

4 point probe 四探针电阻测量仪 4D 280SI

1.0 仪器功能:

4 探针电阻测量仪主要用于测量薄膜的方阻。



2.0 样品材料要求

样品托盘可直接放置 8 寸圆片,小片(至少 1*1cm)需使用胶带粘到 6 寸圆盘上。 厚度<1 mm。

3.0 设备培训和参考资料

3.1 本设备需经过使用资格考核。3.2 考核方法

3.2.1 向平台工程师领取考核表,观摩一般用户或超级用户使用3次, 请一般用户签名,收集3个签名后,即可申请上机考核。



- 3.2.2 联系超级用户预约上机考核时间以及笔试。(注明:本设备为平台<u>1级设备</u>,所有已考核通过用户,使用时长超过 50h,都是超级用户。)
- 3.2.3 通过上机考核后,请超级用户在考核表上签名。
- 3.2.4 递回考核表,待使用权限开通。
- 3.3 培训考核周期:一周。

4.0 常用术语

- 4.1 LIMS: laboratory information management system.
- 4.2 Flat/Notch: 硅片平边或缺口。
- 4.3 Probe Head: 探针头

5.0 安全事项

6.0 技术规格

方块电阻测量范围: 0.001 Ω/sq ~ 800 K Ω/sq
精度(精密电阻): < 0.1%;
重复性(标准电阻): < 0.2%;

7.0 操作步骤

- 7.1 LIMS 登入设备,起算机时。
- 7.2 插上真空泵电源。

A Diagnostics



- 7.3 打开设备软件 , 登录账号, 用户名 user, 密码 user。(若手动测试, 请参考附录设备硬件中的手动操作模式)
- 7.4 检查设备前面板 EXT CONTR 灯是否点亮,点击主界面 Diagnostics Diagnostics

_____。检查电脑和设备是否通讯正常。

AN AND AND AND AND AND AND AND AND AND A	物质科学与技术学院 School of Physical Science and Technology	税物质微狗加工实验室 Soft Matter Nanofabrication Laboratory	
--	--	--	--

2	Company Name Model Number Software Version	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6	Temperature Compensation SPC Option Probe Status	: NO : YES : Ready	
	Current User	: su	Program Description	: Diagnostics Menu	
	Current User	: su RS232 initialize passed; proceed	to select options.	: Diagnostics Menu	Display Machine Status Test front panel switches Test stepper motors Make a measurement Wafer P/N Type Analysis Reserved
					E <u>x</u> it

显示 Passed,则OK。显示 failed,则需再次检查,通讯线是否脱落,EXT CONTR 灯是否亮起,样品台是否处于 HOME 位置,不是按 RESET 键重置到 HOME 位置。

7.5 编辑 Process。(根据实际需求,此步可跳过)

点击 Edit Process/Add a New Process/输入 Proces 的名称,请以<mark>样品材质-课题</mark> 组命名/选择测试类型(测试类型的介绍详见附录)。

		Utilities	Testing		Company Name : LUVA SYSTEM	Temperature Compensation	: NO	
					Model Number : Auto Four-point Probe 200 SI	SPC Option	: YES	
	Contraction of the local distance of the loc	1 Machine Configuration	6 1pt, 5pts, 9pts, ASTM & Dia Scan		Software Version : 5.3R6			
					Current User : su	Program Description	: Process Edit Menu	
		2 Password Utilities	7 Cartesian, Circular & Custom Site Man					
e e			*					2
								Add New Process
Contraction of the second second		<u>1</u> Edit Process 1	<u>B</u> Temperature Coefficient		Input Process Informa	don 💌	5 1	
	1000				Enter a process name you	a wart to add : OK		Edit Process
and the second second	1990 L. 16	4 Database Utilities	9 Reserved			Cancel		
and the second second	and the second sec							Delete Process
					(uplo 16 cherecters with)	io space in beli-seen)		
		5 Additional File Utilities	10 Water P/N Type Test			3		Edit Old Process With
								New Name
		Diagnostics	Data Analysis		(人) カイト まい	124 FT 114 CE 198 FT		
					1个词 m Aprocess 名称, 请以	杆面材 庾-诛彘	觊组命名	
		A Diagnostics	E Trend Report					
		B. Prohe Beneatability	G SECS-II Communication					
		2 · · · · · · · · · · · · · · · · · · ·						
		C Temperature Compensation	H Statistical Process Control					
		D Probe Head Correction Test	I Reserved					
		E Advanced Disgnantic Preasant	L Additional Programs					
		E Mavalicea Diagliostic Program	2 Additional Programs					
E E		1						
About	Show System Info		Express Start Exit					
								Egit
				A				





Company Name Model Number Software Version	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6	Temperature Compensation SPC Option	: NO : YES	
Current User	: su	Program Description	: Select Measurement	Гуре
		选择》	则试类型	Select Test Type 1 Point Test 5 Points Test Diameter Scan Test Cartesian Map Test 4 9 Points Test ASTM/Semi X Test Circular Map Test Custom Sites Test
				Exit

然后弹出 6 个具体的测试界面。依次设置每个界面的主要参数: P/N 类型, 膜厚度, wafer 尺寸, 测量间距等数据, 输入完成后可预览测试 (Preview) 的 点的分布。确认无误后点击 OK 保存。

Company Name : LUVA SYSTEM Model Number : Auto Four-point Pro Software Version : 5.3R6 Current User : su	Temperatu obe 280 SI SPC Option Program Di	re Compensation : NO : YES escription : Set Proces	s Parameters
Enter the process definition in the box Edit Process : 12	xes provided from Page 1 to 1 Measurement Typ Page 3 Page 4	Page 6 : ne:Circular pattern test Page 5 Page	Preview
FIXED Layer Type : 选择P/N型	N	Type	Print Set Skip List
FIXED J Layer Thickness / Re 膜层厚度,用	sistivity: <mark>0.1</mark>]来计算电阻率	Micron	Set Leak Sites
FIXED Ind. Site Thickness E 是否每个点的	dit: NO 的膜层厚度重新输入		
FIXED Lower Specification I 数据SPC分析	.imit: <mark>0</mark> 下限	Ohm/sq	
FIXED Upper Specification I 数据SPC分析	imit: 200000 上限	Ohm/sq	
FIXED Lower Data Plotting I 数据画图下图	.imit : 0	Ohm/sq	
FIXED Upper Data Plotting I 数据画图上附	.imit : 200000	Ohm/sq	
		Q	K <u>C</u> ancel

Company Name Model Number Software Version Current User	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	Temperature Compensation SPC Option Program Description	: NO : YES : Set Process Parameters	
Enter the process defi Edit Process : 12	nition in the boxes provide	d from Page 1 to Page 6 : Measurement Type : Circular pattern	test	Preview
Page <u>1</u>	Page <u>2</u> Page <u>3</u>	Page <u>4</u> Page <u>5</u>	Page <u>6</u>	Drint
OPTIONAL -	Operator Name :			r fint
OPTIONAL -	Fab Name :			S <u>e</u> t Skip Lis
OPTIONAL 💌	Lot Identification :			<u>S</u> et Leak Site
OPTIONAL -	Equipment Information :			
	Device Number :			
FIXED •	Probe Head Serial No. :			
FIXED 🗾	Probe Head Type: 值写Probe探头类型:	A/B		
FIXED 💌	Probe Head Selection :	Not Available		
FIXED -	Probe Head Correction Factor: 固定探头法冲田子	1 武平开松头轻难扫序白云		
FIXED -	县与休大仪在凶丁, Probe Pin Spacing:	以 <u>有从休天仅</u> 在住户日4 1 mm	小与八	
			<u>Ω</u> K	<u>C</u> ancel
Company Name	: LUVA SYSTEM	Temperature Compensation	: NO	
Model Number	: Auto Four-point Probe 280 SI	SPC Option	: YES	
SURWARE VERSION	. 5.510			

Edit Process : 12		_	Measurement Ty	e : Circular patter	m test	Preview
Page <u>1</u>	Page <u>2</u>	Page 3	Page <u>4</u>	Page <u>5</u>	Page <u>6</u>	
FIXED _] Wafer Size : 硅片尺、	⁺ 100 125 150	(<u>for rectangular v</u> 150) 200,特殊尺	^{afer, type W × H} m 寸请按照W	, m VxH输入	P <u>r</u> int S <u>e</u> t Skip List
OMIT] Flat / Notch V 硅片形料	Vafer : 犬	NOTCH	<u> </u>		Set Leak Sites
FIXED _	Max Test Dia	imeter: 昌古久 蛋L	(for rectangular)	mi	m	
FIXED •	取入侧 Mask Circle I	里.且.仁,而レ Diameter :		少小omm 	m	
FIXED •	Number of Te	est Points :	(for rectangular) 65	wafer, type W x H ▼ po	a) bints	
FIXED -	Gain Control	:	AUTO	×		
FIXED	Geometric Co	prrection :	OFF	• (Er	nter Correction Factor above)	
					<u>o</u> ĸ	Cancel

-	HA	1 A	
1	-	-	\$
HANO	2013	Je	
414	Team	UNIN	/

物质科学与技术学院 School of Physical Science and Technology Soft Matter Nanofabrication Laboratory Company Name : LUVA SYSTEM Model Number : Auto Four-point Probe 280 SI SPC Option : YES

	Model Number	: Auto Four-point Probe 280 SI	SPC Option	:Y	ES	
	Software Version Current User	: 5.3R6 : su	Program Descriptio	in :Si	et Process Parameter	s
Pate	the process def	Finition in the boxes provide	d from Page 1 to Page 6			
Edit	Process:12	finition in the boxes provide	Measurement Type : Circu	: ilar pattern tes	at	Preview
	Page <u>1</u>	Page 2 Page 3	Page 4 F	Page <u>5</u>	Page <u>6</u>	
						Print
	OMIT 🗾	Edge Compensation :	OFF	<u>~</u>		
						S <u>e</u> t Skip List
	FIXED 💌	Temperature Compensation :	OFF	Ŧ		Set Leak Sites
1	EIVED -	Data Pre-cort Limit :	(0-15, 0=disable)			
		数据初筛选, 偏离中	心值名小的丰掉	70		
		X1/11/11/11/22, /两闪 11	(0-6. 0=disable)			
[FIXED -	Data Sorting Limit :	3	Sigma		
		数据筛选正态分布区	间			
1	FIXED V	Save Data on Disk :	YES	-		
		自动保存测试数据	1			
	FIXED 💌	Autodraw Contour Map:	YES	•		
		母 (次测试元,是省目	切曲图			
					04	
					ŪK	Gancer
	Company Name	: LUVA SYSTEM	Temperature Comp	ensation : N	10	
2	Company Name Model Number Software Version	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6	Temperature Comp SPC Option	ensation : N : Y	10 'ES	
2	Company Name Model Number Software Version Current User	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	Temperature Comp SPC Option Program Descriptic	pensation : N יץ	10 'ES iet Process Paramete	'S
Ente	Company Name Model Number Software Version Current User	:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su Einition in the boxes provide	Temperature Comp SPC Option Program Descriptio ed from Page 1 to Page 6	orensation : N : Y on : S :	10 'ES iet Process Paramete	'S
Ente	Company Name Model Number Software Version Current User Process : 12	:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su Finition in the boxes provid	Temperature Comp SPC Option Program Descriptio ed from Page 1 to Page 6 Measurement Type : Circo	on : S ular pattern tes	10 'ES et Process Paramete st	rs <u>P</u> review
Ente	Company Name Model Number Software Version Current User er the process def Process : 12 Page 1	:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su finition in the boxes provide Page 2 Page 3	Temperature Comp SPC Option Program Descriptio ed from Page 1 to Page 6 Measurement Type : Circo Page <u>4</u> [F	Densation : N : Y Don : S : ular pattern tes Page 5	10 TES tet Process Paramete st <u>Page 6</u>	Preview
Ente	Company Name Model Number Software Version Current User ar the process def Process : 12 Page 1	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su Finition in the boxes provide Page 2 Page 3 Contour Map Auto Print :	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circo Page 4	ensation : N : Y on : S : ular pattern te: Page 5	IO 'ES et Process Paramete st <u>Page 6</u>	rs Preview Print
Ente	Company Name Model Number Software Version Current User er the process def Process : 12 Page 1 FIXED	:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su Finition in the boxes provid Page 2 Page 3 Contour Map Auto Print: 是否打印,未配打印	Temperature Comp SPC Option Program Descriptio ed from Page 1 to Page 6 Measurement Type : Circu Page <u>4</u> No 机,选No	eensation : N : Y on : S : ular pattern te: Page 5	IO /ES et Process Paramete st Page <u>6</u>	rs Preview Print Sgt Skip List
Ente	Company Name Model Number Software Version Current User er the process def Process : 12 Page 1 FIXED	:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su Efinition in the boxes provide Page 2 Page 3 Contour Map Auto Print: 是否打印,未配打印 First Point Auto Range :	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circu Page <u>4</u> No 机,选NO	eensation : N : Y on : S : ular pattern te: Page 5	10 TES set Process Paramete st Page <u>6</u>	rs Preview Print Sgt Skip List
Ente	Company Name Model Number Software Version Current User Process : 12 Page 1 FIXED GMIT	:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su finition in the boxes provide Page 2 Page 3 Contour Map Auto Print : 是否打印,未配打印 First Point Auto Range :	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circu Page <u>4</u> No 机,选No AUTO	vensation : N : Y on : S : ular pattern te: Page 5 V	10 TES set Process Paramete st <u>Page <u>6</u></u>	S Preview Print Sgt Skip List Set Leak Sites
Ente	Company Name Model Number Software Version Current User ar the process def Process : 12 Page 1 FIXED MIT FIXED FIXED FIXED	:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su finition in the boxes provid Page 2 Page 3 Contour Map Auto Print : 是否打印,未配打印 First Point Auto Range : Contour Interval :	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circl Page 4 No 机,选NO 和J,选NO AUTO (AUTO or a number of %)	rensation : N : Y on : S : ular pattern te: Page 5 V V %	IO 'ES et Process Paramete st <u>Page 6</u>	rs Preview Print Sgt Skip List Set Leak Sites
Ente	Company Name Model Number Software Version Current User er the process def Process : 12 Page 1 FIXED F	:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su Finition in the boxes provid Page 2 Page 3 Contour Map Auto Print : 是否打印,未配打印 First Point Auto Range : Contour Interval : 等高线间隔,画图射	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circo Page 4 No 机,选No 机,选No AUTO (AUTO or a number of \$) 1 文件也可以再次修己	rensation : N : Y on : S : ular pattern te: Page 5 Y %	io /ES et Process Paramete st Page <u>6</u>	rs Preview Print Sgt Skip List Set Leak Sites
Ente	Company Name Model Number Software Version Current User er the process def Process : 12 Page 1 FIXED	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su Einition in the boxes provide Page 2 Page 3 Contour Map Auto Print: 是否打印,未配打印 First Point Auto Range : Contour Interval : 等高线间隔,画图射 Carrier Density Calculation :	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circu Page 4 [F No 机,选No 和,选No [AUTO (AUTO or a number of \$) [1 文件也可以再次修己 [ON]	rensation : N : Y on : S : ular pattern te: Page 5 文 文	IO /ES et Process Paramete st Page <u>6</u>	rs Preview Print Sgt Skip List Set Leak Sites
Ente	Company Name Model Number Software Version Current User er the process def Process : 12 Page 1 FIXED	:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su Einition in the boxes provide Page 2 Page 3 Contour Map Auto Print: 是否打印,未配打印 First Point Auto Range : Contour Interval : 等高线间隔,画图射 Carrier Density Calculation : 载流子浓度计算,厚	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circu Page 4 [F No 机,选No 和,选No [AUTO (AUTO (AUTO (AUTO (AUTO (AUTO (AUTO (AUTO CON 和) 和) (AUTO (AUTO (AUTO (AUTO (AUTO (AUTO)	rensation : N : Y on : S : ular pattern te: Page 5 Page 5 文 、 文 、 文	IO /ES et Process Paramete st Page <u>6</u>	rs Preview Print Sgt Skip List Set Leak Sites
	Company Name Model Number Software Version Current User er the process def Process : 12 Page 1 FIXED	:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su finition in the boxes provide Page 2 Page 3 Contour Map Auto Print: 是否打印,未配打印 First Point Auto Range : Contour Interval : 等高线间隔,画图转 Carrier Density Calculation : 载流子浓度计算,质 Ohm-cm Calculation :	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circu Page 4 No 机,选No 机,选No [AUTO (AUTO (AUTO or a number of 4) [1 次件也可以再次修改 [0] 家子未给出公式,不 [0]	vensation : N : Y on : S : ular pattern ter Page 5 〔 · · · · · · · · · · · · · · · · · · ·	10 YES set Process Paramete st Page <u>6</u>	rs Preview Print Sgt Skip List Set Leak Sites
	Company Name Model Number Software Version Current User Process : 12 Page 1 FIXED	<pre>:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su finition in the boxes provid Page 2 Page 3 Contour Map Auto Print : 是否打印,未配打印 First Point Auto Range : Contour Interval : 等高线间隔,画图转 Carrier Density Calculation : 载流子浓度计算,质 Ohm-cm Calculation : 电阻率计算,测出的</pre>	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circu Page 4 No 机,选No 和,选No AUTO (AUTO (AUTO (AUTO (AUTO) (AUTO	pensation : N : Y an : S : ular pattern te: Page 5 ? ? ? ? ? % 女 下推荐使, 夏度	IO 作ES et Process Paramete st Page <u>6</u>	'S Preview Print Sgt Skip List Set Leak Sites
	Company Name Model Number Software Version Current User Process : 12 Page 1 FIXED FIXE	:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su Finition in the boxes provid Page 2 Page 3 Contour Map Auto Print : 是否打印,未配打印 First Point Auto Range : Contour Interval : 等高线间隔,画图矩 Carrier Density Calculation : 载流子浓度计算,质 Ohm-cm Calculation : 电阻率计算,测出的 Statistical Process Control :	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circu Page 4 I No 机,选No 和,选No [AUTO (AUTO (AUTO or a number of %) [1 次件也可以再次修改 [0N 原厂未给出公式,7 [0] 为方阻乘以输入的厚	rensation : N : Y on : S : ular pattern te: Page 5	io rES <mark>et Process Paramete</mark> st <u>Page 6</u>	rs Preview Print Sgt Skip List Set Leak Sites
	Company Name Model Number Software Version Current User Process : 12 Page 1 FIXED FIXE	<pre>:LUVA SYSTEM :Auto Four-point Probe 280 SI :5.3R6 :su finition in the boxes provide Page 2 Page 3 Contour Map Auto Print: 是否打印,未配打印 First Point Auto Range : Contour Interval : 等高线间隔,画图转 Carrier Density Calculation : 载流子浓度计算,质 Ohm-cm Calculation : 电阻率计算,测出的 Statistical Process Control : SPC控制,选择ON后</pre>	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circo Page 4 No 机,选No 和,选No (AUTO (AUTO (AUTO) (A	rensation : N : Y on : S : ular pattern te: Page 5 ? ? % 文 、 》 下推荐使, 了 更度	IO /ES et Process Paramete st Page <u>6</u>	rs Preview Print Sgt Skip List Set Leak Sites
	Company Name Model Number Software Version Current User Process : 12 Page 1 FIXED FIX	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su Einition in the boxes provide Page 2 Page 3 Contour Map Auto Print: 是否打印,未配打印 First Point Auto Range : Contour Interval : 等高线间隔,画图射 Carrier Density Calculation : 载流子浓度计算,质 Ohm-cm Calculation : 电阻率计算,测出的 Statistical Process Control : SPC控制,选择ON后 Polynomial Correction :	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circu Page 4 No 机,选No 和,选No AUTO (AUTO (AUTO (AUTO (AUTO (AUTO)	rensation : N : Y on : S : ular pattern te: Page 5 Page 5	IO rES et Process Paramete st Page <u>6</u>	rs Preview Print Sgt Skip List Set Leak Sites
	Company Name Model Number Software Version Current User er the process def Process : 12 Page 1 FIXED	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su finition in the boxes provide Page 2 Page 3 Contour Map Auto Print: 是否打印,未配打印 First Point Auto Range : Contour Interval : 等高线间隔,画图束 Carrier Density Calculation : 载流子浓度计算,质 Ohm-cm Calculation : 电阻率计算,测出的 Statistical Process Control : SPC控制,选择ON后 Polynomial Correction :	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circu Page 4 [F No 机,选No AUTO (AUTO (AUTO or a number of %) [T ChUTO or a number of %) [T	rensation : N : Y on : S : ular pattern te: Page 5 Page 5 文 文 文 文 文 文 文 文 文 文 文	IO rES et Process Paramete st Page <u>6</u>	rs Preview Print Sgt Skip List Set Leak Sites
	Company Name Model Number Software Version Current User er the process def Process : 12 Page 1 FIXED	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su finition in the boxes provid Page 2 Page 3 Contour Map Auto Print : 是否打印,未配打印 First Point Auto Range : Contour Interval : 等高线间隔,画图转 Carrier Density Calculation : 载流子浓度计算,质 Ohm-cm Calculation : 电阻率计算,测出的 Statistical Process Control : SPC控制,选择ON后 Polynomial Correction :	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circu Page 4 No M, 选NO [AUTO (AUTO (AUTO (AUTO) (rensation : N : Y an : S : ular pattern te: Page 5 ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?	IO YES et Process Paramete st Page <u>6</u> 用	S Preview Print Sgt Skip List Set Leak Sites
	Company Name Model Number Software Version Current User Process : 12 Page 1 FIXED FIX	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su finition in the boxes provide Page 2 Page 3 Contour Map Auto Print : 是否打印,未配打印 First Point Auto Range : Contour Interval : 等高线间隔,画图乾 Carrier Density Calculation : 载流子浓度计算,质 Ohm-cm Calculation : 电阻率计算,测出的 Statistical Process Control : SPC控制,选择ON后 Polynomial Correction :	Temperature Comp SPC Option Program Description ed from Page 1 to Page 6 Measurement Type : Circu Page 4 I No 机,选No 和,选No AUTO (AUTO (AUTO or a number of \$) [1 次件也可以再次修改 [0N 意厂未给出公式,不 [0N 句方阻乘以输入的厚 [0FF 可以使用SPC功能	rensation : N : Y on : S : ular pattern te: Page 5	IO YES et Process Paramete st Page <u>6</u> 用	S Preview Print Sgt Skip List Set Leak Sites Cancel

Company Name Model Number Software Version	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6	Temperature Compensation SPC Option	: NO : YES	
Enter the process de: Edit Process : 12	finition in the boxes provide	d from Page 1 to Page 6 : Measurement Type : Circular patter	n test	Preview
Page <u>1</u>	Page <u>2</u> Page <u>3</u>	Page <u>4</u> Page <u>5</u>	Page 6	
				P <u>r</u> int
FIXED <u>•</u>	Correction Constant: 校准常数,填0,在测	」。 引出的方阻加上输入的常	"数值	S <u>e</u> t Skip Li
FIXED 💌	Auto SECS-II Data Transfer (serial)	: OFF		<u>S</u> et Leak Si
OMIT	Notch Reference Pattern :	V		
FIXED	Set Max Current Range :	(-1:high to 4:low)		
OMIT	Measure Leakage Current :	NO		
FIXED •	Auto Data File Save :	NO		
FIXED •	Auto Data File Save :	NO VE NI		

- 7.6 放样。
 - 7.6.1 插入对应尺寸位置的 PIN 针, 4 寸以上的位置, 需手动将 PIN 针空 位向左旋转 90 角度。
 - 7.6.2 样品厚度确认,先手动进样,检查 head 是否与样品接触。若接触, 需将 head 稍微向上固定。并重新校准。测试完毕后,需再重新固定 在最低位置。
- 7.7 选择 Process。
 - 7.7.1 在 Testing 目录下, 1 点和 5 点测试点击第一个按钮, circle 或者其他 测试点击第二个按钮。

	U	Itilities	Test	^{ing} 无mappir	g功能
1		1 Machine Configuration		<u>6</u> 1pt, 5pts, 9pts, AST	M & Dia Scan
Ų		2 Password Utilities		7 Cartesian, Circular	& Custom Site Map
9		<u>3</u> Edit Process		8 Temperature Coeffi	cient
1.00		<u>4</u> Database Utilities		9 Reserved	
		5 Additional File Utilities		10 Wafer P/N Type Te	est
	D	Diagnostics	Data	Analysis	
		A Diagnostics		E Trend Report	
		B Probe Repeatability		<u>G</u> SECS-II Communic	cation
		<u>C</u> Temperature Compensation		H Statistical Proces	s Control
		D Probe Head Correction Test		I Reserved	
		E Advanced Diagnostic Program		J Additional Program	ms
		[
Abo <u>u</u> t	Show System Info			Express <u>S</u> tart	Exit



7.7.2 弹出的测试界面点击 Start Measurement。

7.7.3 选择一个已经编辑好的 recipe, 点击 ok。

	Company Name Model Number Software Versie Current User	 : LUVA SYSTEM : Auto Four-point Pr in : 5.3R6 : su 	robe 280 SI	Temperature Co SPC Option Probe Status Program Descri	ompensation iption	: NO : YES : Ready : Select Process		
1 3 LMMest 选择一个已经编辑好的recipe LMMest 选择一个已经编辑好的recipe Notest Notest Notest Notest <tr< th=""><th>Use mouse to click t</th><th>the name you want to e</th><th>dit and then</th><th>click OK OR simply double o</th><th>click the name</th><th>:</th><th></th><th></th></tr<>	Use mouse to click t	the name you want to e	dit and then	click OK OR simply double o	click the name	:		
人 弹出具体的测试参数,确认后点击ok。 Company Name: LUVA SYSTEM: Temperature Compensation: NO: Model Number : Auto Fourpoint Probe 280 SI: SPC Option: YYES Stoware Version: 5.316: Term Probe Status: Temperature Compensation: 100: TYES Company Name: : LUVA SYSTEM: Temperature Compensation: : YYES Subvare Version: : S.316: Term Probe Status: Temperature Compensation: : YYES Concern User: : :: :: Program Description: :: Enter Test Parameter: Process name: 49point Layer type: [N	DEMU LUVAtest	选择一个	已经编	辑好的 recipe	0000	o o o o o o o o o o o o o o o o o o o	VFlat	>
Company Name: : LUVA SYSTEM Temperature Compensation: : NO Model Number: : Auto Four-point Probe 280 SI SPC Option : YES Software Version: : 5.386 Probe Status : Ready Current User: : su Program Description : Enter Test Parameter Process name: : 49point Layer type: N Layer type: N Ype Generatic control: Auto Layer type: N Ype Generatic control: Auto Sigma Lower specimit: 0 Ohming Ohming Data pre-sort limit: 0 Sigma Upper data limit: 00000 Ohming Ohming Sigma Sigma Sigma Probe head serial no: Image: Image: <t< th=""><th>.4 弹出具1</th><th>体的测试参</th><th>数,矿</th><th>角认后点击 ok</th><th>0</th><th><u>0</u>K</th><th>4 <u>C</u>ancel</th><th></th></t<>	.4 弹出具1	体的测试参	数,矿	角认后点击 ok	0	<u>0</u> K	4 <u>C</u> ancel	
Test Type : Circular test Change Scan Angl Layer thickness/resistivity: [0:1 Micron Individual sites edit: NO Micron Gain Control: [AUTO Y Individual sites edit: NO Micron Geometric correction: [DFF Y Individual sites edit: NO Micron Temperature compensation: [DFF Y Individual sites edit: NO Micron Ohm/sq Data pre-sort limit: [0 Ns Upper data limit: [0 Ohm/sq Ohm/sq Data sorting limit: [3 Sigma Operator name: IMA Micron Save data on disk : [YES Y Equipment infomation: Y Contour interval: [AUTO Ns Device fio: Y Contour interval: [AUTO Ns Probe head serial no. : M Correction Constant: [0 M Probe head seried fio: Y M Correction Constant: [0 M Y Max test diameter: [34 mm Mats Correction: [ON Y Set Max Current Range : Y Number of Test Points: [43 points Blue = Fixed Item Mue = Fixed Item Mue = Fixed Item	Company Name Model Number Software Versio Current User	: LUVA SYSTEM : Auto Four-point Pr in : 5.3R6 : su	robe 280 SI	Temperature Co SPC Option Probe Status Program Descri	ompensation iption	: NO : YES : Ready : Enter Test Para	meter	
Layer type: N Type Gain Control: AUTO Control: AUTO Control: AUTO Control: Contro: Contr	Process name : 49point	1	т	est Type : Circular test			Change Peer	to alo
Lower data initit: Contour Save data on disk: YES YES Operator name: MAI Main Contour map: YES YES Fab name: Main Contour map: YES YES YES Lot identification: Main Contour map: YES YES YES Equipment infomation: Main Contour map: YES YES YES Probe head serial no. Main Main YES YES YES Probe head serial no. Main Main YES YES YES Probe head serial no. Main Main YES YES YES Probe head serial no. Main YES YES YES YES Probe head serial no. Main YES YES YES YES YES Probe head correct factor: Interval: Auto SECS-II Data Transfer: ON YES YES YES Mask circle diameter: Main Main Main Main Auto ASCII File Export: YES YES YES Note: Red -	Layer type : Layer thickness/resistivity : Individual sites edit : Lower spec limit : Upper spec limit :	N 200000	Type Micron Ohm/sq Ohm/sq	Gain Control : Geometric correction : Temperature compensation : Data pre-sort limit : Data sertion limit :	AUTO OFF OFF 0	× × %		Angle
Device Ho : Carrier density calculation : IN Ohn-em calculation : IN On Set Max Current Range : On On Auto ASCII File Export : YES On Ohn-em calculation : On On<td>Upper data limit : Operator name : Fab name : Lot identification : Equipment infomation :</td><td>200000 HAI</td><td>Ohm/sq Ohm/sq</td><td>Save data on disk : Autodraw contour map : Contour map printer dump : Contour interval :</td><td>YES YES NO AUTO</td><td>× • • • • • • • • • • • • • • • • • • •</td><td></td><td></td>	Upper data limit : Operator name : Fab name : Lot identification : Equipment infomation :	200000 HAI	Ohm/sq Ohm/sq	Save data on disk : Autodraw contour map : Contour map printer dump : Contour interval :	YES YES NO AUTO	× • • • • • • • • • • • • • • • • • • •		
Probe Pin Spacing : mm Wafer size : 100 Max test diameter : 94 Mask circle diameter : 0 Mumber of Test Points : 43 Points 143 Note : Red = Required Item Magenta = Optional Item Blue = Fixed Item	Device No : Probe head serial no. : Probe head type : Probe head selection : Probe head correct factor :	Not Available		Carrier density calculation : Ohm-cm calculation : Polynomial Correction : Correction Constant : [ON ON ON O	Y		
Number of Test Points: 13 points Note : Red = Required Item Magenta = Optional Item		1100	mm mm	Auto SECS-II Data Transfer :	OFF	•		
	Probe Pin Spacing : Wafer size : Max test diameter : Mask circle diameter :	94	mm	Auto ASCII File Export :	YES			
	Probe Pin Spacing: Water size : Max test diameter : Mask circle diameter : Number of Test Points : Note : Bed - Bequired the	: 94 : 0 : 49 m Maganta - Octio	mm points	Auto ASCII File Export :	YES		_	

7.7.5 弹出的对话框输入样品名(不要超过16个字符,不能有空格),点 击 ok。



2	Company Name Model Number Software Version Current User	: LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	Temperature Compensation SPC Option Probe Status Program Description	: NO : YES : Ready : Enter Wafer ID	
		Please enter V for name same Previous Wafe Enter Wafe	Vafer identification below : (Press F2 e as previous) er ID : Zc-1 (Upto 16 characters no space) er ID : Zc-1]	
				<u></u> ΩK	Cancel
.7.6	等待测试	完成,如 process	中勾选自动 mappi	ng, 则会自:	动弹出,否
.7.6	等待测试 则需要点 Company Name Model Number Software Version Current User	完成,如 process 击右侧 Contour M : LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	中勾选自动 mappi fap 按钮。 Temperature Compensation SPC Option Probe Status Program Description	ng,则会自: :NO :YES :Ready :Test Pattern Confirm	动弹出,否
.7.6	等待测试 则需要点 Company Name Model Number Software Version Current User	完成,如 process 击右侧 Contour M : LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	中勾选自动 mappi fap 按钮。 Temperature Compensation : SPC Option : Probe Status : Program Description : Test Result Unit in :	ng,则会自: NO :YES : Ready : Test Pattern Confirm	动弹出,否
.7.6	等待测试 则需要点 Company Name Model Number Software Version Current User	完成,如 process 击右侧 Contour M : LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	中勾选自动 mappi fap 按钮。 Temperature Compensation SPC Option Probe Status Program Description Test Result Unit in : No Result	ng,则会自: NO :YES :Ready :Test Pattern Confirm	动弹出,否 Statistics
.7.6	等待测试 则需要点 Company Name Model Number Software Version Current User	完成,如 process 击右侧 Contour M : LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	中勾选自动 mappi fap 按钮。 Temperature Compensation : SPC Option : Probe Status : Program Description : Test Result Unit in : No Result	ng,则会自: :NO :YES :Ready :Test Pattern Confirm	动弹出,否 Statistics Saye Data
.7.6	等待测试 则需要点 Company Name Model Number Software Version Current User	完成,如 process .击右侧 Contour M : LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	中勾选自动 mappi fap 按钮。 Temperature Compensation : SPC Option : Probe Status : Program Description : Test Result Unit in : No Result	ng,则会自: NO :YES :Ready : Test Pattern Confirm	动弹出,否 Statistics Saye Data Print Data
.7.6	等待测试 则需要点 Company Name Model Number Software Version Current User	完成,如 process 击右侧 Contour M : LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	中勾选自动 mappi fap 按钮。 Temperature Compensation : SPC Option : Probe Status : Program Description : Test Result Unit in : No Result	ng,则会自: NO :YES : Ready : Test Pattern Confirm	动弹出,否 Statistics Saye Data Print Data Export Data
.7.6	等待测试 则需要点 Company Name Model Number Software Version Current User	完成,如 process 击右侧 Contour M : LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	中勾选自动 mappi fap 按钮。 Temperature Compensation SPC Option Probe Status Program Description Test Result Unit in : No Result	ng,则会自: NO YES : Ready : Test Pattern Confirm	动弹出,否 Statistics Saye Data Print Data Export Data Set Limit
.7.6	等待测试 则需要点 Company Name Model Number Software Version Current User	完成,如 process 击右侧 Contour M : LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	中勾选自动 mappi fap 按钮。 Temperature Compensation :: SPC Option :: Probe Status :: Program Description :: Test Result Unit in : No Result	ng,则会自: NO :YES :Ready :Test Pattern Confirm	动弹出,否 <u>Statistics</u> Saye Data <u>Print Data</u> <u>Export Data</u> <u>Set Limit</u> <u>Contour Map</u>
.7.6	等待测试 则需要点 Company Name Model Number Software Version Current User	完成,如 process 击右侧 Contour M : LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	中勾选自动 mappi fap 按钮。 Temperature Compensation : SPC Option : Probe Status : Program Description : Test Result Unit in : No Result	ng,则会自: :N0 :YES :Ready :Test Pattern Confirm	动弹出,否 Statistics Saye Data Print Data Export Data Set Limit Contour Map 3D Map
.7.6	等待测试 则需要点 Company Name Model Number Software Version Current User	完成,如 process 击右侧 Contour M : LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su	中勾选自动 mappi fap 按钮。 Temperature Compensation : SPC Option : Probe Status : Program Description : Test Result Unit in : No Result	ng,则会自: :N0 :YES :Ready :Test Pattern Confirm	动弹出,否 Statistics Saye Data Print Data Export Data Set Limit Contour Map 3D Map Scan Graph
.7.6	等待测试 则需要点 Company Name Model Number Software Version Current User	完成,如 process 击右侧 Contour M : LUVA SYSTEM : Auto Four-point Probe 280 SI : 5.3R6 : su Wafer Size : 100 mm Test No : 4 st pattern OK?	中勾选自动 mappi fap 按钮。 Temperature Compensation :: Probe Status :: Program Description :: Interference :: No Result Result Result Result	ng,则会自: NO :YES :Ready :Test Pattern Confirm	动弹出,否 Statistics Saye Data Print Data Export Data Set Limit Contour Map 3D Map Scan Graph

7.8 取样品和保存数据。

<u>Edited on 2019-12-03 (第一版)</u>



测试结束后,点击右侧 Save Data 保存为 txt 文件(不包含坐标点信息), Export Data 保存为 excel 文件(包含坐标点信息)。

7.9 LIMS 登出设备,结束收费。记录本次实验测试点数,用于判定探头使用寿命的状况以及是否需要清洁判定,正常探头使用次数为 250000,或者 2000 次 mapping。

8.0 问题排除

8.1 问题: 通讯异常

可能原因: 连接故障, 连接线松掉, COM 口被篡改

解决方法:请查看连接线否正常, Machine Configuration 界面里 COM port 是 否与电脑硬件的 COM 口编号一致。

8.2 问题:无法测出结果

可能原因: 探头类型不合适,薄膜太薄方块电阻太小或方块电阻过大超出量程,薄膜太硬导致无法接触进 sample 表面,

解决办法:更换探头

8.3 问题:测试报错,如下图:



可能原因:几何校正开,导致边缘测不出来报错; High gain, low gain 和 auto 的问题。

解决办法:关闭几何校正,软件使用自动反而报错,尝试用 high gain 或者 low gain 来测试。

9.0 附录

<u>Edited on 2019-12-03 (第一版)</u>



9.1 方块电阻和体电阻以及电阻率的关系 (https://wenku.baidu.com/view/b2b8c88002d276a200292e89.html)



图2.3 方块电阻示意图

Fig. 2.3 Diagram of block resistance

图示为电流平行流过膜层的情形,其中 d 为膜厚, I 为电流, L_1 为在电 流方向的膜层长度, L_2 为在垂直于电流方上的膜层长度。则该层的电阻为:

$$R_s = \frac{\rho L_1}{dL_2}$$

式中 ρ 为导电膜的电阻率,对于给定的膜层, ρ 和d可以看成是定值。L1=L2时,即为正方形的膜层,其电阻值均为定值 ρ/d 。这就是方块电阻的定义。

$$R_{\Box} = \frac{\rho}{d}$$

式中的 R_{\Box} 单位为欧姆/ \Box (Ω/\Box)。由此可以看出方阻的特点:对于给定的材料,其阻值不随采用的正方形的大小变化,仅与薄膜材料的厚度有关。

9.2 四探针测量方块电阻的原理以及几何修正

(https://wenku.baidu.com/view/69b06187227916888586d702.html)
四探针测试法如图 2.4 所示,在半径无穷大的均匀试样上有四根等间距为
S 的探针排列成一直线。由恒流源向外面两根探针 1、4 通入小电流 I,
测量中间两根探针 2、3 间的电位差 U,则由 U、I、S 的值求得样品的电阻率ρ。





图2.4 四探针测试法示意图

Fig. 2.4 Schematic diagram of four-probe method

当电流 I 由探针 1 流入样品时,若将探针与接触出看成点电源,则等势 面是以点电源为中心的圆柱面,在距离探针r处的电流密度为:

$$J = \frac{I}{A} = \frac{I}{2\pi r \cdot d}$$

由微分欧姆定律 J=E/ρ 可得出距探针 r 处的电场强度为

$$E = J * \rho = \frac{\rho}{d} \cdot \frac{I}{2\pi r}$$

用直线四探针法测量电阻率时,电流 I 从探针 1 流入,探针 4 流出,则探 针 2 和 3 的电位差为:

$$U_{23} = U_2 - U_3 = \int_{s}^{2s} 2Edr = \frac{\rho}{d} \cdot \frac{l}{\pi} \int_{s}^{2s} \frac{dr}{r} = \frac{\rho}{d} \cdot \frac{l}{\pi} \cdot \ln 2$$

根据方阻的定义可以得到:

$$R_{\Box} = \frac{\rho}{d} = \frac{\pi}{\ln 2} \cdot \frac{U_{23}}{I}$$

上式为四探针法测无穷大薄层的方块电阻的公式,为准确测量要求样品 厚度d远比探针间距s小,样品尺寸远远大于探针间距。且各边界与探针 的距离大于探针的间距。实际上当样品厚度及任意探针与样品最近边界 的距离至少大于四倍探针间距时即可认为满足上述条件。不满足上述条 件时,采用如下修正公式:

$$R_{\Box} = C \cdot \frac{U_{23}}{I}$$

C为修正因子,与薄层的几何尺寸有关。 本设备的几何校正过程如下:

1、 电流源为1和4,2和3测的的电压为V1;

2、 电流源为1和3,2和4测的的电压为V2;
无限大样品,V1和V2的比值满足:V1/V2=ln4/ln3=1.262
几何校正开时,会使用输入的校正系数使得比值仍在1.262.
Tips: 薄膜较厚(>0.3mm),样品不是圆形,样品尺寸很小或者由于
V1/V2超出 range 导致的 Bad Contact 报错时,几何校正应该关闭。





First Configuration Measurement



Second Configuration Measurement



9.3 常用测试方法点分布图



9.4 High Gain 和 Low Gain 的选择



(Ohms/sq)	(Best Gain)	(Ohms/sq)	(Best Gain)
0 to .175	LOW	175 TO 700	HIGH
.175 TO .70	HIGH	700 TO 1750	LOW
.70 TO 1.75	LOW	1750 TO 7000	HIGH
1.75 TO 7.0	HIGH	7000 TO 17.5K	LOW
7.0 TO 17.5	LOW	17.5K TO 70K	HIGH
17.5 TO 70	HIGH	70K TO 175K	LOW
70 TO 175	LOW	175K TO 800K	нідн

9.5 常用 probe head 类型和测试的薄膜以及更换

Four-Point Probe Selection Guide

Туре	Application	Material	Tip Radius @ Contact Area Radius	Force
Туре-А	Metal films, ITO, amorphous Si, poly silicon, SOI, bulk substrates	Tungsten Carbide	25 um or 45um	90- 200g
Туре-В	General Purpose: medium to thick epitaxial layers, diffused layers, metal films, implants 2-10 microns	Tungsten Carbide	100um	- 90- 200g
Туре-М	epitaxial, diffused and ion implanted layers (500 A to 5 um), especially very shallow ion implanted layers	Tungsten Carbide	300um @ 120um	90- 200g
Type-N	Very shallow implants	Tungsten Carbide	500um	90- 200g
Туре-С	III-V compound semiconductors, e.g. GaAs, InAs	Osmium	100um	60- 150g
Mercury	Ultra shallow implants, ultra thin layers	Mercury		~0
Custom	Customized tips	Various	Various	

平台提供的有 Type A 一个用于, Type B 2 个, 待机状态请安装 Type B, 测试比较厚的薄膜(例如原生厚晶圆)和比较硬的材料可以更换为 Type A, 使用完毕后请更换为 Type B。

更换方法请可前往<u>\\10.15.45.200\SPST-Softnanolab\SOP-只放原厂和最终版\4</u>point probe_四探针电阻测量仪_4D 280SI 观看视频。

9.6 设备硬件界面和手动操作

二次菜单切换 先点击需要的二级菜单按钮,点击 PAUSE(connect special function),再点击 RESET(activate special function),此时二次菜单功能灯 点亮,再点击 PAUSE(取消 PAUSE 键功能)退出调节二级菜单功能。

a.选择1PT, STAGE MOVEMENT 中前后, 左旋和右旋按钮把样品置于探针下方, 然后点击 START, 屏幕中间显示出方块电阻。

b. 选择 5 PT, 机台默认 5 点位置如下表 (五点的位置已确定, 不能改变)

wafer size (mm) 100 125 150 200	
---	--



Center shift	32	40	48	64
distance (mm)				

机台依次测出 5 点值后,通过 5 PT DISPL SELECT 在屏幕中查看 5 点的数据。

9.7 Software 界面简介

- 一、 Main 界面
- 二、 Process 界面
- 三、 校准界面
- 四、 重复性测试界面
- 10.0 注意事项

如果被测导电薄膜材料表面上不干净,存在油污或材料暴露再空气中时间过长,形成 氧化层,会影响测试精度;

由于探针有少子注入及探针移动存在,所以在测量中可以进行正方两个方向电流测量,然后取其平均值以减小误差;

电流选择适当,太小会影响测试精度,太大会引起发热或非平衡载流子注入; 对于高阻及光敏感性材料测试时,光电导效率会影响测量,请关闭测试盒盖。

11.0 原厂 SOP 请参考软纳米平台云盘: <u>\\10.15.45.200\SPST-Softnanolab\SOP-只放原</u> <u>厂和最终版\4 point probe_四探针电阻测量仪_4D 280SI</u> Model 280 Manual_V53 原厂 使用手册