Diameter	A	$\geq 0.2\text{mm} \& \geq Z$ ( $Z \leq 1.0\text{mm}$ )	$\geq 0.15\text{mm} \& \geq Z$ ( $Z \leq 1.0\text{mm}$ )	
	Catch Pad Diameter	B	$\geq A + 0.2\text{mm}$ (单边0.1mm)	$\geq A + 0.1\text{mm}$ (单边0.05mm)	
	Via-to-Via Centerline	C	$\geq 3A \text{ mm}$	/	
	Via-to-Edge	D	$\geq 0.10\text{mm}$	/	
Metallization	Au layer	Line Width/ Line Space	Q/R	$\geq 0.02\text{mm}$	$\geq 0.015\text{mm}$
	AuSn Alloy	Line Width	S	$\geq 0.05\text{mm}$	$\geq 0.04\text{mm}$
	Resistor	Line Width/ Line Space	T/U	$\geq 0.10\text{mm}$	$\geq 0.05\text{mm}$
Cutting	Pull back	Top	V	$\geq 0.02\text{mm}$	$\geq 0.01\text{mm}$
		Bottom		$\geq 0.03\text{mm}$	$\geq 0.02\text{mm}$

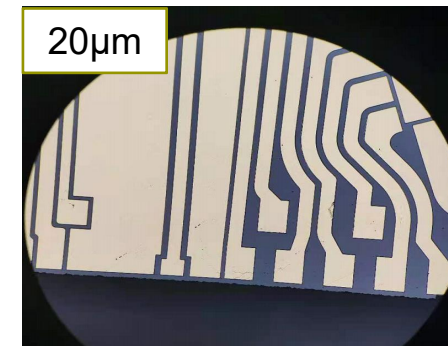
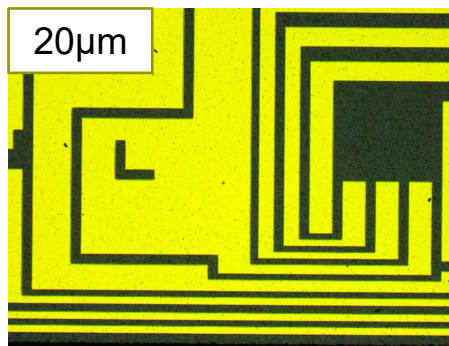
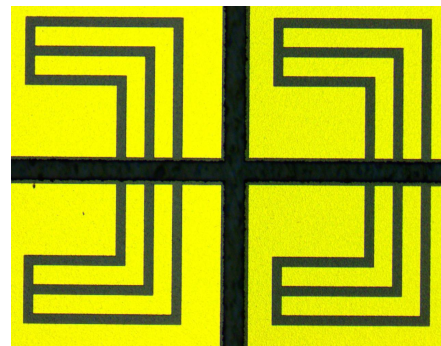
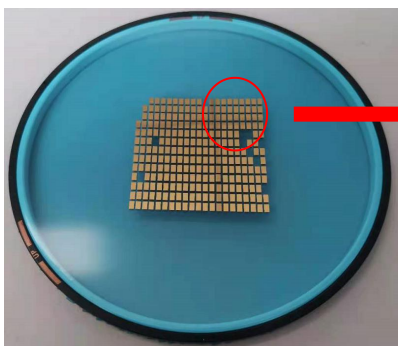
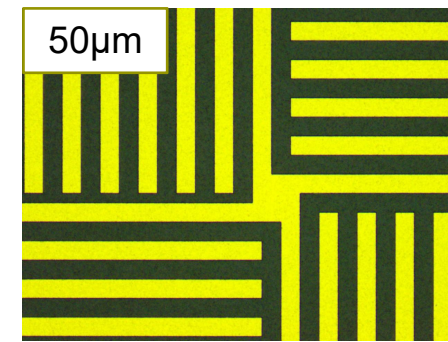
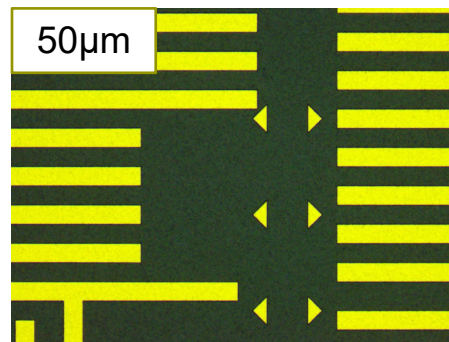
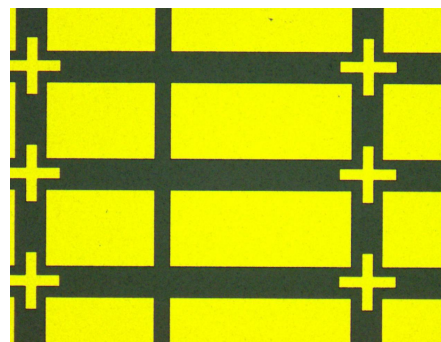
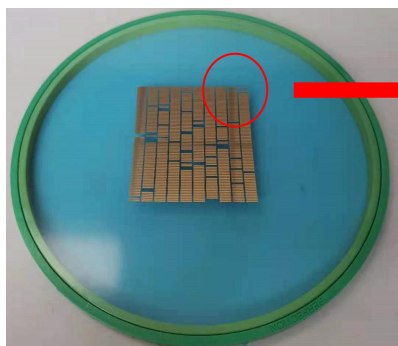
# Production Line



# 2 Product&Capability-Single-layer Au


 AuSn   Au   Pt   Ti   AlN

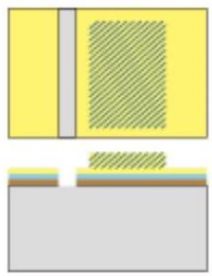
Type	Metallization	Suitable Material	Graphic	Y20 PO	Technical Specification
Single-layer Thin Film Substrate	Ti/Pt/Au	95% Al <sub>2</sub> O <sub>3</sub> 99.6% Al <sub>2</sub> O <sub>3</sub> ALN		1KK	Line Width/Line Space: 15μm(Min.) Thickness: 0.5μm~2.0μm (>2.0μm Electroplating) Wire Bonding: ≥6g @25um golden wire Ball Shear: Individual >21.1g; Average >30.8g Reliability: 320°C/3min in air, No discoloration, crack, blister

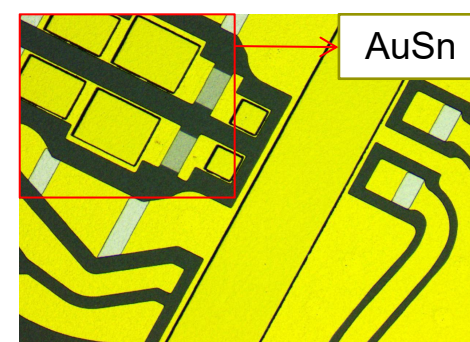
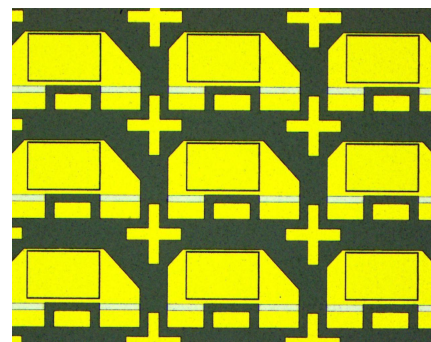
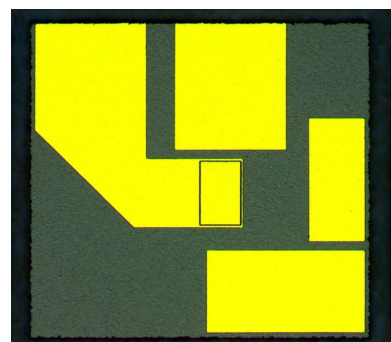
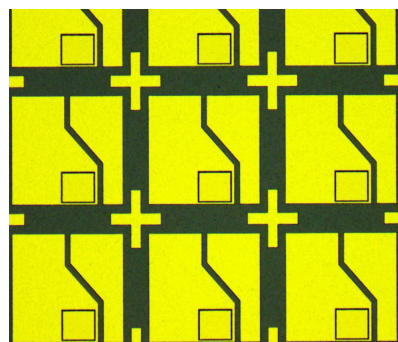
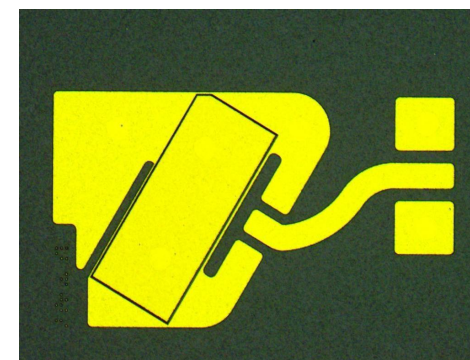
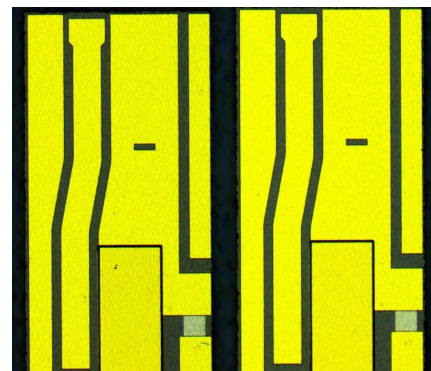
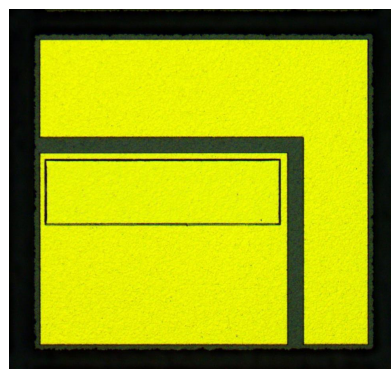
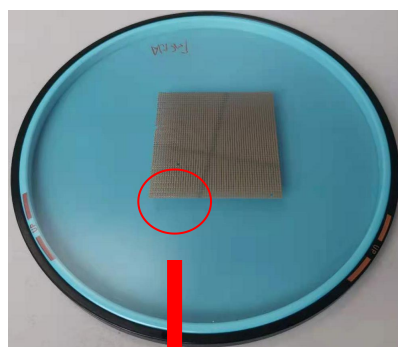




# 2 Product&Capability-Single-layer-AuSn

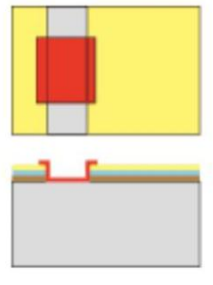

 AuSn Au Pt Ti AlN

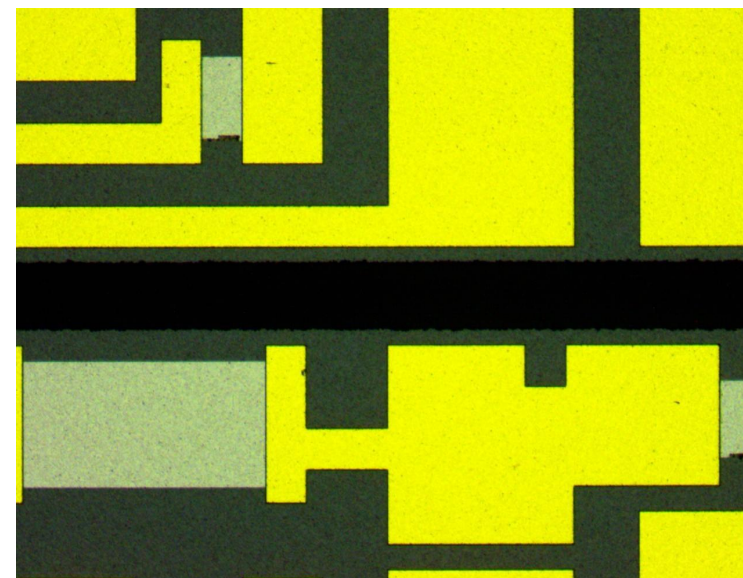
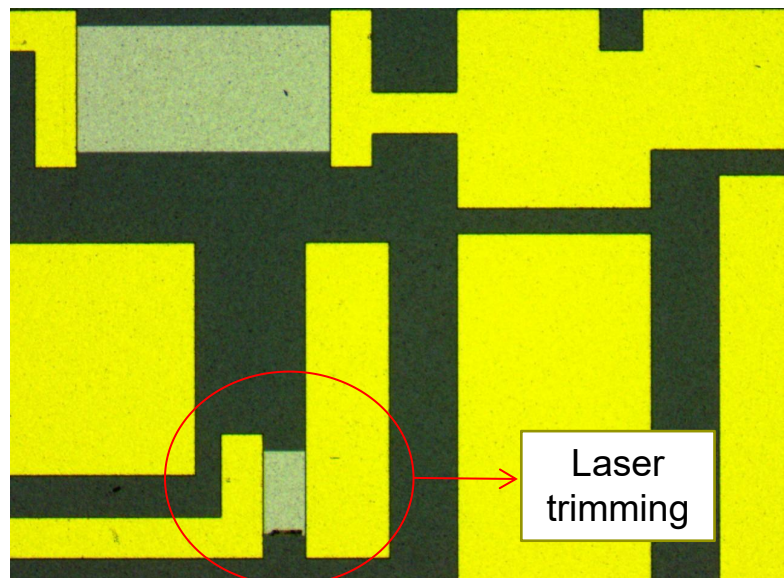
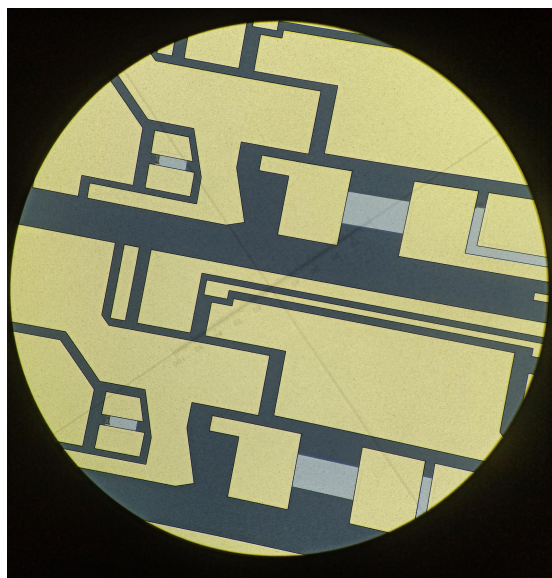
Type	Metallization	Suitable Material	Graphic	Y20 PO	Technical Specification
Single-layer Thin Film Substrate	Ti/Pt/Au+ Pt/AuSn	ALN		500K	Solder Composition: 75wt%(Typical)±5wt% Solder Thickness:3.0~6.0μm, Au surface barrier Melting Temperature: 300°C, 10s Holding Time: 320°C/90s



# 2 Product&Capability-Single-layer-TaN

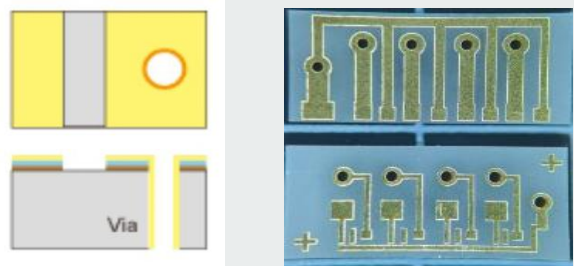
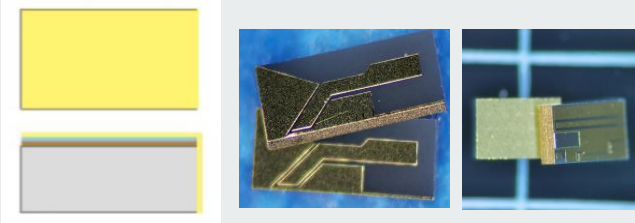
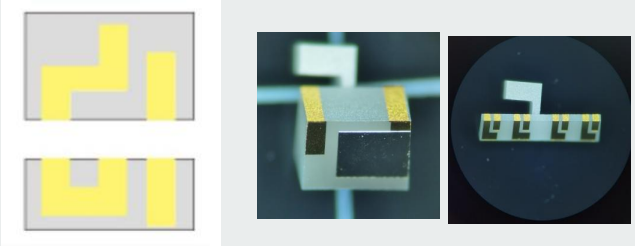
AuSn
  Au
  Pt
  Ti
  AlN

Type	Metallization	Suitable Material	Graphic	Y20 PO	Technical Specification
Single-layer Thin Film Substrate	TaN+Ti/Pt/Au	99.6% Al <sub>2</sub> O <sub>3</sub> ALN		200K	High temperature annealing treatment, ensuring stability of TaN Square Resistance: 25Ω/□、50Ω/□、100Ω/□ Tolerance: ±5% (Laser trimming)



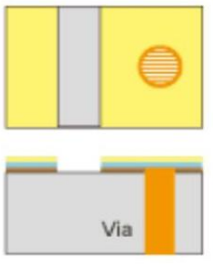
# 2 Product&Capability-Single-layer-Other

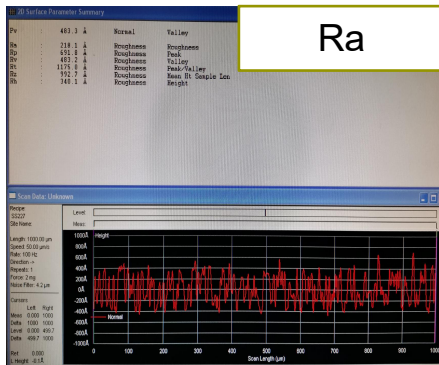
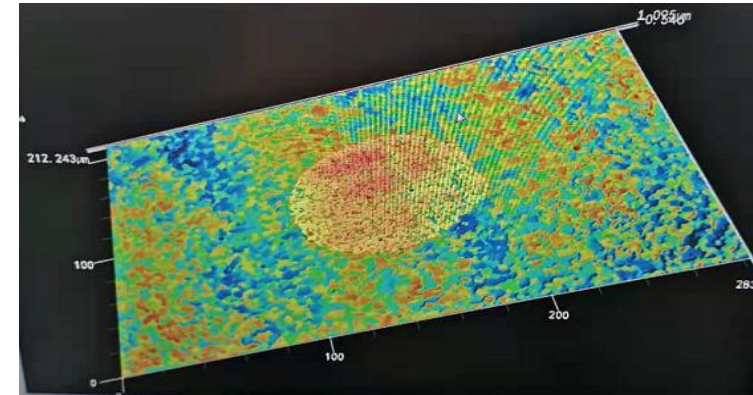
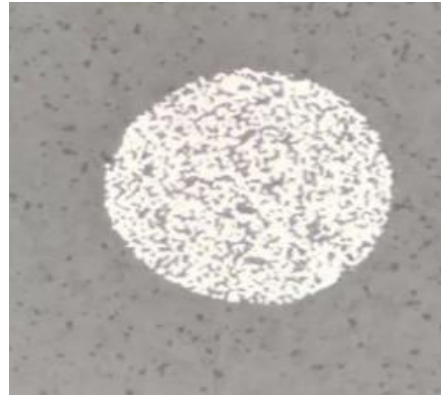
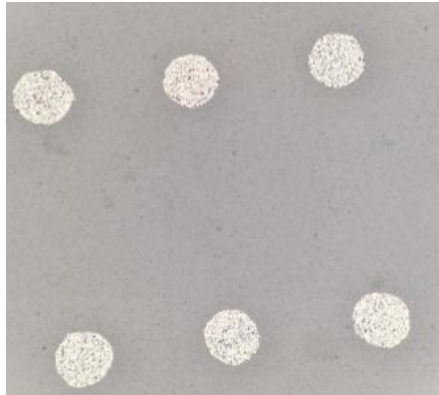


Type	Metallization	Suitable Material	Graphic	Y20 PO	Technical Specification
Through Via	Ti/Pt/Au	99.6% Al <sub>2</sub> O <sub>3</sub> ALN		100K	Diameter: 0.6XCeramic Thickness Tolerance: ±0.03mm Position Accuracy: ±0.015mm Surface Roughness(Ra): <0.05µm Reliability: 320°C/3min in air, No discoloration, crack, blister Ensure conduction of top and bottom
Side Metallization	Ti/Pt/Au	ALN		200K	Dimension Tolerance: ±0.03mm Surface Roughness(Ra): <0.05µm Single side/Double side gold plating Ensure conduction of top and bottom
Side Pattern Metallization	Ti/Pt/Au	99.6% Al <sub>2</sub> O <sub>3</sub> ALN		Small Batch Delivery	Top-Sde position deviation: ≤30µm Dimension of gold flanging: ≤50µm Conducting Resistance: ≤300mΩ Wire Bonding(Side Pattern): ≥6g @25um golden wire

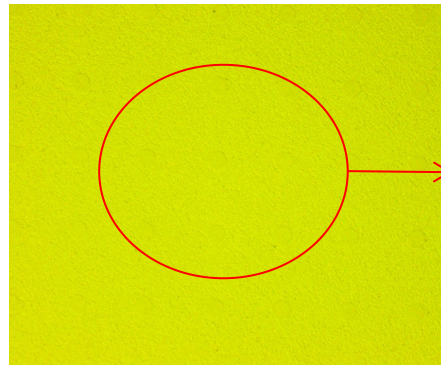
# 2 Product&Capability-Multi-layer



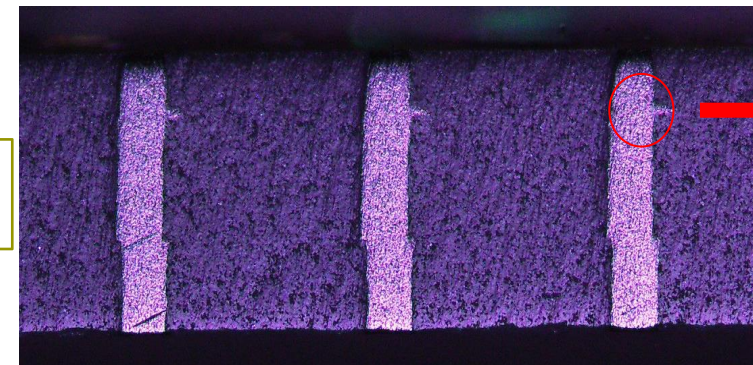
Type	Metallization	Suitable Material	Graphic	Y20 PO	Technical Specification
Multi-layer Thin Film Substrate	Mid-Layer&VIA: W Thin Film: TaN+Ti/Pt/Au+AuSn	ALN		Small Batch Delivery	W Filled Via: 75~100μm Height of VIA: ≤0.1μm Single-layer Ceramic Thickness: 0.10mm Surface Roughness(Ra): <0.05μm Graphic Alignment Accuracy: ±0.01mm



Ra

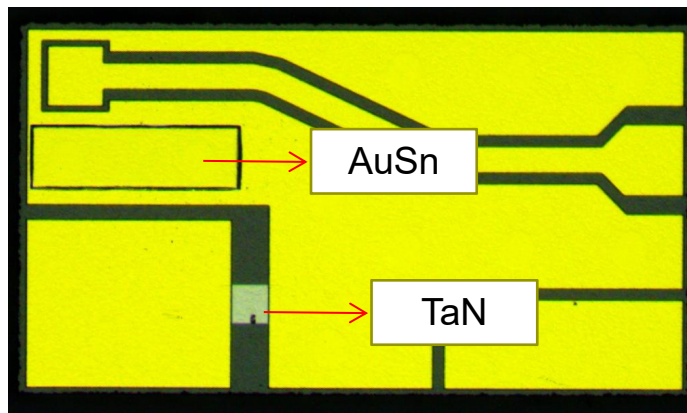
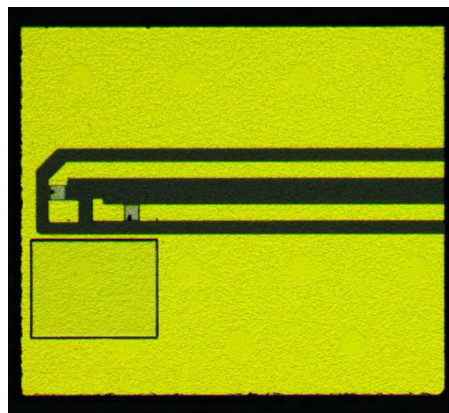
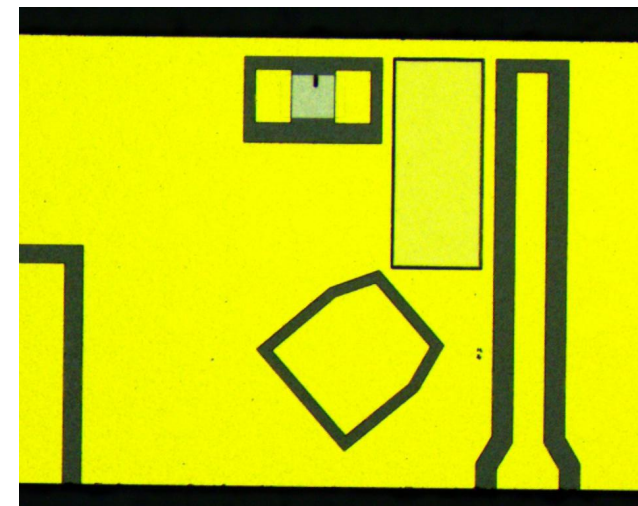
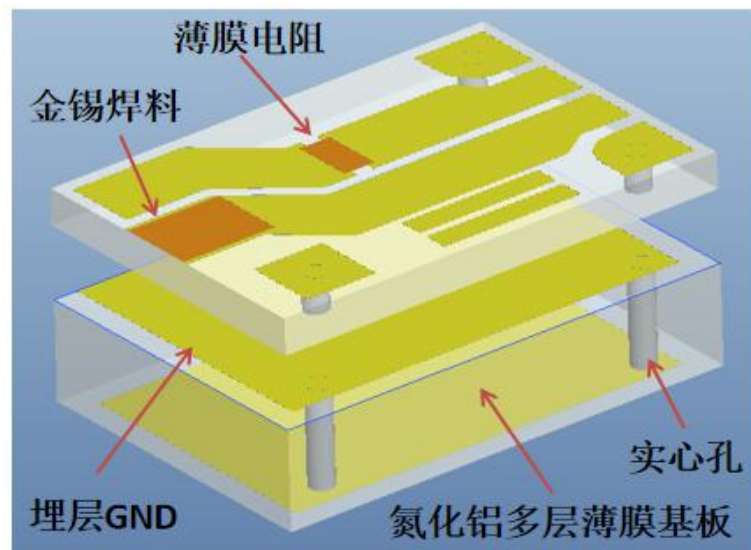
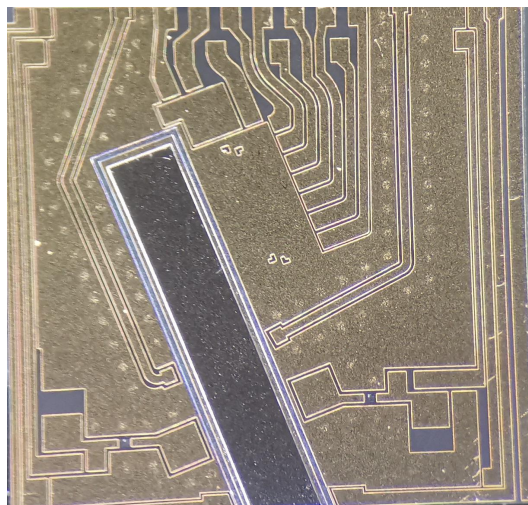
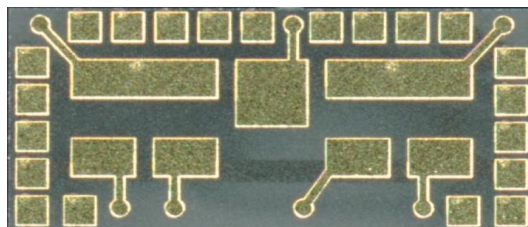
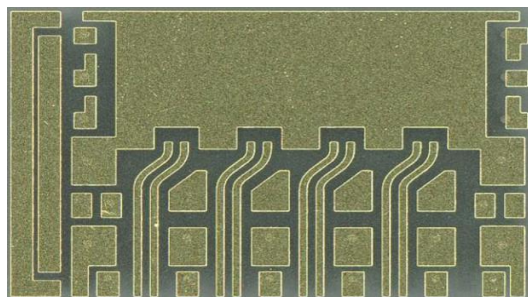


Filled VIA

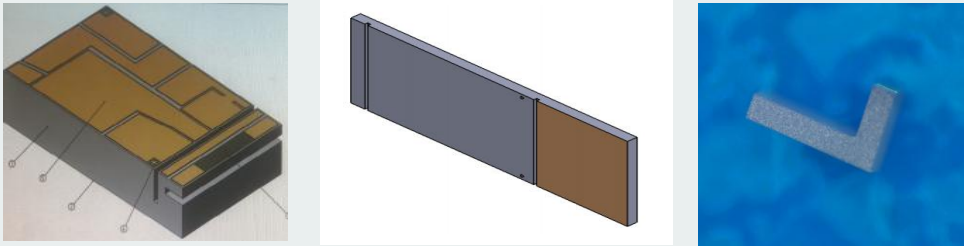
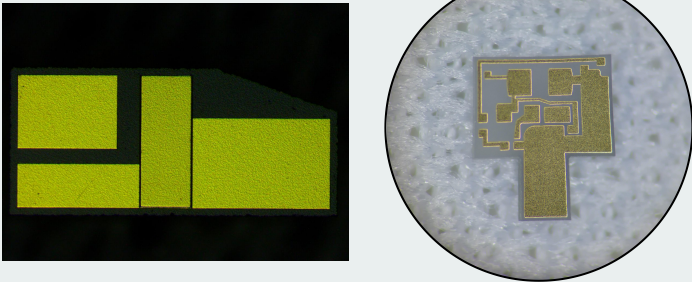



Hole Plate Structure

## 2 Product&Capability-Multi-layer



## 2 Product&Capability-Special-shaped Structure

Capability	Graphic	Technical Specification	
<p><b>Grooving &amp; Step</b></p>		<p><b>Groove</b>            Width: 0.10/0.20/0.30mm etc            Width Tolerance: <math>\pm 0.03\text{mm}</math>            Depth Tolerance: <math>\pm 0.05\text{mm}</math></p> <p><b>Step</b>            Depth Tolerance: <math>\pm 0.05\text{mm}</math></p>	
<p><b>Bevel&amp;L&amp;Arc Structure</b></p>		<p>Dimension Tolerance: <math>\pm 0.03\text{mm}</math>            Ceramic Thickness:            0.15~0.50 <math>\pm 0.02\text{mm}</math></p>	<p>Flatness <math>&lt; 0.01\text{mm}</math>            Parallelism <math>&lt; 0.02\text{mm}</math>            Roughness <math>&lt; 0.05\mu\text{m}</math></p>
<p><b>Cavity Structure</b></p>		<p>Dimension Tolerance:  <math>\pm 0.03\text{mm}</math>            Single-layer Cavity Size            Tolerance: <math>\pm 0.03\text{mm}</math>            Multi-layer Cavity Depth            Tolerance: <math>\pm 0.035\text{mm}</math></p>	

# 3 Quality Assurance

All Inspection Items were based on MIL-883

No.	Inspection Item	Inspection Equipment	Inspection level
1	Visual Inspection	OM	Full
2	Resistance	DVOM	Full
3	Dimension	Digital Caliper 3D Measuring Instrument	5(0)
4	Metallization Thickness	X-ray Tester/Step Tester	5(0)
5	AuSn Composition	X-ray Tester	5(0)
6	Quality of Gold Layer	Hot Plate	5(0)
7	Wire Bonding Strength	Wire-bond machine	5(0)
8	Conduction Performance	Flying needle test bench	According to Drawing Requirement
9	Insulation Performance	Flying needle test bench	According to Drawing Requirement

# 3 Quality Assurance



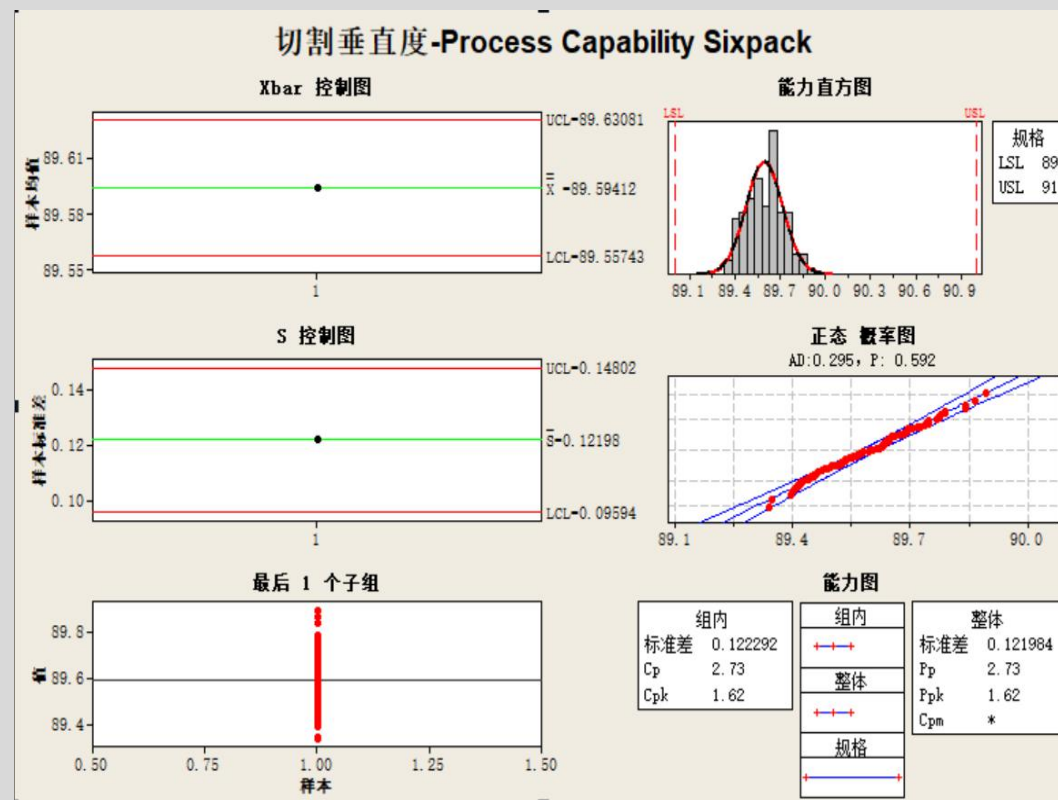
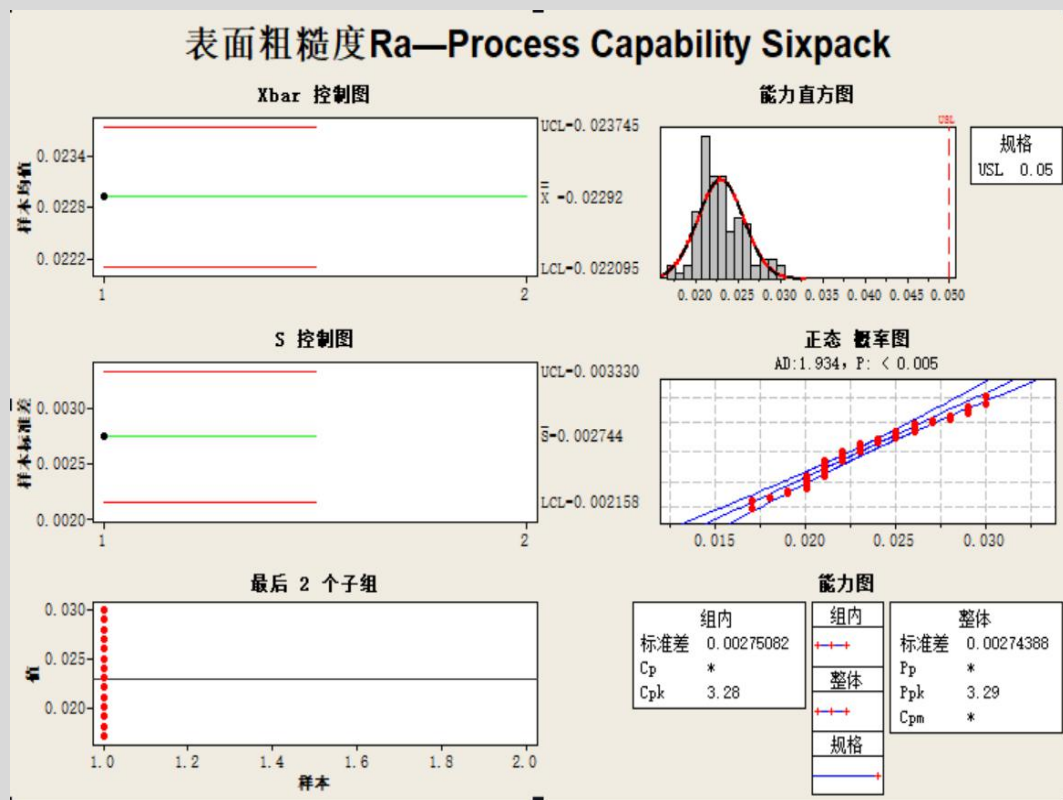


# 3 Quality Assurance-Process Control

## Process Control Ability, CPK > 1.33

➤ Roughness: Ra ≤ 0.05 μm

➤ Vertical Degree of Cutting: 90° ± 1°

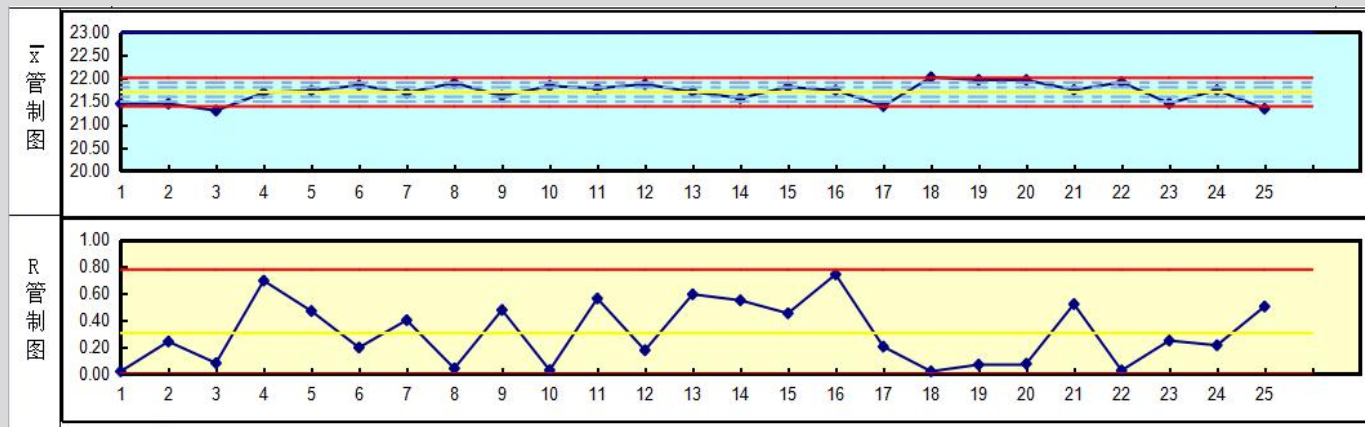


# 3 Quality Assurance-Process Control

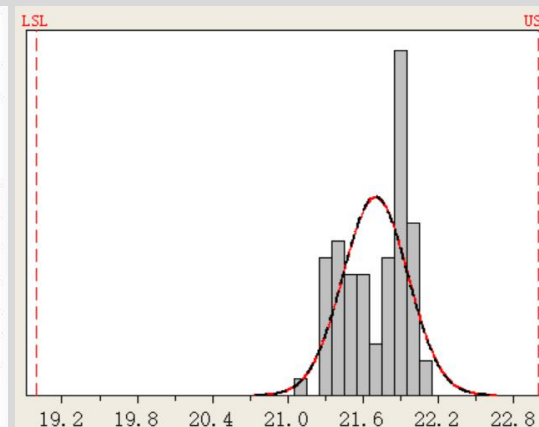
## Process Control Ability, CPK > 1.33

➤ Line Precision:  $\pm 5 \mu\text{m}$

20 $\mu\text{m}$  Line SPC

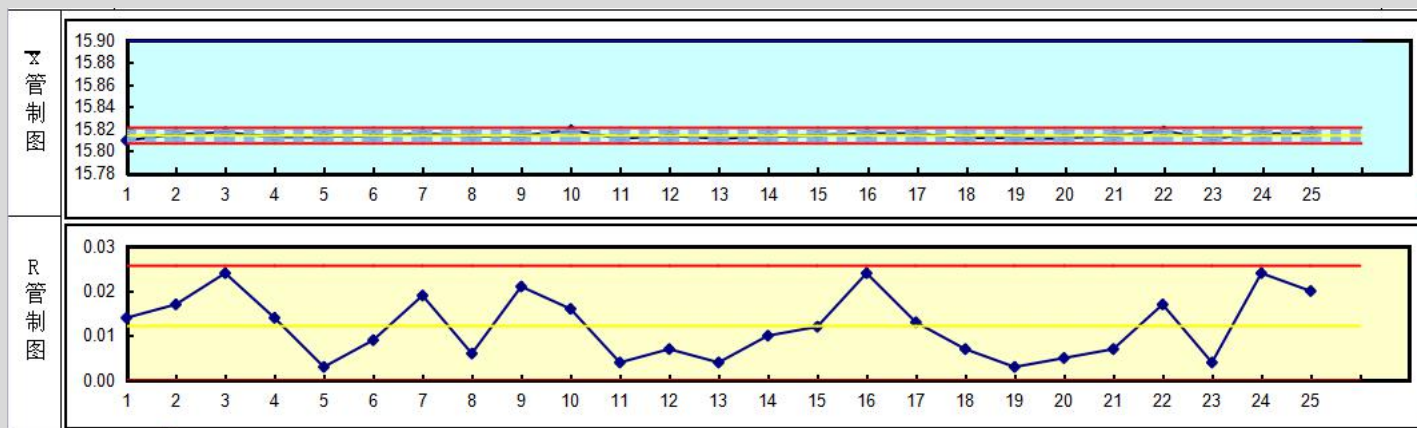


预估不良率 (PPM)	0
制程能力分析	
Std.Dev. =	0.260
Sigma =	0.179
P P K =	1.67
PP =	2.57
Ca =	0.3504
C P K =	2.42
CP =	3.72
Grade =	A

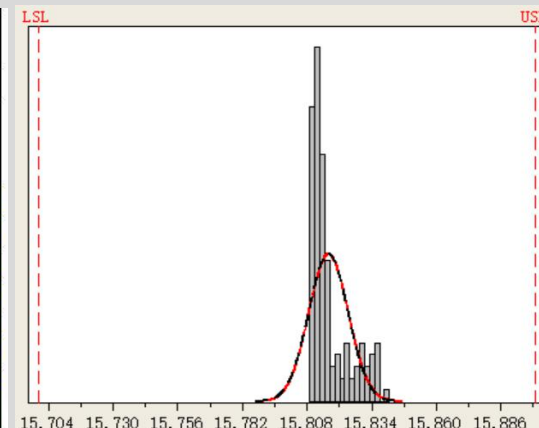


➤ Resistance Accuracy:  $\pm 5\%$

Resistance SPC



预估不良率 (PPM)	0
制程能力分析	
Std.Dev. =	0.006
Sigma =	0.005
P P K =	5.05
PP =	5.87
Ca =	0.1399
C P K =	5.49
CP =	6.39
Grade =	A

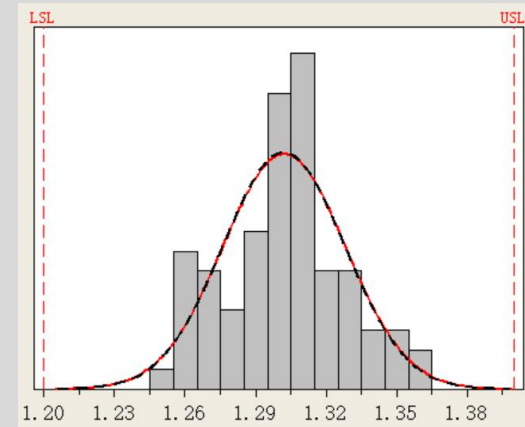
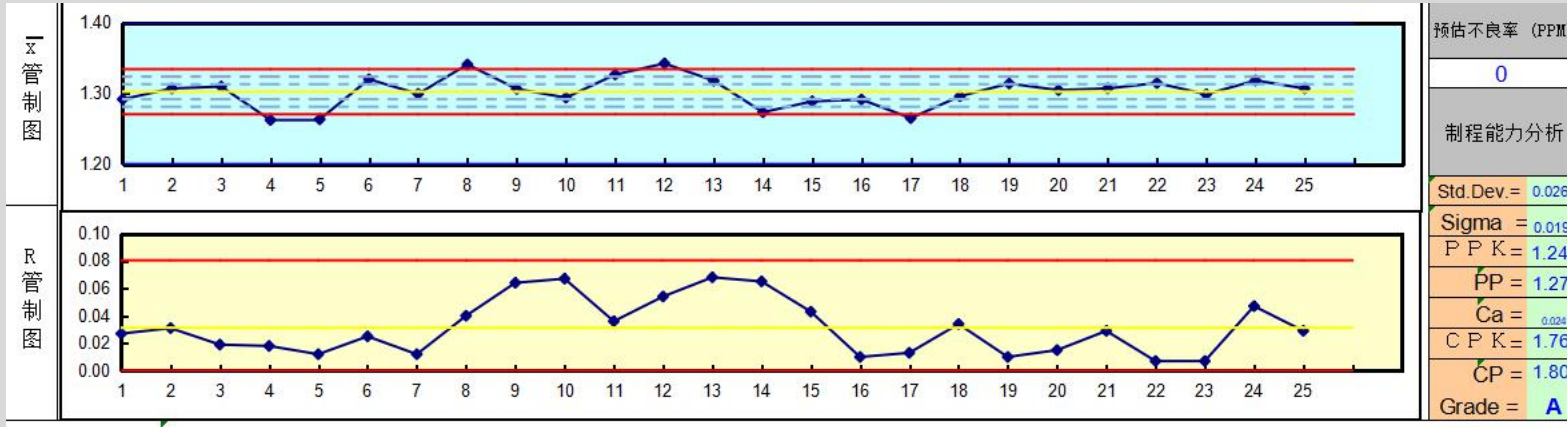


# 3 Quality Assurance-Process Control-Au

Process Control Ability, CPK > 1.33

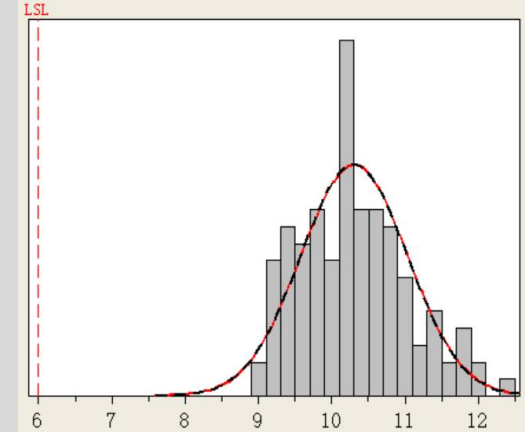
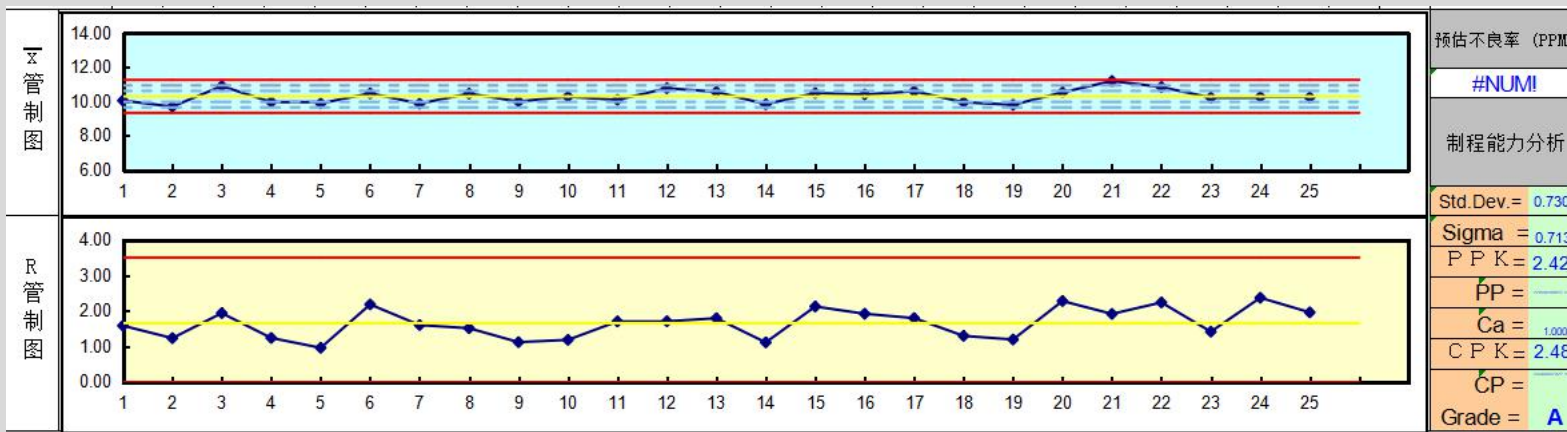
➤ Plating Thickness:  $\pm 20\%$

1.30 $\mu$ m SPC

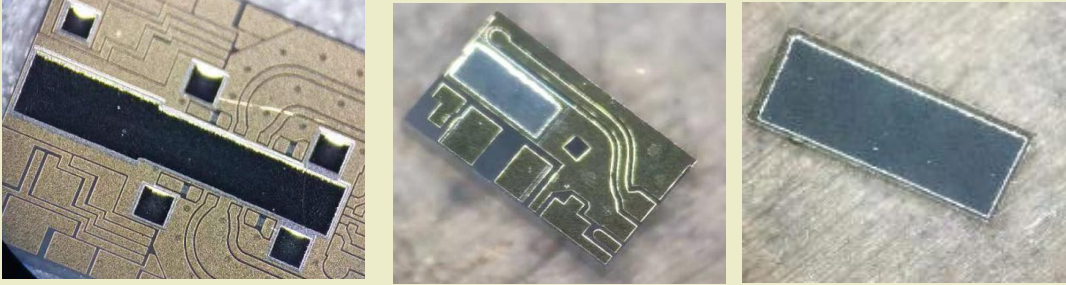
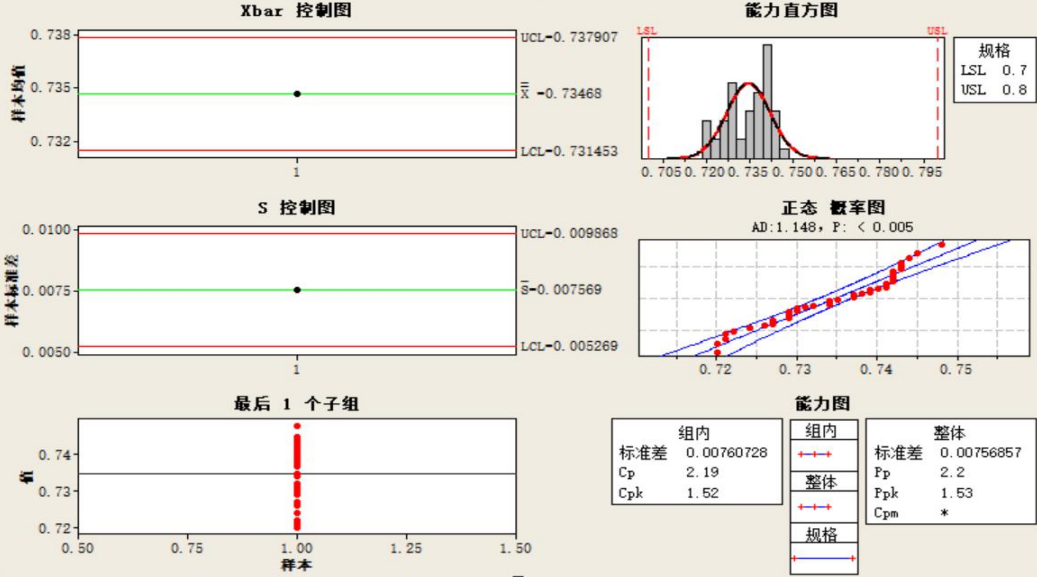


➤ Wire Bonding:  $\geq 6gf$  (25 $\mu$ m)

25 $\mu$ m Wire Strength SPC



# 3 Quality Assurance-Process Control-AuSn

AuSn	Inspection Equipment	Standard	Graphic																				
Appearance	OM	According to Inspection Standard																					
Composition	X-ray Tester	75 ± 5 wt%																					
Thickness	Step Tester	3~6μm																					
Melting State	High Temperature Microscope	Full and Bright	<p data-bbox="1574 711 2127 739">AuSn 的 Process Capability Sixpack</p>  <p data-bbox="1574 749 1694 763">Xbar 控制图</p> <p data-bbox="1592 942 1668 956">S 控制图</p> <p data-bbox="1567 1135 1694 1149">最后 1 个子组</p> <p data-bbox="2076 749 2178 763">能力直方图</p> <p data-bbox="2102 942 2229 956">正态 概率图</p> <p data-bbox="2127 1135 2178 1149">能力图</p> <table border="1" data-bbox="1949 1163 2369 1263"> <tr> <td>标准差</td> <td>0.00760728</td> <td>组内</td> <td>标准差</td> <td>0.00756857</td> </tr> <tr> <td>Cp</td> <td>2.19</td> <td>整体</td> <td>Pp</td> <td>2.2</td> </tr> <tr> <td>Cpk</td> <td>1.52</td> <td>规格</td> <td>Ppk</td> <td>1.53</td> </tr> <tr> <td></td> <td></td> <td></td> <td>Cpm</td> <td>*</td> </tr> </table>	标准差	0.00760728	组内	标准差	0.00756857	Cp	2.19	整体	Pp	2.2	Cpk	1.52	规格	Ppk	1.53				Cpm	*
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			Cpm	*																			
Holding time	High Temperature Microscope	320°C/40s(Single) 320°C/90s(Multiple)																					
Die Shear	Hot Plate	Shear Strength & Failure Mode Qualified																					

## 4 Storage&Handling

Packing Type	Model Specification	Suitable Product	Recommended Storage Condition
Gel Pack	5510(55-55-10) 8512(85-85-12) 12012(120-120-12)	R&D	Temperature: 20 - 25°C Humidity: 30-60% Environment : Area where does not effect activated gas (sulfurous acid gas etc) or dust are not enough. Storage Term: 6 months (If used after 6 months, visual inspection and functional testing are recommended)
Waffle Pack	2" OR 4"	R&D OR MP	
Blue Film&Wafer Frame	6"	R&D OR MP	

Product Application	Surface Cleaning (If Required)	Wire Bonding	AuSn Welding
Recommended Process Condition	Ar plasma cleaning	25µm Au Wire Ball OR Wedge welding	Temperature: 310°C~340°C Nitrogen Atmosphere Protection

