

觸控面板用白色光阻

SW 5550

台灣永光化學 電子化學事業 研發二部
2016/12/30

Properties

Properties of SW 5550

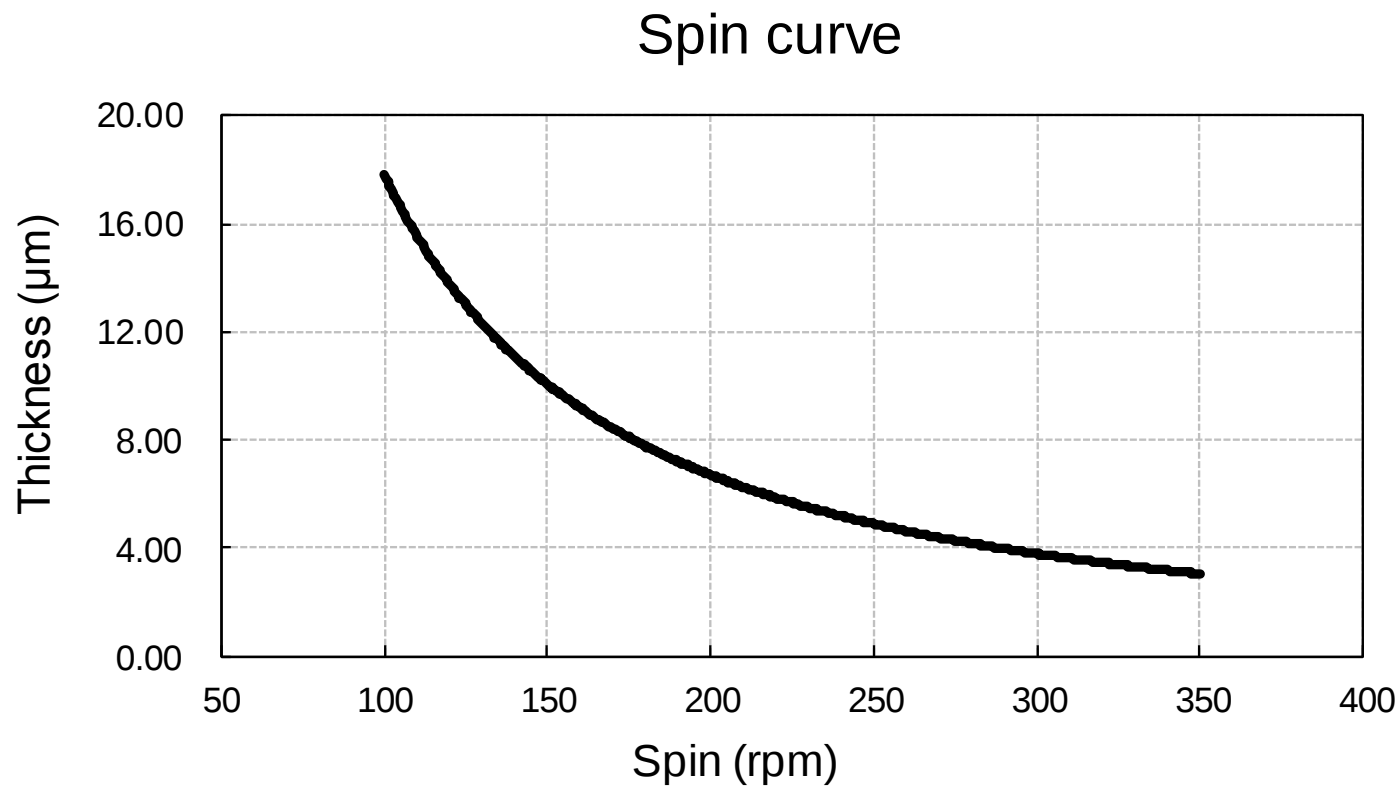
Characteristic	Properties
Solid content	48.0 %
Viscosity	6.0 $\pm$ 1.5 cP
OD value (glass side)	0.75 (12 μ m)
Surface resistance	$>10^{14}$ (230 $^{\circ}$ C $\times$ 30 min.) Ω / cm ²
Uniformity	$\leq$ 5 %
Adhesion (Cross-cut tester with 3M 610 tape)	$\geq$ 4B (STN/TNCS)

Recipe

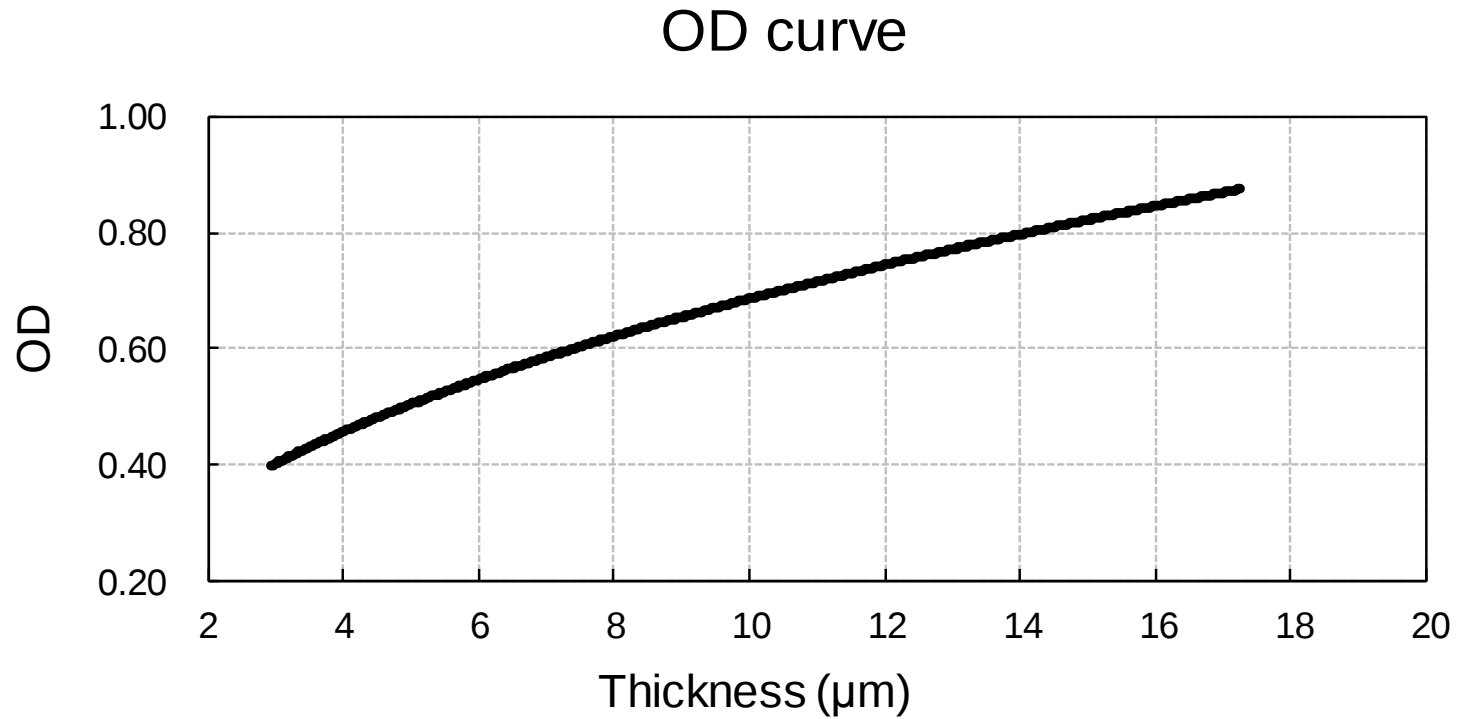
Process Condition of SW 5550

Target thickness	12.0 μm
Substrate	STN/TNCS
Vacuum	400 Pa
Pre-bake (hot plate)	100 °C × 5min. (100 °C keep time 120 sec.)
Exposure (broad band)	400 mJ/cm ² (H line), 240 mJ/cm ² (I line), gap = 100 μm
Development	23 °C, 40 ~ 60 sec. (spray), ENPD 23 (KOH type) 1 wt.% 24 °C, 40 ~ 60 sec. (spray), ENPD 22 (KOH type) 2 wt.% 23 °C, 40 ~ 50 sec. (spray), ENPD 72 (Buffer type) 5 wt.% 25 °C, 30 ~ 50 sec. (spray), ENPD 80 (Buffer type) 10 wt.%
Rinse	Running DI water, 30 sec.
Post-bake	230 °C × 30 min. (oven)

Spin Curve



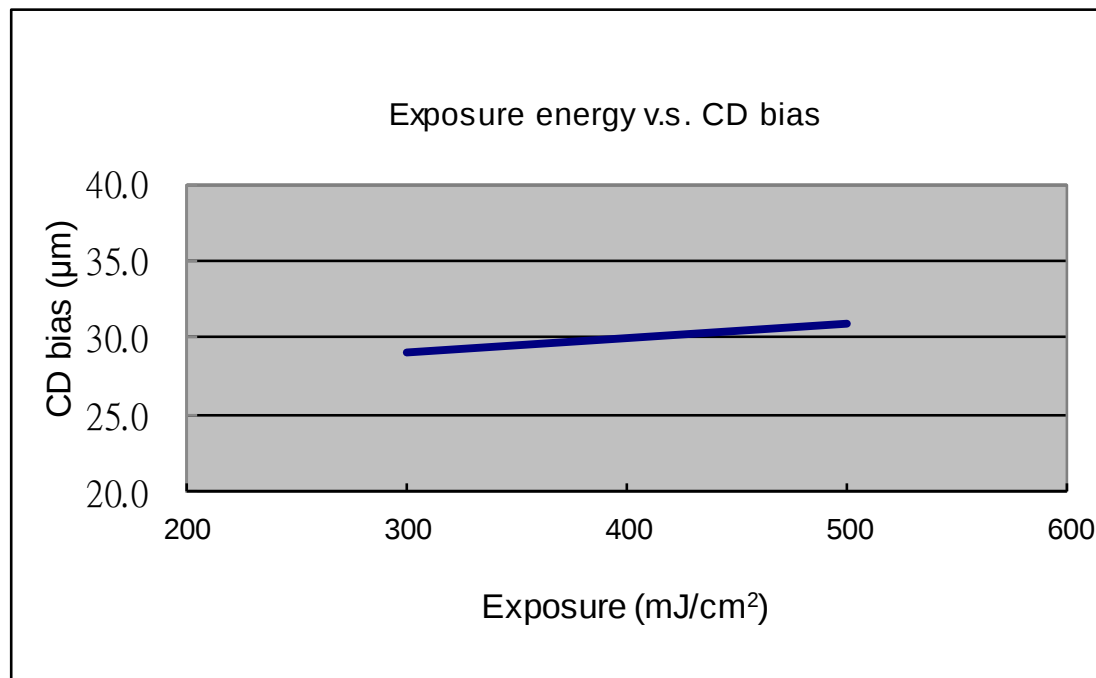
OD Curve



Exposure Windows (ENPD 23)

Exposure (mJ/cm ²)	CD Bias (μm)
300	29
400	30
500	31

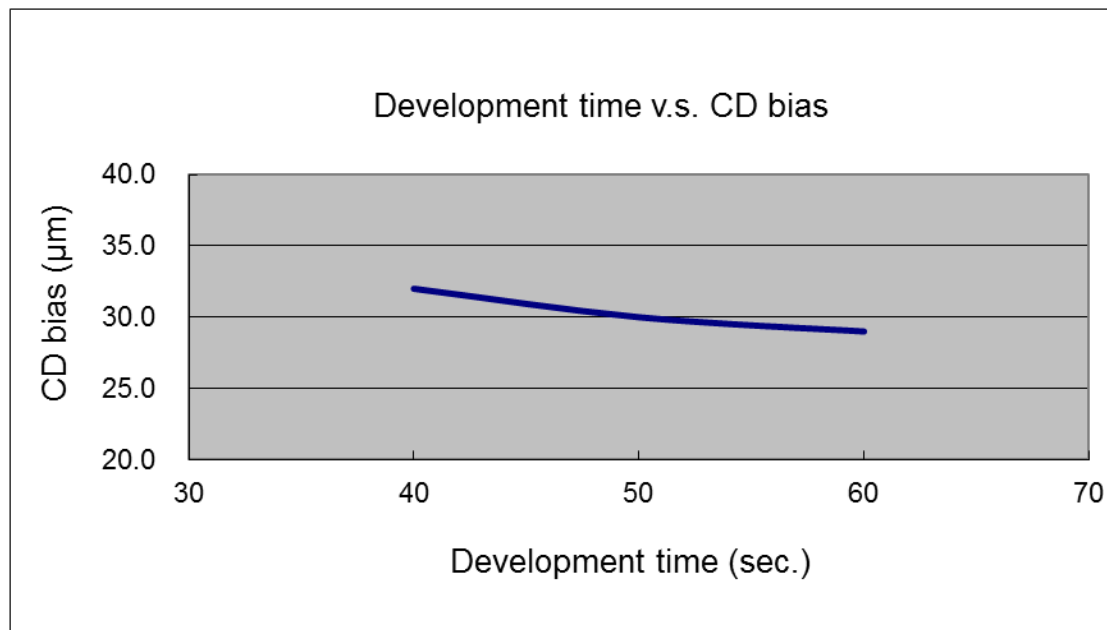
- Development time : 50 sec.
- Thickness :12.0 μm
- Mask line space : 200.0 μm
- Exposure(broad band):H line



Development Windows (ENPD 23)

D.T. (sec.)	CD Bias (μm)
40	33
50	30
60	29

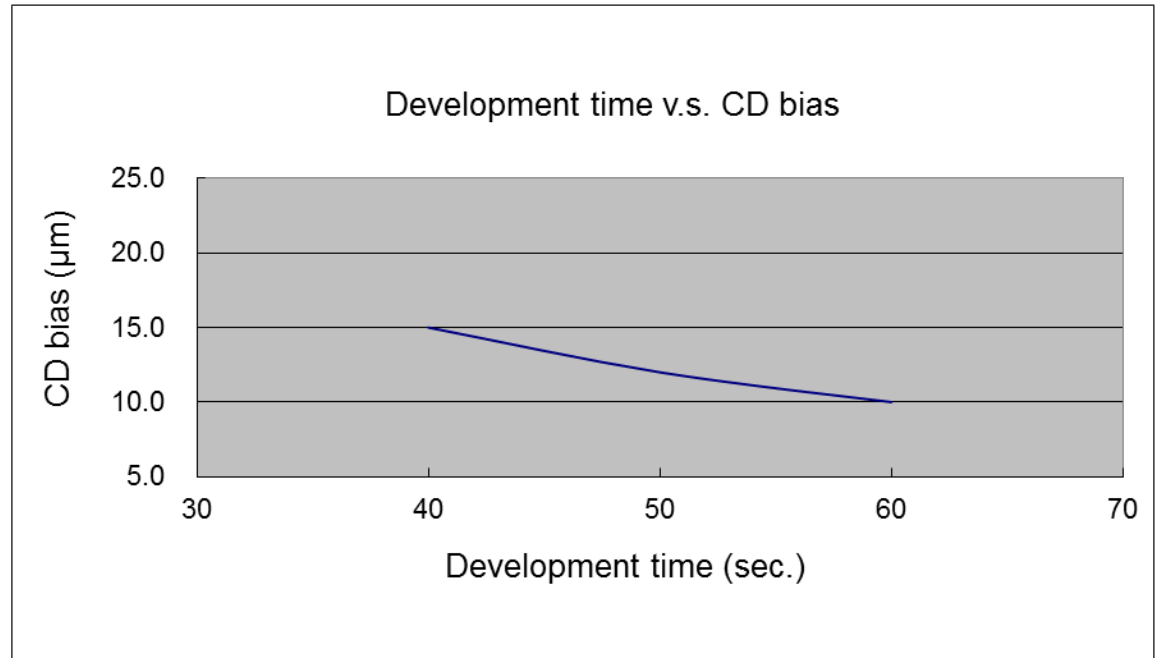
- Exposure(broad band) :
H line 400 mJ/cm²
- Thickness :12.0 μm
- Mask line space : 200.0 μm



Development Windows (ENPD 22)

D.T. (sec.)	CD Bias (μm)
40	15
50	12
60	10

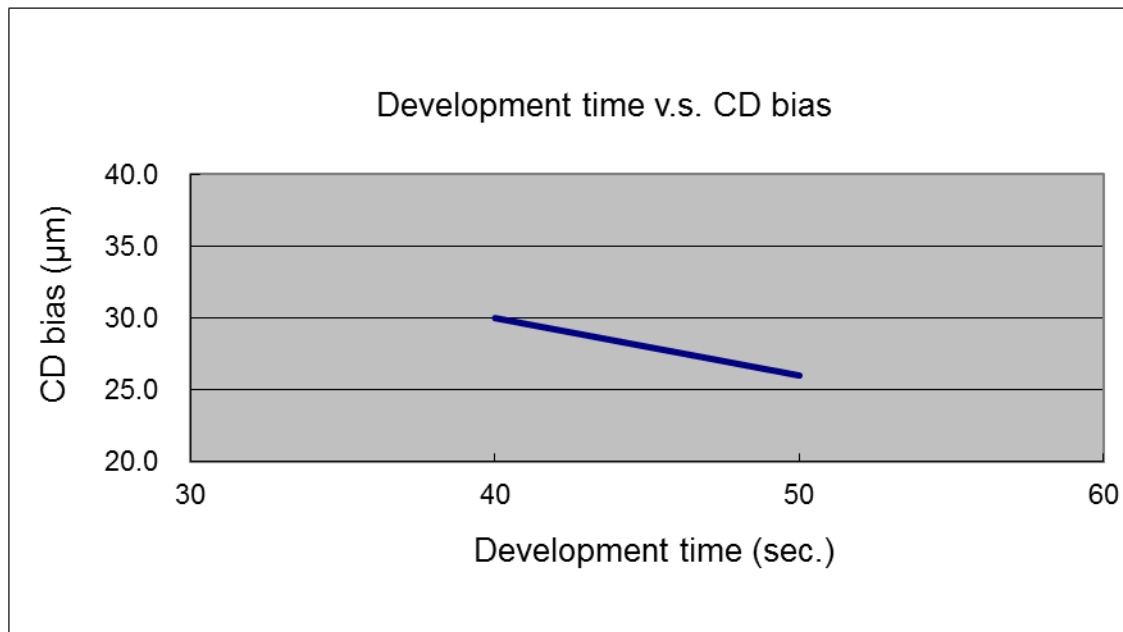
- Exposure(broad band) :
H line 400 mJ/cm²
- Thickness :12.0 μm
- Mask line space : 200.0 μm



Development Windows (ENPD 72)

D.T. (sec.)	CD Bias (μm)
40	30
50	26

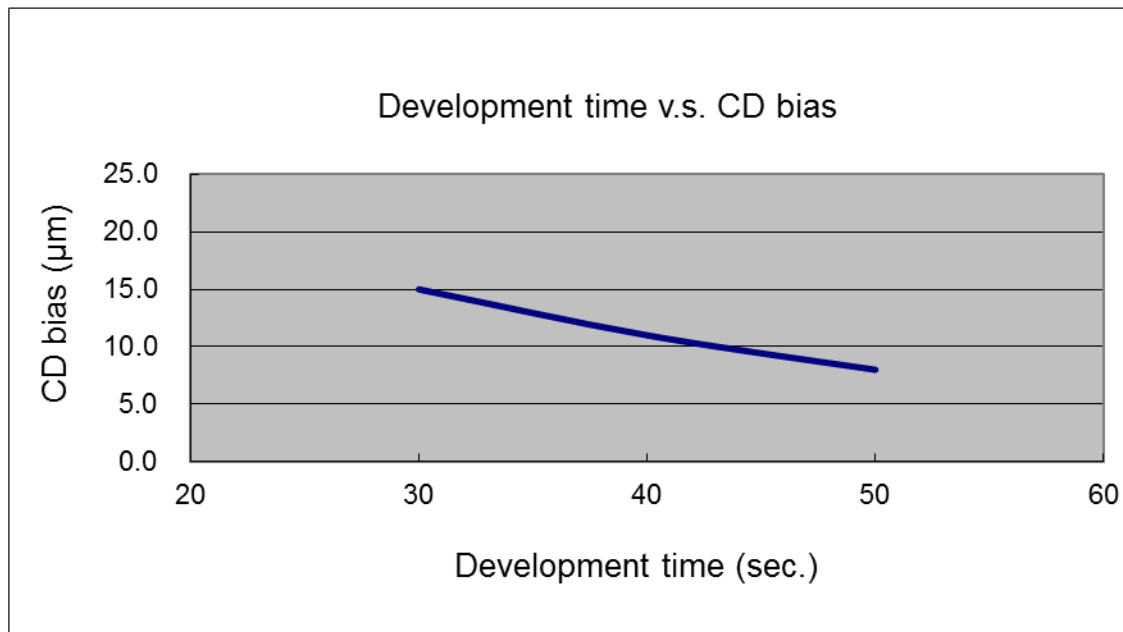
- Exposure(broad band) :
H line 400 mJ/cm^2
- Thickness : $12.0 \mu\text{m}$
- Mask line space : $200.0 \mu\text{m}$



Development Windows (ENPD 80)

D.T. (sec.)	CD Bias (μm)
30	15
40	11
50	8

- Exposure(broad band) :
H line 400 mJ/cm²
- Thickness :12.0 μm
- Mask line space : 200.0 μm



Single-layer WPR=12 μm

Heat Test (230 °C 、 250 °C) L* a* b*

	Thickness (μm)	OD value	L*	a*	b *
WPR $\times$ 1 (after post-bake)	12.00	0.75	84	-1.38	-0.67
Heat test 1 (230 °C $\times$ 150 min.)	11.95	0.75	84	-1.47	-0.42
Heat test 2 (230 °C $\times$ 150 min. $\rightarrow$ 250 °C $\times$ 60 min.)	11.90	0.75	84	-1.52	-0.20

- Substrate : TFT
- WPR : White photoresist SW 5550
- Heat test*¹ : after post-bake $\rightarrow$ 230 °C $\times$ 150 min. (oven)
- Heat test*² : after post-bake $\rightarrow$ 230 °C $\times$ 150 min. $\rightarrow$ 250 °C $\times$ 60 min. (oven)
- Chromaticity : measured by Konica Minolta CM-700d

Single-layer WPR=10 μm

Heat Test (230 °C 、 250 °C) L* a* b*

	Thickness (μm)	OD value	L*	a*	b *
			(measured from glass side)		
WPR × 1 (after post-bake)	10.12	0.70	84	-1.44	-0.34
Heat test 1 (230 °C × 150 min.)	10.09	0.70	84	-1.47	-0.14
Heat test 2 (230 °C × 150 min. → 250 °C × 60 min.)	10.00	0.70	84	-1.51	0.06

- Substrate : TFT
- WPR : White photoresist SW 5550
- Heat test*¹ : after post-bake → 230 °C × 150 min. (oven)
- Heat test*² : after post-bake → 230 °C × 150 min. → 250 °C × 60 min. (oven)
- Chromaticity : measured by Konica Minolta CM-700d

Surface Resistance

Surface resistance (Ω/cm^2)		
Post-baked	230 °C × 30 min.	$>10^{14}$
Heat test	250 °C × 60 min.	$>10^{14}$

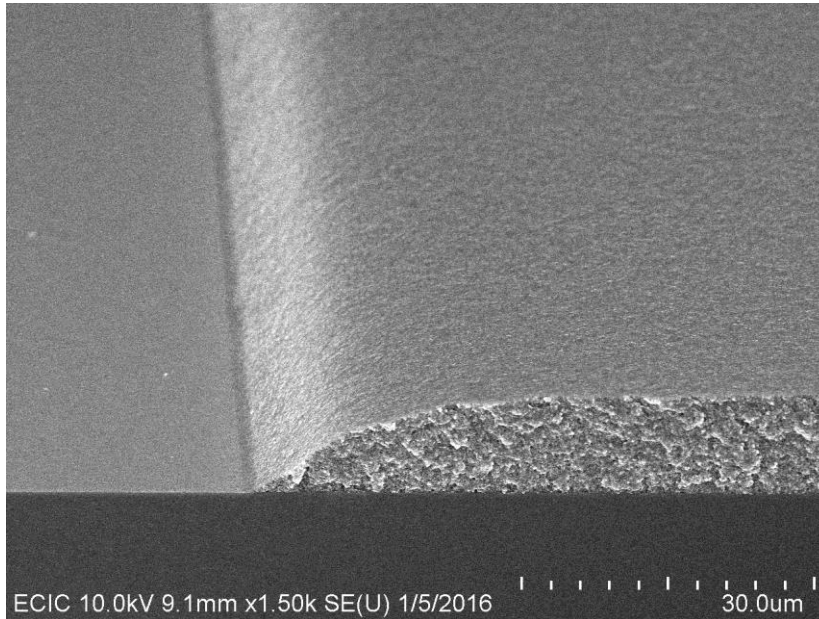
- Recipe : spin coating → 100 °C × 5 min. (100 °C keep time 120 sec.)
→ 400 mJ/cm² (H line) → 23 °C, 50 sec., ENPD 23, 1 wt.% → 230 °C
× 30 min. (oven) → 250 °C × 60 min. (oven) resistance test.
- Using HIOKI SM-8220 with 500 V.

Adhesion

Thickness (μm)	FeCl_3 $40\text{ }^\circ\text{C} \times 90\text{ sec.}$	10 % 王水 $40\text{ }^\circ\text{C} \times 120\text{ sec.}$	25 % HCl $40\text{ }^\circ\text{C} \times 15\text{ min.}$	超音波 $25\text{ }^\circ\text{C} \times 20\text{ min.}$	環測
WPR = 12 μm	$\geq 4\text{B}$	$\geq 4\text{B}$	$\geq 4\text{B}$	$\geq 4\text{B}$	$\geq 4\text{B}$

- 1.製程：塗佈(STN/TNCS)→軟烤→曝光→顯影→硬烤→信賴性測試→百格刮刀→3M膠帶
- 2.耐氯化鐵蝕刻條件：26 ml 之 37 wt % HCl + 10 ml H_2O + 0.8 ml 之 42 % FeCl_3 。
- 3.耐王水蝕刻條件：10 wt %王水。
- 4.耐超音波震盪條件：80 W ; 43 KHz 。
- 5.耐鹽酸蝕刻條件：25 % HCl 。
- 6.環境測試：工作溫度：60 $^\circ\text{C}$; 相對溼度90 % ; Process time : 240 hr. 。

SEM



Taper angle = 28°
Thickness = $12.0\ \mu\text{m}$

- Recipe : spin coating → vacuum 400 Pa (no keep time) → $100\ ^{\circ}\text{C} \times 5\ \text{min.}$ ($100\ ^{\circ}\text{C}$ keep time 120 sec.) → $400\ \text{mJ/cm}^2$ (H line) → $23\ ^{\circ}\text{C}$, 50 sec., ENPD 23, 1 wt.% → $230\ ^{\circ}\text{C} \times 30\ \text{min.}$ (oven)

TGA

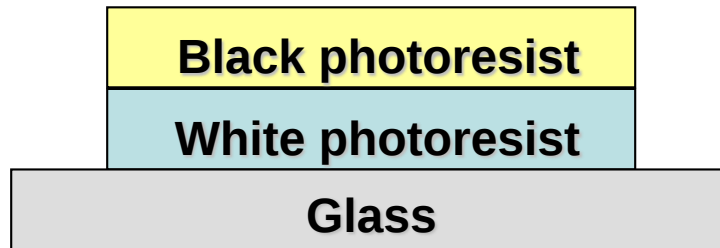
	Program 1		Program 2	Program 3
	°C	wt. loss (%)	wt. loss (%)	wt. loss (%)
SW 5550	280	1.0	1.0	1.2
	360	2.0		
	395	3.0		
	> 400	4.0		
		5.0		

Program 1 : 25 °C to 400 °C, Rate = 10 °C/min.

Program 2 : 25 °C to 250 °C, Rate = 10 °C/min. → 250 °C Hold 60 min.

Program 3 : 25 °C to 280 °C, Rate = 10 °C/min. → 280 °C Hold 60 min.

Multi-layer Solution(WPR+BM)



Recipe

* White photoresist **SW 5550** (12.0 μm) $\times$ 1 layers

SW 5550 (12.0 μm) : spin coating $\rightarrow$ vacuum 400 Pa (no keep time) $\rightarrow$ 100 $^{\circ}\text{C} \times$ 5 min. (100 $^{\circ}\text{C}$ keep time 120 sec.) $\rightarrow$ 400 mJ/cm^2 (H line) $\rightarrow$ 23 $^{\circ}\text{C}$, **50 sec.**, ENPD 23 , 1 wt.% $\rightarrow$ 230 $^{\circ}\text{C} \times$ 30 min. (oven)

* Black photoresist **EK 620** (1.5 μm) $\times$ 1 layer

90 $^{\circ}\text{C} \times$ 5 min. $\rightarrow$ 200 mJ/cm^2 (H line) $\rightarrow$ 23 $^{\circ}\text{C}$, **90 sec.**, ENPD 23 , 1 wt.% $\rightarrow$ 230 $^{\circ}\text{C} \times$ 30 min. (oven)

Multi-layer WPR=12 μm

Heat Test (230 °C 、 250 °C) L* a* b*

	Thickness (μm)	OD value	L*	a*	b *
			(measured from glass side)		
WPR $\times$ 1 + EK 620 $\times$ 1 (after post-bake)	13.50	3.75	83	-1.85	-1.14
Heat test 1 (230 °C $\times$ 150 min.)	13.40	3.75	83	-1.92	-0.90
Heat test 2 (230 °C $\times$ 150 min. $\rightarrow$ 250 °C $\times$ 60 min.)	13.33	3.75	83	-1.97	-0.40

- Substrate : TFT
- WPR : White photoresist SW 5550
- Heat test*1 : after post-bake $\rightarrow$ 230 °C $\times$ 150 min. (oven)
- Heat test*2 : after post-bake $\rightarrow$ 230 °C $\times$ 150 min. $\rightarrow$ 250 °C $\times$ 60 min. (oven)
- Chromaticity : measured by Konica Minolta CM-700d

Multi-layer WPR=10 μm

Heat Test (230 °C 、 250 °C) L* a* b*

	Thickness (μm)	OD value	L*	a*	b *
			(measured from glass side)		
WPR $\times$ 1 + EK 620 $\times$ 1 (after post-bake)	11.62	3.70	83	-1.84	-0.73
Heat test 1 (230 °C $\times$ 150 min.)	11.55	3.70	83	-1.89	-0.54
Heat test 2 (230 °C $\times$ 150 min. $\rightarrow$ 250 °C $\times$ 60 min.)	11.42	3.70	83	-1.97	-0.27

- Substrate : TFT
- WPR : White photoresist SW 5550
- Heat test*¹ : after post-bake $\rightarrow$ 230 °C $\times$ 150 min. (oven)
- Heat test*² : after post-bake $\rightarrow$ 230 °C $\times$ 150 min. $\rightarrow$ 250 °C $\times$ 60 min. (oven)
- Chromaticity : measured by Konica Minolta CM-700d

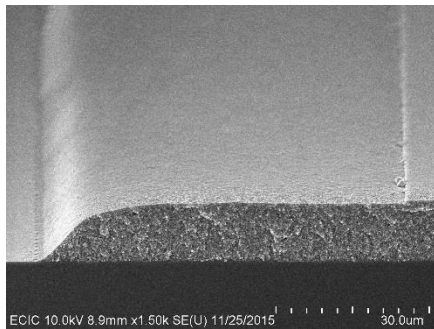
Adhesion

Thickness (μm)	FeCl_3 40 °C × 90 sec.	10 % 王水 40 °C × 120 sec.	25 % HCl 40 °C × 15 min.	超音波 25 °C × 20 min.	環測
WPR×1 + BM×1 ≒ 13.5 μm	≥ 4B	≥ 4B	≥ 4B	≥ 4B	≥ 4B

- 1.製程：塗佈(STN/TNCS)→軟烤→曝光→顯影→硬烤→信賴性測試→百格刮刀→3M膠帶
- 2.耐氯化鐵蝕刻條件：26 ml 之 37 wt % HCl + 10 ml H_2O + 0.8 ml 之 42 % FeCl_3 。
- 3.耐王水蝕刻條件：10 wt %王水。
- 4.耐超音波震盪條件：80 W；43 KHz。
- 5.環境測試：工作溫度：60 °C；相對溼度90 %；Process time：240 hr.。

SEM-(WPR+BM)疊層設計

漸縮式



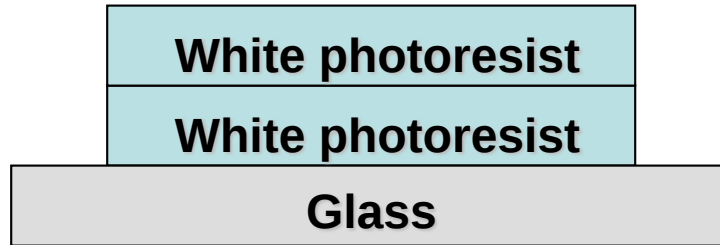
覆蓋式



SW 5550 (12.0 μm) : spin coating $\rightarrow$ vacuum 400 Pa (no keep time) $\rightarrow$
100 $^{\circ}\text{C} \times 5$ min. (100 $^{\circ}\text{C}$ keep time 120 sec.) $\rightarrow$ 400 mJ/cm^2 (H line) $\rightarrow$
23 $^{\circ}\text{C}$, **50 sec.**, ENPD 23 , 1 wt.% $\rightarrow$ 230 $^{\circ}\text{C} \times 30$ min. (oven)

EK 620 (1.5 μm) : spin coating $\rightarrow$ 90 $^{\circ}\text{C} \times 5$ min. $\rightarrow$ 200 mJ/cm^2 (H line) $\rightarrow$
23 $^{\circ}\text{C}$, **90 sec.**, ENPD 23 , 1 wt.% $\rightarrow$ 230 $^{\circ}\text{C} \times 30$ min. (oven)

Multi-layer Solution(WPR+WPR)



Recipe

* White photoresist **SW 5550 (12.0 μm)** × **2 layers**

SW 5550 (12.0 μm) : spin coating → vacuum 400 Pa (no keep time) → 100 °C × 5 min. (100 °C keep time 120 sec.) → 400 mJ/cm² (H line) → 23 °C, **50 sec.**, ENPD 23 , 1 wt.% → 230 °C × 30 min. (oven)

SW 5550 (12.0 μm) : spin coating → vacuum 400 Pa (no keep time) → 100 °C × 5 min. (100 °C keep time 120 sec.) → 400 mJ/cm² (H line) → 23 °C, **50 sec.**, ENPD 23 , 1 wt.% → 230 °C × 30 min. (oven)

Multi-layer

Heat Test (230 °C 、 250 °C) L* a* b*

	Thickness (μm)	OD value	L*	a*	b *
			(measured from glass side)		
WPR × 2 (after post-bake)	24.15	0.90	86	-1.47	1.09
Heat test 1 (230 °C × 150 min.)	24.08	0.90	86	-1.52	1.55
Heat test 2 (230 °C × 150 min. → 250 °C × 60 min.)	23.94	0.90	86	-1.52	1.98

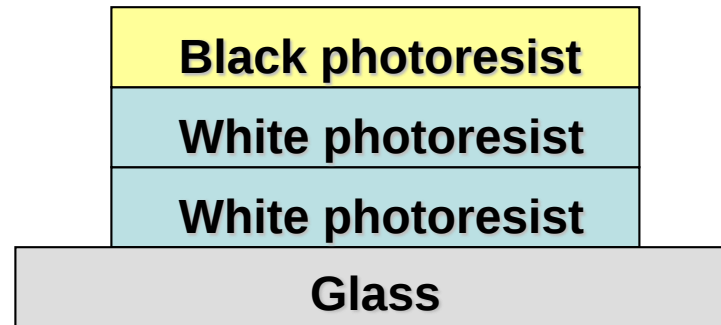
- Substrate : TFT
- WPR : White photoresist SW 5550
- Heat test*¹ : after post-bake → 230 °C × 150 min. (oven)
- Heat test*² : after post-bake → 230 °C × 150 min. → 250 °C × 60 min. (oven)
- Chromaticity : measured by Konica Minolta CM-700d

Multi-layer Adhesion

Thickness (μm)	FeCl_3 40 °C × 90 sec.	10 % 王水 40 °C × 120 sec.	超音波 25 °C × 20 min.	環測
WPR×2 ≒ 24 μm	$\geq 4\text{B}$	$\geq 4\text{B}$	$\geq 4\text{B}$	$\geq 4\text{B}$

- 1.製程：塗佈(STN/TNCS)→軟烤→曝光→顯影→硬烤→信賴性測試→百格刮刀→3M膠帶
- 2.耐氯化鐵蝕刻條件：26 ml 之 37 wt % HCl + 10 ml H_2O + 0.8 ml 之 42 % FeCl_3 。
- 3.耐王水蝕刻條件：10 wt %王水。
- 4.耐超音波震盪條件：80 W；43 KHz。
- 5.環境測試：工作溫度：60 °C；相對溼度90 %；Process time：240 hr.。

Multi-layer Solution(WPR+WPR+BM)



Recipe

* White photoresist **SW 5550** (12.0 μm) $\times$ 2 layers

SW 5550 (12.0 μm) : spin coating $\rightarrow$ vacuum 400 Pa (no keep time) $\rightarrow$ 100 $^{\circ}\text{C} \times$ 5 min. (100 $^{\circ}\text{C}$ keep time 120 sec.) $\rightarrow$ 400 mJ/cm^2 (H line) $\rightarrow$ 23 $^{\circ}\text{C}$, **50 sec.**, ENPD 23, 1 wt.% $\rightarrow$ 230 $^{\circ}\text{C} \times$ 30 min. (oven)

SW 5550 (12.0 μm) : spin coating $\rightarrow$ vacuum 400 Pa (no keep time) $\rightarrow$ 100 $^{\circ}\text{C} \times$ 5 min. (100 $^{\circ}\text{C}$ keep time 120 sec.) $\rightarrow$ 400 mJ/cm^2 (H line) $\rightarrow$ 23 $^{\circ}\text{C}$, **50 sec.**, ENPD 23, 1 wt.% $\rightarrow$ 230 $^{\circ}\text{C} \times$ 30 min. (oven)

* Black photoresist **EK 620** (1.5 μm) $\times$ 1 layer

90 $^{\circ}\text{C} \times$ 5 min. $\rightarrow$ 200 mJ/cm^2 (H line) $\rightarrow$ 25 $^{\circ}\text{C}$, **90 sec.**, ENPD 23, 1 wt.% $\rightarrow$ 230 $^{\circ}\text{C} \times$ 30 min. (oven)

Electronic Chemicals

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Multi-layer

Heat Test (230 °C 、 250 °C) L* a* b*

	Thickness (μm)	OD value	L*	a*	b *
			(measured from glass side)		
WPR $\times$ 2 + EK 620 $\times$ 1 (after post-bake)	25.65	4.20	86	-1.64	1.28
Heat test 1 (230 °C $\times$ 150 min.)	25.50	4.20	86	-1.65	1.69
Heat test 2 (230 °C $\times$ 150 min. $\rightarrow$ 250 °C $\times$ 60 min.)	25.40	4.20	86	-1.66	2.09

- Substrate : TFT
- WPR : White photoresist SW 5550
- Heat test*¹ : after post-bake $\rightarrow$ 230 °C $\times$ 150 min. (oven)
- Heat test*² : after post-bake $\rightarrow$ 230 °C $\times$ 150 min. $\rightarrow$ 250 °C $\times$ 60 min. (oven)
- Chromaticity : measured by Konica Minolta CM-700d

Multi-layer Adhesion

Thickness (μm)	FeCl_3 40 °C × 90 sec.	10 % 王水 40 °C × 120 sec.	超音波 25 °C × 20 min.	環測
WPR×2 + BM×1 ≒ 25.5 μm	≥4B	≥4B	≥4B	≥4B

- 1.製程：塗佈(STN/TNCS)→軟烤→曝光→顯影→硬烤→信賴性測試→百格刮刀→3M膠帶
- 2.耐氯化鐵蝕刻條件：26 ml 之 37 wt % HCl + 10 ml H_2O + 0.8 ml 之 42 % FeCl_3 。
- 3.耐王水蝕刻條件：10 wt %王水。
- 4.耐超音波震盪條件：80 W；43 KHz。
- 5.環境測試：工作溫度：60 °C；相對溼度90 %；Process time：240 hr.。

SW 5550 使用前處理方式

- SW 5550滾動分散方式：

環境溫度 (°C)	瓶身轉速 (rpm)	滾動時間 (hr.)
25	80	2

- SW 5550白色光阻靜置發生沉降後，25 °C恆溫30min.後經滾動80 rpm × 2小時，可使光阻分散均勻。
- SW 5550白色光阻經滾動分散後，靜置下可使用時間為8小時。