

Defect reduction and particle control in localized Track

KINGSEMI

2020.11



Part 1

**Recipe Tuning for Developer
defect reduction in Customer A**

Y Company verification Schedule



Localized Track completed the Process verification within 3 weeks

Plan

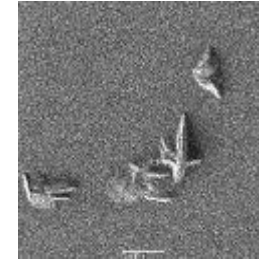
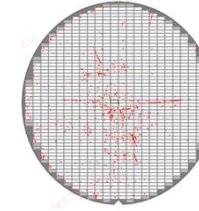
Real

Customer	A	Week	2							3							4							5							6							7							8																		
Tool ID	FT300-XX		2020、Apr																														2020\May																														
		Date	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31												
		Items	时长(天)	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun											
Process verification 1. ZR8X verification 2. IP5X	ZR8X DEV	Plan	33																																																												
		real																																																													
	IP5X DEV	Plan	50																																																												
		real																																																													
	THK monitor	Plan	27																																																												
		real																																																													
Process chambers verification : 1. ZR8X 2. IP5X 3. ADH WPA	ZR8X multiple DEV chamber	Plan																																																													
		real																																																													
	IP5X multiple DEV chamber	Plan																																																													
		real																																																													
	ADH WPA	Plan																																																													
		real																																																													

- Plan the schedule , and list the working items .
- Achievement :
 - 2 resists DEV recipe tuning ,
 - complete the multiple chambers matching with 2 resists in 6 DEV chambers .
 - Adhesion unit modification to reduce the wet particle .

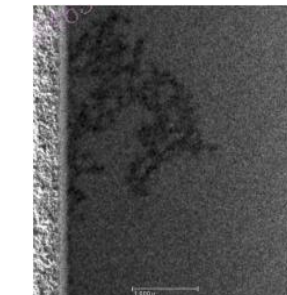
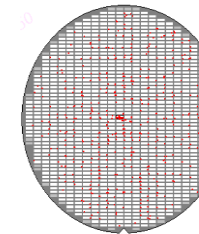
1. IP5X Defect improvement Action (Loop 2,3)

- Defect Type : Resist Residue on resist .
- Action 1.DI rinse : change to agitation DI rinse
- Action 2.Remove Spin Dry before 2nd Develop dispense
- Result : defect count : 93ea (Base line 96ea) ,
- Spec 100ea . (Done)

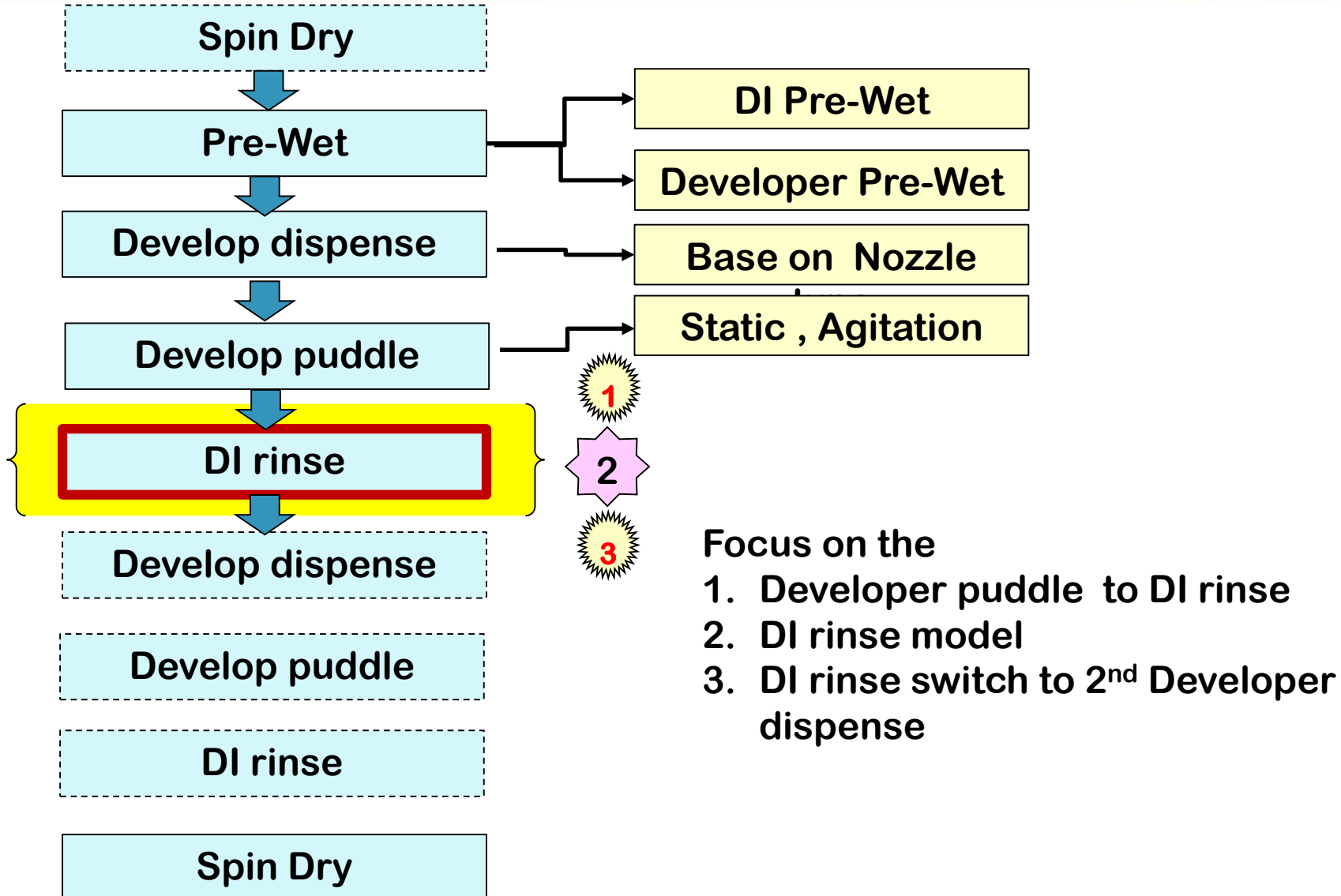


2. ZR8X Defect improvement Action (Loop 1,2,3)

- Defect Type : Resist Residue in exposed region .
- Action 1: Add DI rinse 2sec after DI puddle
- Action 2 :change to agitation DI rinse
- Action 3.Remove Spin Dry after 1st rinse
- Result : defect count : 59 ea (Base line ~60ea) , Spec 100 . (Done)



Normal Develop Recipe Sequence



IP5X Recipe



Old recipe :



	12	13	14	15	16
Step	5	2	Short	long	2
Step time	5	2	Short	long	2
Vel	0	100	slow	Fast	Super Fast
Acc	3000	3000	3000	3000	3000
GP disp	None	HDIW	HDIW	HDIW	None
GP scan	0	0	0	0	0
GP arm speed	0	0	0	0	0
GP arm pos start	DIW2	DIW2	DIW2	DIW2	Home
GP arm pos end	Home	Home	Home	Home	Home
LD disp	None	None	None	None	None
LD scan	0	0	0	0	0
LD arm speed	0	0	0	0	0
LD arm pos start	Home	Home	Home	Home	Home
LD arm pos end	Home	Home	Home	Home	Home
Swing flag	No	No	No	No	No
LD nozzle clean	None	None	None	None	None
BSR	Off	Off	On	On	Off
Auto damper	On	On	On	On	On
Bubble drain	Off	Off	Off	Off	Off
Wait type	Wait	Wait	Wait	Wait	Wait

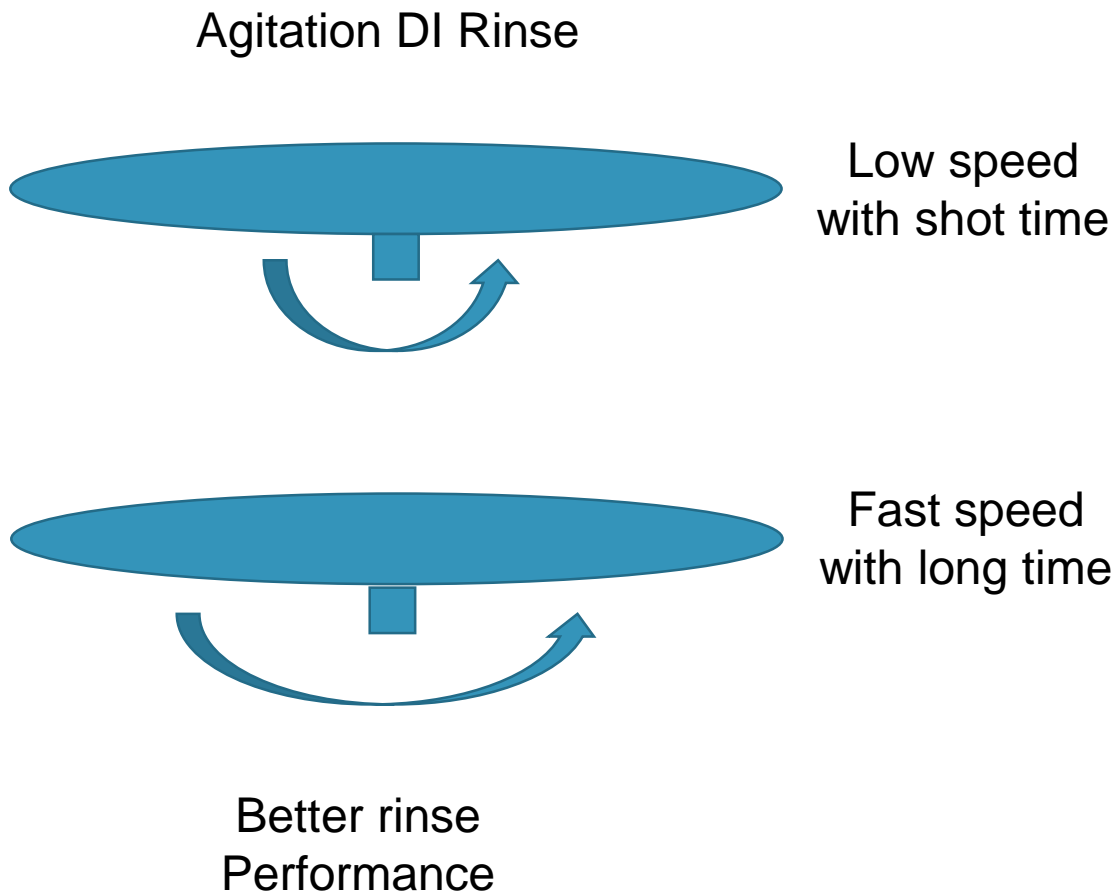
New recipe :



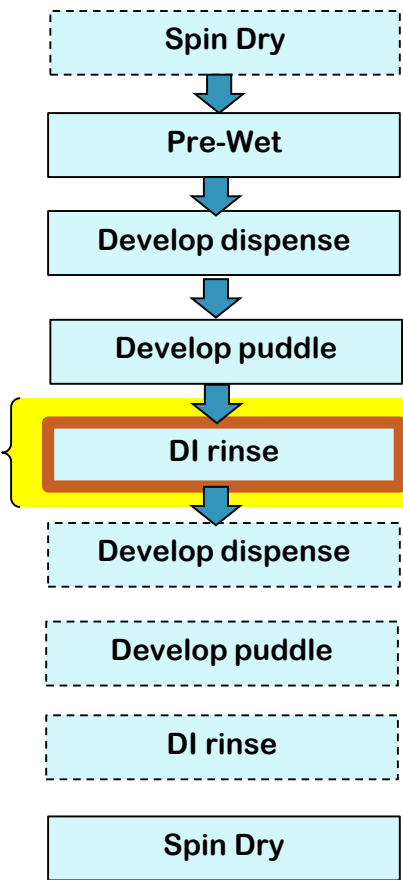
	12	13	14	15	16	17	18
Step	5	2	Shorter	Medium Long	Shorter	Medium Long	2
Step time	5	2	Shorter	Medium Long	Shorter	Medium Long	2
Vel	0	100	slow	Fast	slow	Fast	Super-Fast
Acc	3000	3000	3000	3000	3000	3000	3000
GP disp	None	HDIW	HDIW	HDIW	HDIW	HDIW	None
GP scan	0	0	0	0	0	0	0
GP arm speed	0	0	0	0	0	0	0
GP arm pos start	DIW2	DIW2	DIW2	DIW2	DIW2	DIW2	Home
GP arm pos end	Home	Home	Home	Home	Home	Home	Home
LD disp	None	None	None	None	None	None	None
LD scan	0	0	0	0	0	0	0
LD arm speed	0	0	0	0	0	0	0
LD arm pos start	Home	Home	Home	Home	Home	Home	Home
LD arm pos end	Home	Home	Home	Home	Home	Home	Home
Swing flag	No	No	No	No	No	No	No
LD nozzle clean	None	None	None	None	None	None	None
BSR	Off	Off	On	On	On	On	Off
Auto damper	On	On	On	On	On	On	On
Bubble drain	Off	Off	Off	Off	Off	Off	Off
Wait type	Wait	Wait	Wait	Wait	Wait	Wait	Wait

New recipe : (recipe overall process time was reduced by 2 secs)

No	Old Recipe			New			Purpose
	Step	Detail	Time	Step	Detail	Time	
1	14 /15	Slow RPM with short spin , Fast RPM with long spin	17s	14~17	Slow RPM with shorter Spin, Fast RPM with medium long spin , Slow RPM shorter Spin, Fast RPM with medium long spin	17s	Agitation DI rinse mode to increase the cleaning efficiency
2	16	Super fast RMP with short spin	2	18	Delete this step	0	keep the wafer surface wettability , and make the developer have strong mobility



DI wafer → Developer scan



2

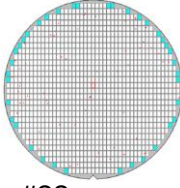
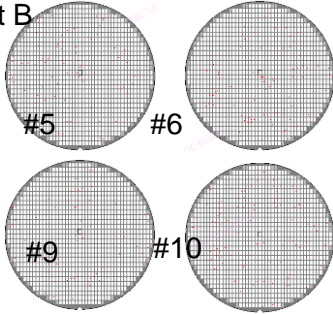
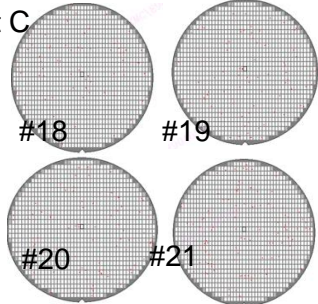
3

Lo op	Motor	Nozzl e	Surface property
2	Spin	DI water	Hydrophilic
3	Spin		Hydrophob ic
	Spin	2nd DEV	Hydrophilic

Keep wafer surface always hydrophilic , can get better defect performance.

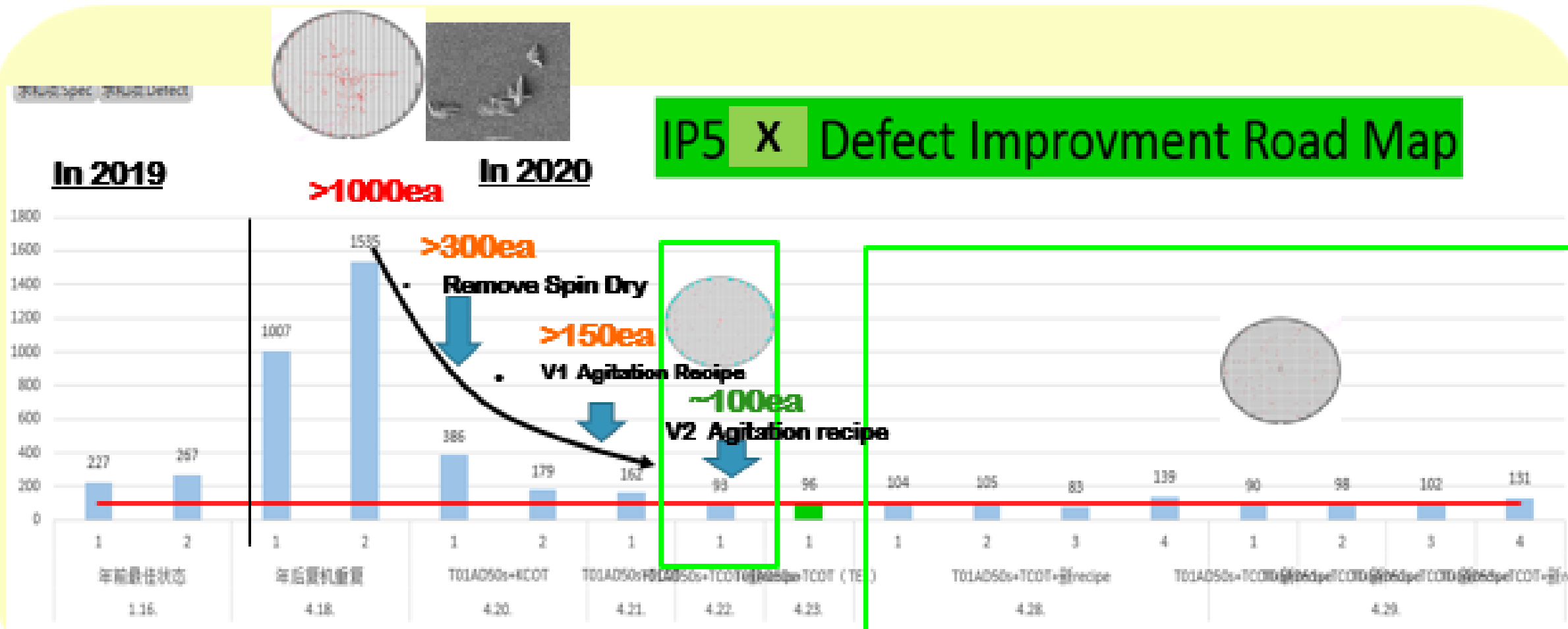
IP5X SDC2 DEV defect performance in consist 3 days



A	Unit	<u>KDEV (New recipe)</u>		
Base line Total defect : ~96	Day	23-Apr-20	28-Apr-20	30-Apr-20
	Defect Map	Lot A  #22	Lot B  #5 #6 #9 #10	Lot C  #18 #19 #20 #21
	Defect count	93	104/105/83/136	90/98/102/131
	Defect Spec	Total Defect ~ 100ea within consistent 3 days		
	Conclusion	Pass the defect verification ✓		



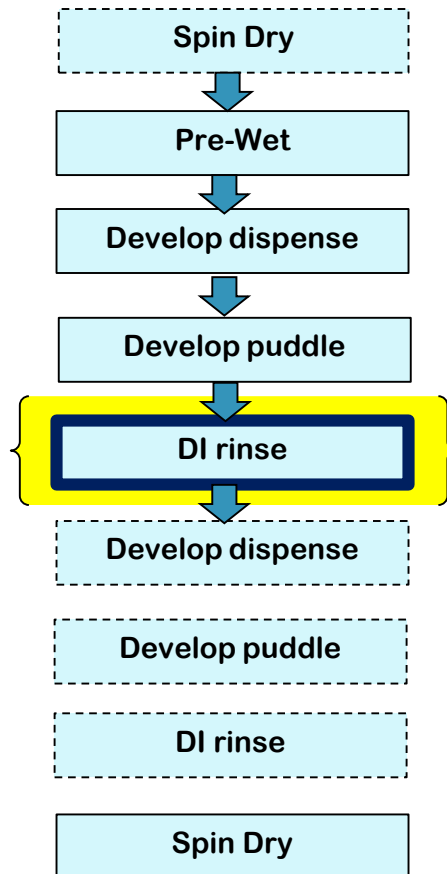
IP5X SDC2 DEV defect long term performance



Old recipe :

Step	1	11	12	13	14	15	16	17	18	19	20
Step time	1	4	5	2 sec	Long time	Short time	1	1	0.5	6	0.5
Vel	0	0	0	Low spin	Fast Spin	Low spin	Super Fast	0	0	0	0
Acc	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
GP disp	None	None	None	None	HDIW	HDIW	None	None	None	None	None
GP scan	0	0	0	0	0	0	0	0	0	0	0
GP arm speed	0	0	0	0	0	0	0	0	0	0	0
GP arm pos start	Home	Home	DIW2	DIW2	DOW2	DIW2	Home	Home	Home	Home	Home
GP arm pos end	Home	Home	Home	Home	Home	Home	Home	Home	Home	Home	Home
LD disp	None	None	None	None	None	None	None	None	HDEV	HDEV	HDEV
LD scan	0	0	0	0	0	0	0	0	0	1	0
LD arm speed	4	4	4	4	4	4	4	4	4	25	0
LD arm pos start	Left	Home	Home	Home	Home	Home	Home	Left	Left	Left	Right
LD arm pos end	Home	Home	Home	Home	Home	Home	Home	Home	Home	Right	Home
Swing flag	No	No	No	No	No	No	No	No	No	No	No
LD nozzle clean	None	None	None	None	None	None	None	None	None	None	None
BSR	Off	Off	Off	Off	On	On	Off	Off	Off	Off	Off
Auto damper	Off	Off	On	On	On	On	On	Off	Off	Off	Off
Bubble drain	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	On
Wait type	Wait	Wait	Wait	Wait	Wait	Wait	Wait	Wait	Wait	Wait	Wait

No	Step	Old	New	Purpose
1	13	Low spin & 2sec w/o DI	Low spin & 2Sec with DI	Extend the cleaning time , to prevent the PH shock effect .
2	14 /15	Fast Spin with long time Low spin with short time	Low Spin with short time Fast spin with medium long time Low Spin with short time Fast spin with medium long time	Agitation DI rinse mode to increase the cleaning efficiency
3	16	Super Fast with 1sec	Delete this step	No need Spin Dry , keep the wafer surface wettability , and make the developer have strong mobility



1

2

3

Loop	Motor	Nozzle	Surface property
1	No Spin	DEV	Hydrophilic
	No Spin(puddle)		Hydrophilic
	Spin		Hydrophobic
2	Spin	DI water	Hydrophilic
3	Spin		Hydrophobic
	Spin	2 nd DEV	Hydrophilic

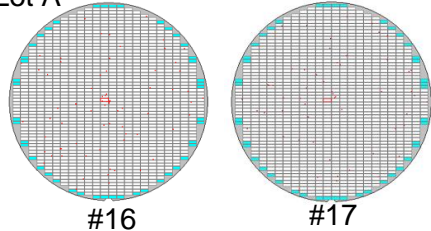
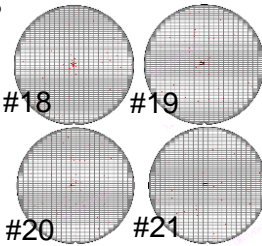
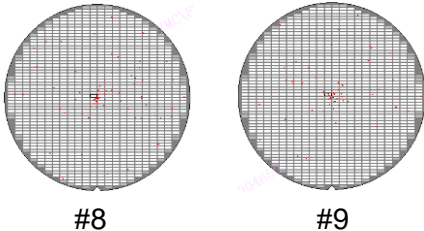
Loop 1 DEV puddle → DI water rinse :

← If you want to spin , must turn on DI wafer

Loop 3 DI rinse → DEV delete spin dry before DEV

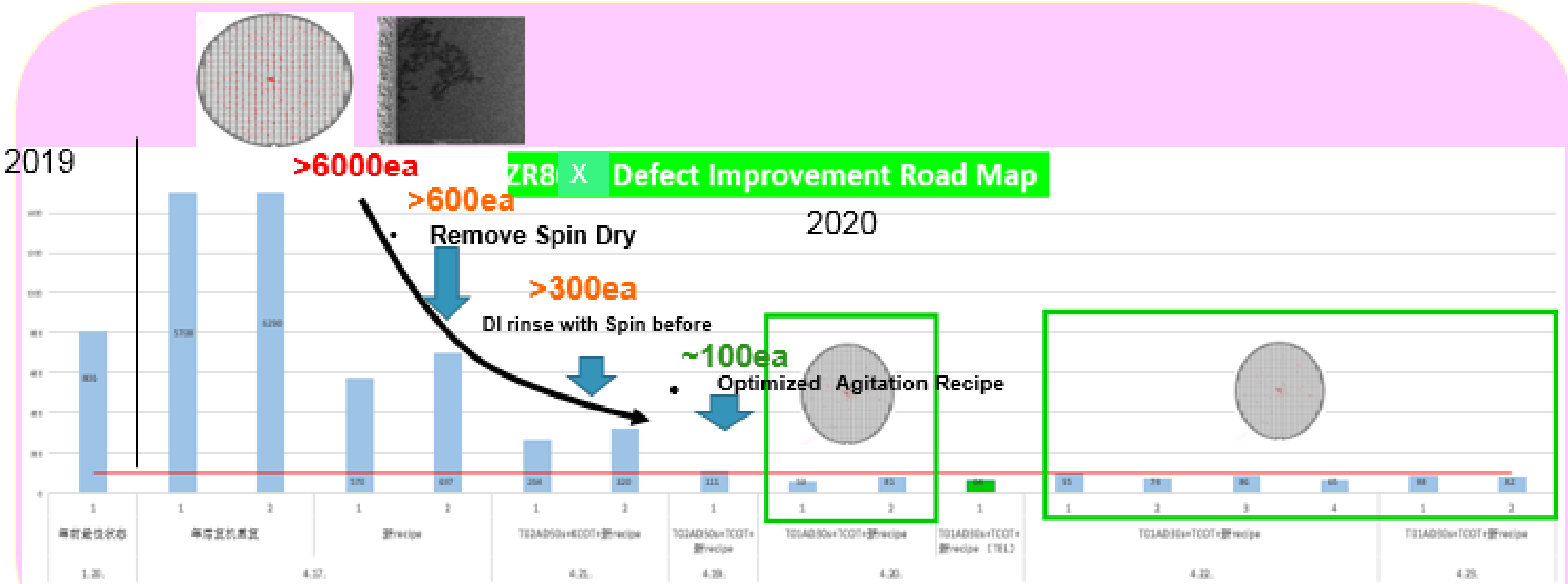
← Delete spin dry before 2nd DEV

Keep wafer surface always hydrophilic ,
can get better defect performance.

Product	Unit	KDEV (Optimized recipe)		
J Base line Total defect : ~60	Day	21-Apr-20	22-Apr-20	23-Apr
	Defect Map	Lot A  #16 #17	Lot B  #18 #19 #20 #21	Lot C  #8 #9
	Defect count	81 / 59	95 / 74 / 86 / 65	88 / 82
	Defect Spec	Total Defect < 100ea within consistent 3 days		
	Conclusion	Pass the verification ✓		

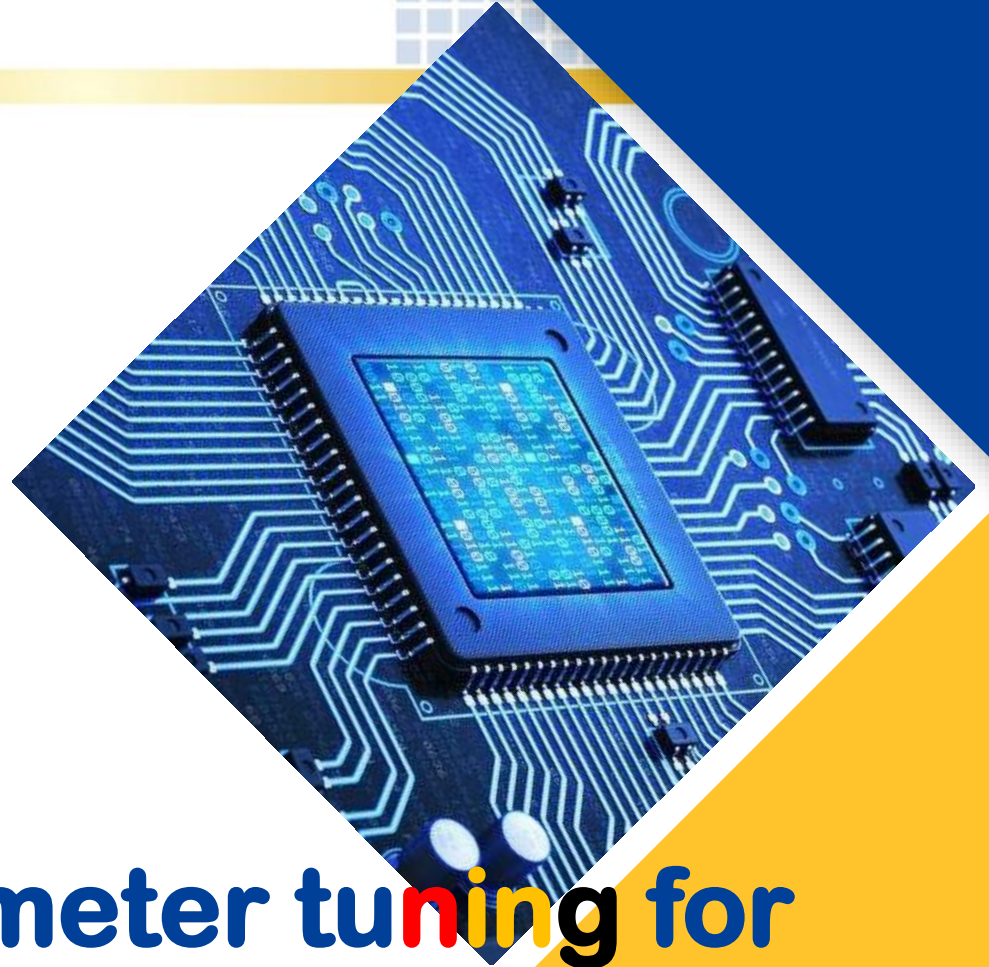


ZR8X SDC2 DEV defect long term performance



K: 59/81/95/74/86/65/88/82

Base line :64

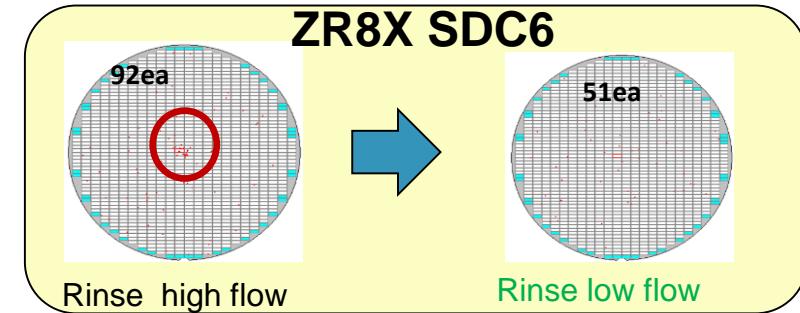


Part 2

- Hardware parameter tuning for chamber matching
- New Design for Defect control

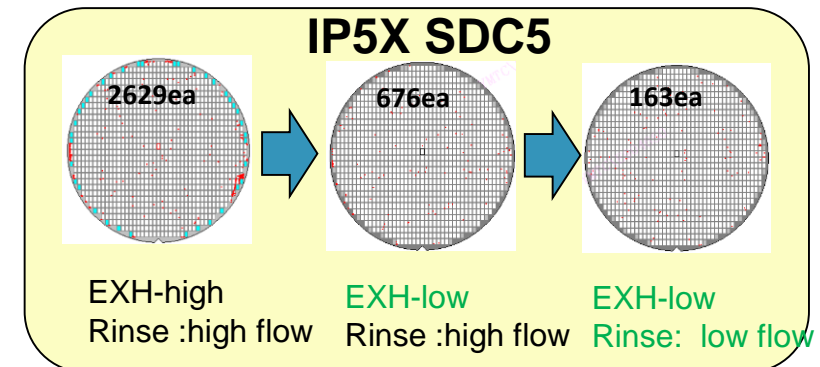
1. ZR8X multiple chamber defect verification

- Defect Type :multi chamber **Center defect cluster**.
- **Action :reduced Rinse flow**
- Result : no center cluster
- Status : pass chamber matching verification ✓



2. IP5X multi chamber defect verification

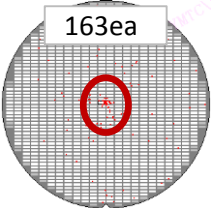
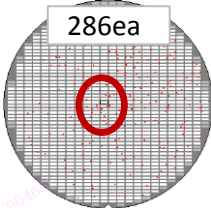
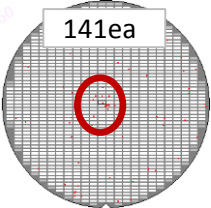
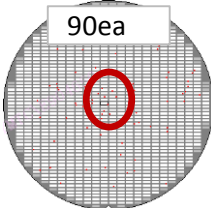
- Defect Type : **SDC5 cluster defect** in non-exposure area
- **Action 1.adjust SDC5 EXH change**
- **Action 2. reduced Rinse flow rate,**
- Result : solve SDC5 edge cluster
- Status : pass chamber matching verification ✓



ZR8X multiple chamber verification

(Rinse flow rate ~1200ml/min)



Resist	Product		<u>DEV units</u>				
		Unit	SDC2	SDC3	SDC4	SDC5	SDC6
ZR8X	J (005) Base line Total defect : ~100	Defect Map					
		Conclusion	SDC2-6 chamber shows that wafer center has a cluster of defect, belonging to special map, and it must be solved				

ZR8X multi chamber verification

(Rinse flow rate ~1000ml/min)



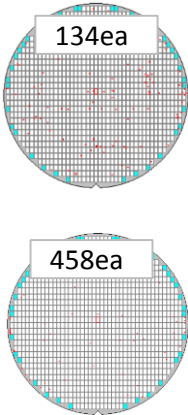
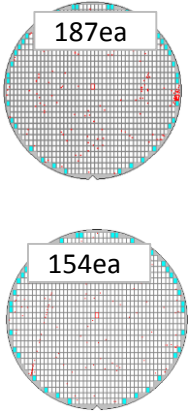
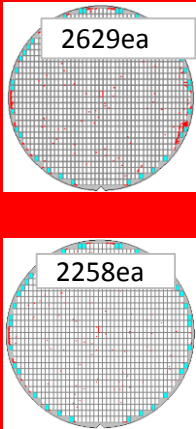
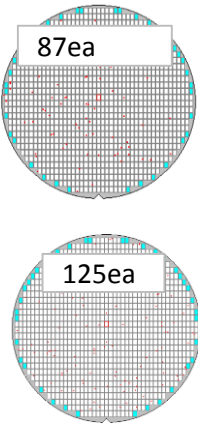
Hardware parameters	rinse pressure	rinse flow rate ml/min	Nozzle angle/C	Nozzle height/mm	BSR	EXH	Chuck VAC/pa	Chuck stauts	Rinse lead	LD dispense	rinse pipe size	AWC position
SDC2	0. 49mpa	High	big	15	Normal	low	Normal	Normal	No	Normal	Normal	Normal
SDC3		Low	small	15	Normal	medium	Normal	Normal	No		Normal	
SDC4		Low	big	15. 5	Normal	medium	Normal	Normal	No		Normal	
SDC5	0. 48mpa	Medium	big	15	Normal	strong	Normal	Normal	No		Normal	
SDC6		low	small	12	Normal	Error	Normal	Normal	No		Normal	

SDC center problem solving process (in SDC6 unit)							
ZR8X	J (005)	chan ges	None	Rinse center left shift 5mm	Rinse center right shift 2mm	Rinse DIW2-DIW3 scan , distance between D2 and D3 5mm	Reduce Rinse flow rate,
	Base line Total defec t : ~100	Defe ct Map					
	concl usion	1.At present, there is no jig to judge the center of wafer , removing the Rinse off center and adding scan in recipe can reduce the center cluster to some extent 2.Reducing the rinse flow rate can solve the center problem, because in this way, flow rate and spin speed can have a better combination to give a better cleaning effect					



IP5X DEV chamber Matching

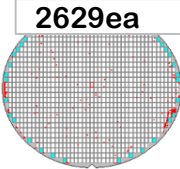
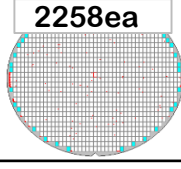
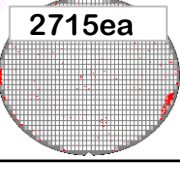
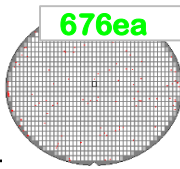
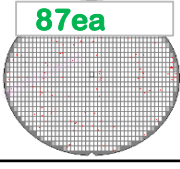


Resi st	Prod uct		DEV Units				
IP5X	Base line Total defect : ~100	Unit	SDC2	SDC3	SDC4	SDC5	SDC6
		Defect Map					
		Concl usion	SDC5 Unit shows that wafer edge has much defect in unexposed area, and this situation is mainly fixed in SDC5, but never happened in SDC2 with the same recipe, so compare the hardware differences between different units				

SDC2-6 hardware comparison

Hardware parameters	rinse press	rinse flow rate ml/min	Nozzle angle/度	Nozzle height/m	BSR	EXH	Chuck VAC/pa	Chuck condition	Rinse lead	LD dispense	rinse 管径	AWC position
SDC2	0.49mpa	High	big	high	Normal	low	Normal	Normal	No	Normal	same	Normal
SDC3		Low	small	High	Normal	medium	Normal	Normal	No		same	
SDC4		Low	big	High	Normal	medium	Normal	Normal	No		same	
SDC5	0.48mpa	Medium	big	High	Shift 1mm	strong	Normal	Normal	No		same	
SDC6		low	small	low	Normal	Error	Normal	Normal	No		same	

According to the position of defect, four most possible hardware settings are changed to make comparison experiment

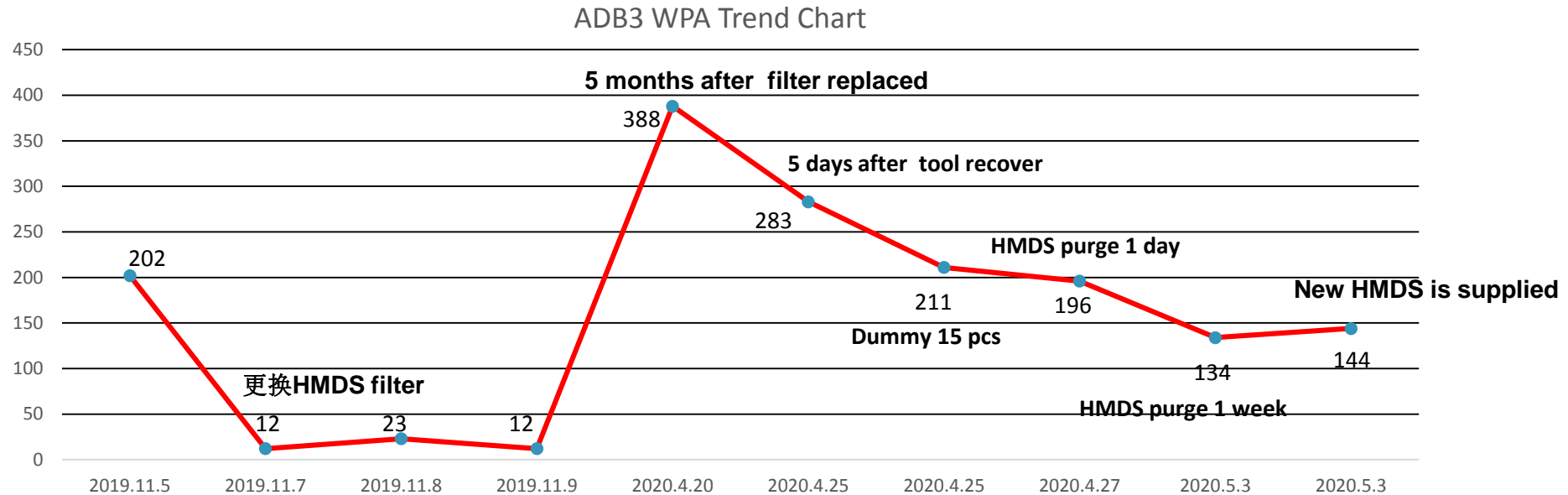
SDC center problem solving process (in SDC5 unit)							
IP5X	Base line Total defect : ~100	changes	None	EBR position	SDC5&7cupre placement	Reduce Exh pressure	reduced Rinse flow rate
		Defect Map					
		conclusion	Defect in edge is related to EXH and Rinse flow.				



1. HMDS suffered high wet Particle .
 - **Direct cause :** HMDS tank long idle , the remaining chemical soak in tank too long . HMDS gel generated and induce the particle after evaporation .
 - **Root cause :** HMDS Tank design weakness .
 1. HMDS HH to H to L sensor distance is too long , result fresh HMDS can't be refilled on time.
 2. tank have big capacity , long width and height , HMDS top up slowly .
 3. HMDS supply without temperature control .



ADB3 HMDS WPA trend chart



1. After filter replacement , WPA trend down . After 1 week , WPA trend up again. It mean, the pipe line or HMDS tank contain particle.

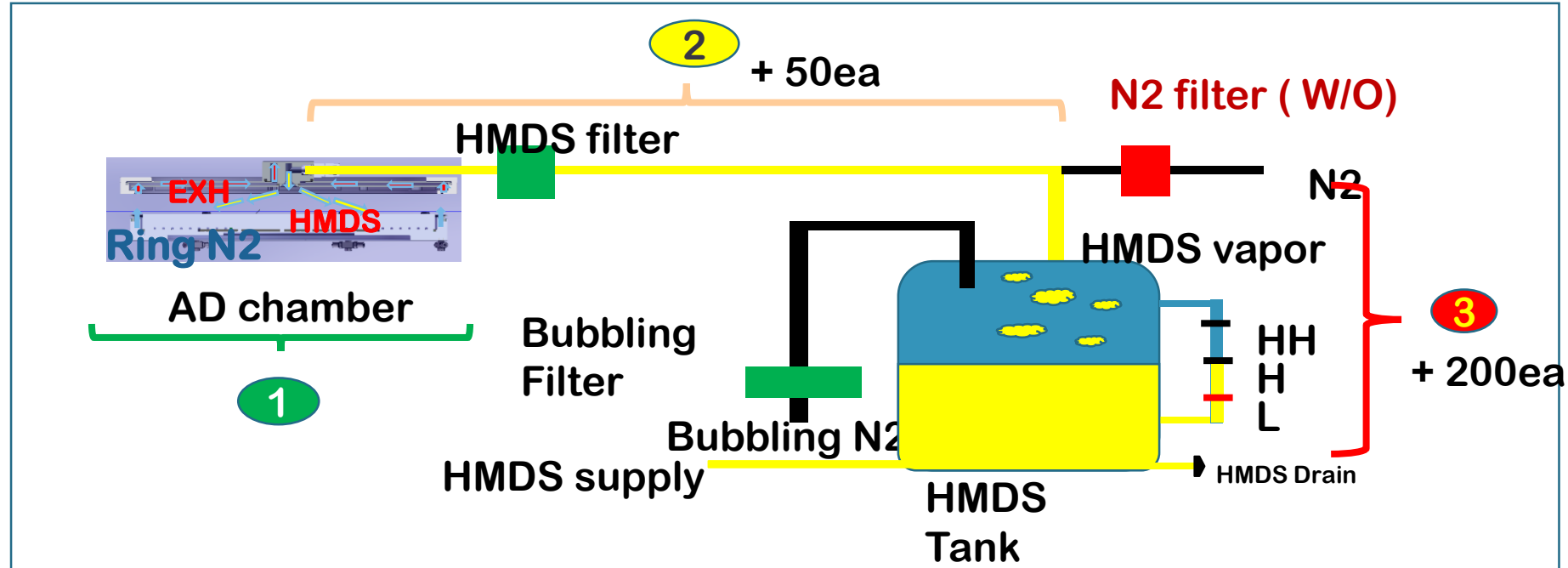
2. Pipe accounts for only 50 in total AD WPA of about 300, and it can be eliminated through N2 purge

3. AD contamination is not from outdated HMDS, because after new liquid is supplied, no change in its WPA

Possible cause : Long idle cause chemical crystal result contamination in the TANK .

K HMDS Structure :

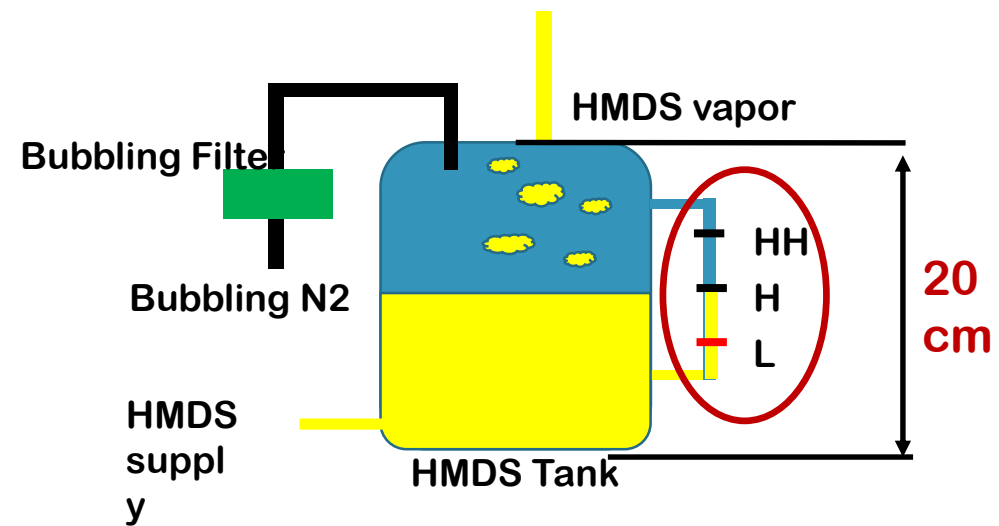
K ADH chamber Structure :



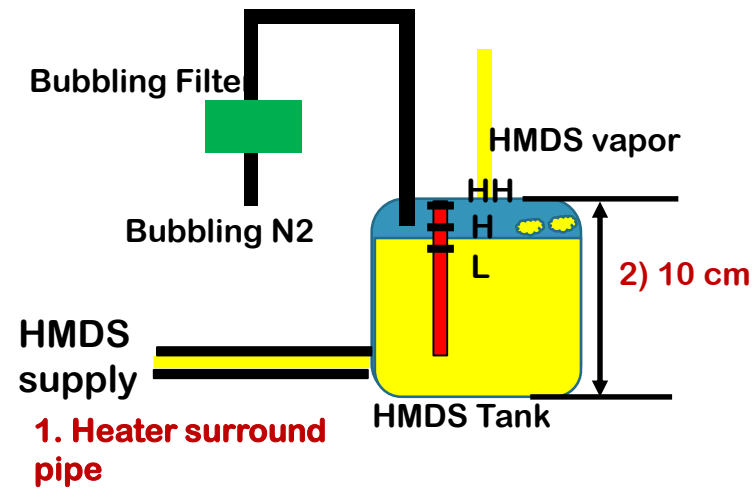
ADH Wet Particle 3 major paths

1. **AD chamber** : no correlation after multiple parameters split
2. **HMDS + N2 Pipe line** : **minor factor** , Add 50 ea after tuning on N2 W/O HMDS
3. **HMDS vapor line + Tank** : **Major Factor** , add 200 ea+ after tuning on HMDS .
 - Possible cause : HMDS tank long idle , tank was contaminated after HMDS soaking longy .

K ADH chamber old Structure :



ADH chamber new Structure :



	Height of Tank	Liquid level sensor	HMDS supply pipe
New HMDS TANK	10mm	in tank	with heat preservation
old HMDS TANK	20mm	out of tank	Without heat preservation
conclusion	1.HMDS is a kind of chemical that is easy to volatile and crystallize between liquid and solid 2.New tank can effectively avoid the volatilization and crystallization of HMDS		





Part 3

Company Introduction

- Founded in 2002 and headquartered at Shenyang with branches at **Shanghai, Guangzhou, and Taiwan**
- Number 1 domestic photo track supplier in China
- Serviced markets: photo tracks for LED, bumping, advanced packaging and IC manufacturing
- 350 employees, IP portfolio includes over 300 patents
- Fully-equipped R&D labs for hardware design and process verification
- In-house manufacturing capability

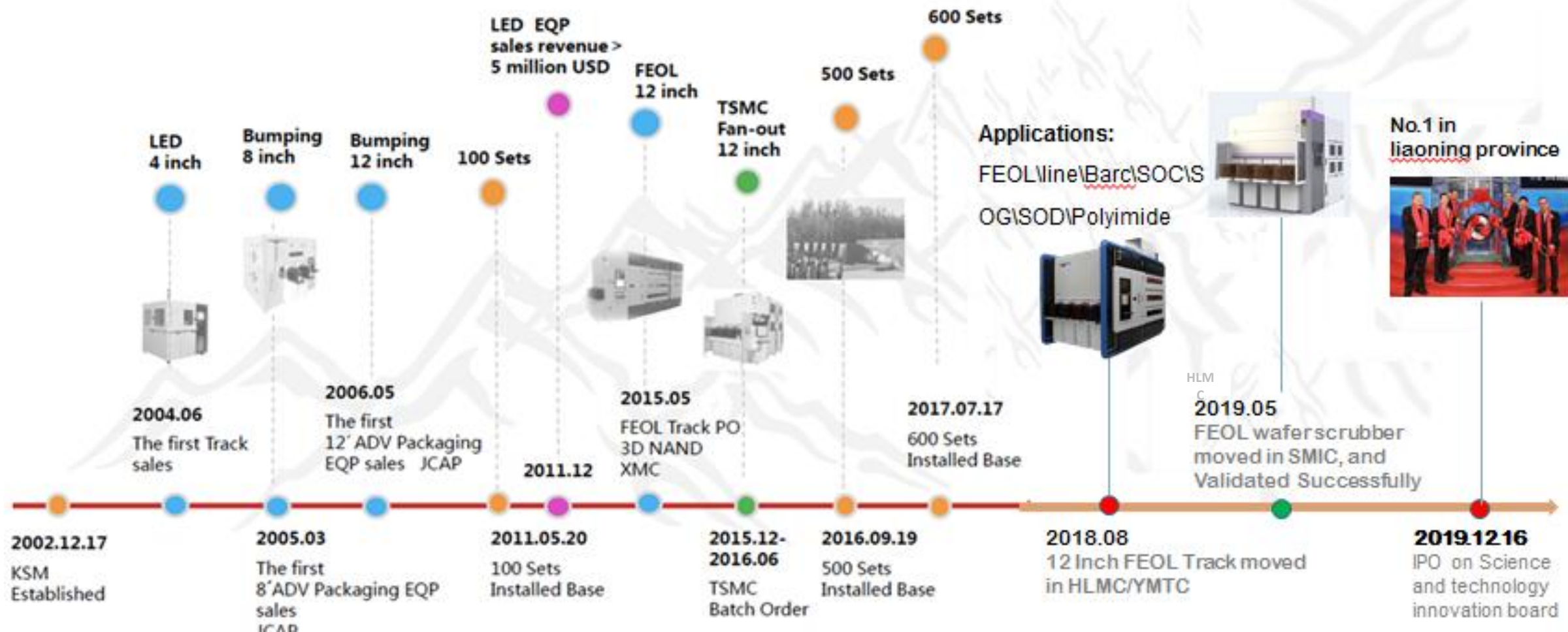


Our vision: To become a world-class company respected by the community

Our mission: To create value for our customers with high-quality products and services

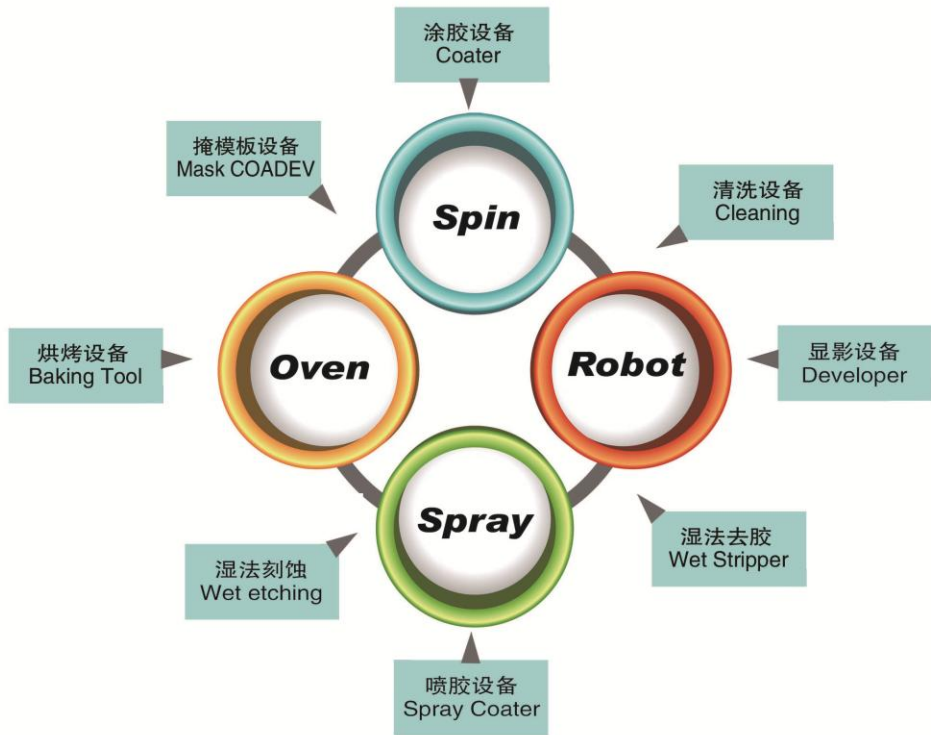
KINGSEMI Profile

KSM Roadmap



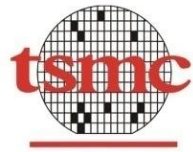
KINGSEMI Profile

Markets and customer base



- LED, CIS, Domestic market share $\geq 60\%$
- Install base > 800 sets; Customer > 100
- Advanced packaging products penetration to TSMC, for major components of Apple Iphone .

Application	Customer
IC manufacturing	YMTC\HLMC\SMIC \GTA\CXMT\BOE
Advanced packaging 200mm 300mm	WLCSP
	HuaTian
	JCAP
	Xintec
	TSMC LT
LED/Compound/MEMS	> 200



KINGSEMI Profile



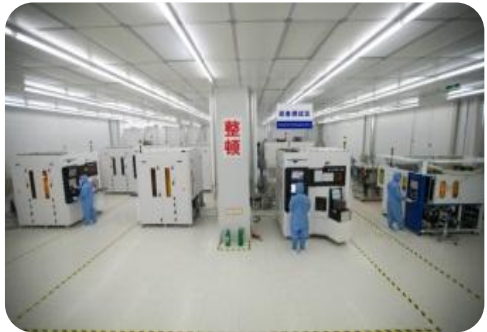
R&D and production Capacity



Class 10 clean Room : > 16.3 m²



Class 100 Lab : 240m²



Class 1K & 10K Clean Room
1020m²



Class 100K installation Room :
720m²

Company have enough capability for tool installation .



KingSemi owned self inspection platform, include SP3 , CD SEM , FX ...

KSM FEOL Track Introduction



Coater/Developer System



Front Track KS-FT300

Features

- Low Particle wafer Transfer system
- Improved overall equipment efficiency (OEE) for litho cells
- Reduced Cost of Owner (CoO) 、 Cost of Consumables (CoC)
- **Throughput: ≥ 240 WPH , Inline or offline**

Applications

- **DUV、 I-line lithography、 Barc 、 PI Coating**
- Spin-on carbon、 dielectrics、 glass
- 200mm and 300mm wafers

Configuration

- **Multiple chambers, flexible configuration according to customer requirements**

Thanks

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