



허들링 2017

LS-9029 TDS

KOLON INDUSTRIES

2017. 5. 30

1. Summary of General Properties < CONFIDENTIAL >

Item		LS-9029	LS-9025	A (25 μ m)
Minimum Develop Time (sec.)		25	21	20
Develop Break Point		50%	50%	50%
Sensitivity (sst/41sst)	40 mJ/cm ²	10.8	10.8	11.2
	50 mJ/cm ²	12.3	12.7	12.9
	62 mJ/cm ²	13.8	14.0	14.2
	75 mJ/cm ²	15.2	15.3	15.8
Resolution (μ m) (400 μ m / X)	40 mJ/cm ²	10.0	9.0	12.0
	50 mJ/cm ²	10.5	10.0	12.5
	62 mJ/cm ²	11.0	10.5	13.5
	75 mJ/cm ²	12.0	12.0	15.0
Adhesion (μ m) (X / 400 μ m)	40 mJ/cm ²	8.5	8.0	8.5
	50 mJ/cm ²	7.5	7.0	7.5
	62 mJ/cm ²	7.0	7.0	7.0
	75 mJ/cm ²	6.5	6.0	6.5
1/1 Resolution (μ m)	40 mJ/cm ²	8.5	8.5	12.0
	50 mJ/cm ²	9.5	9.0	11.0
	62 mJ/cm ²	10.0	10.0	12.0
	75 mJ/cm ²	11.0	10.5	14.0

본 문서는 영업상 주요 자산으로서 부정경쟁방지 및 영업비밀보호에 관한 법률을 포함하여 관련 법령에 따라 보호되는 중요한 정보를 포함하고 있으므로, 그 전부 또는 일부를 무단으로 열람하거나 공개, 사용, 복제, 유출 등은 하는 행위는 엄격히 금지됩니다.

1. Summary of General Properties

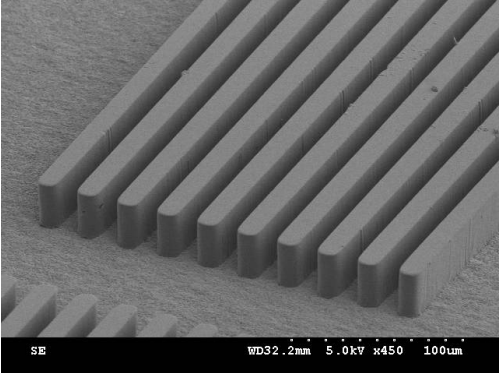
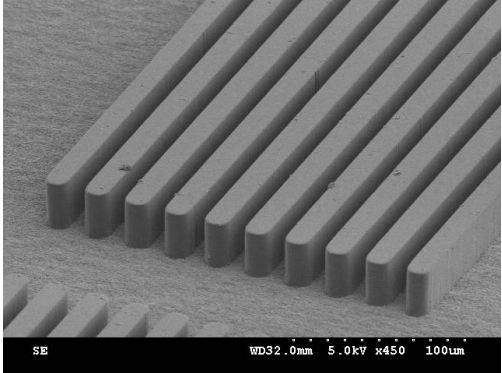
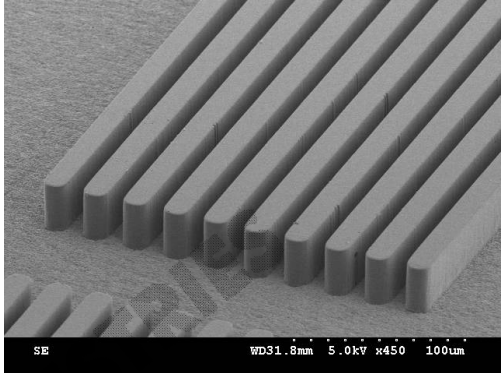
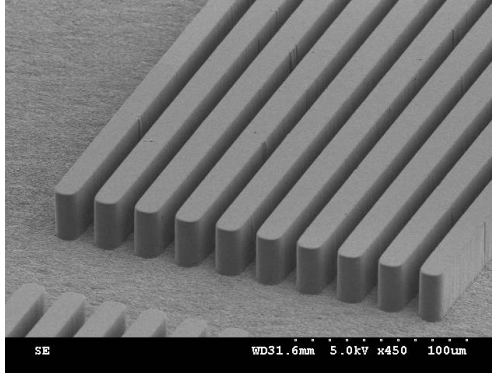
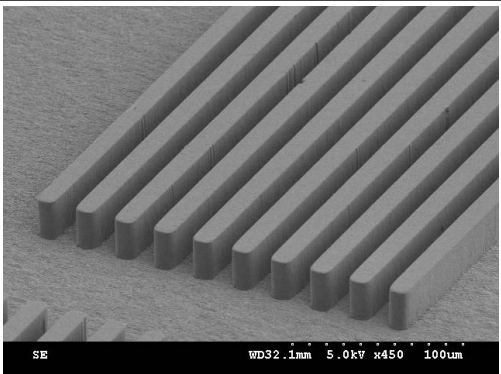
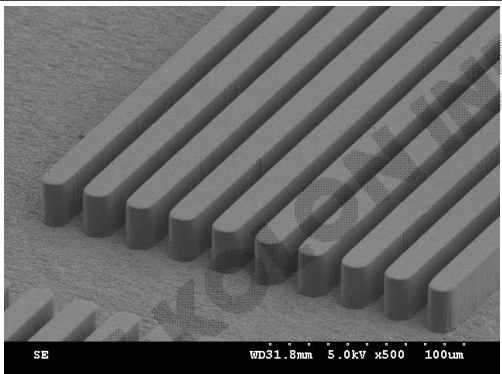
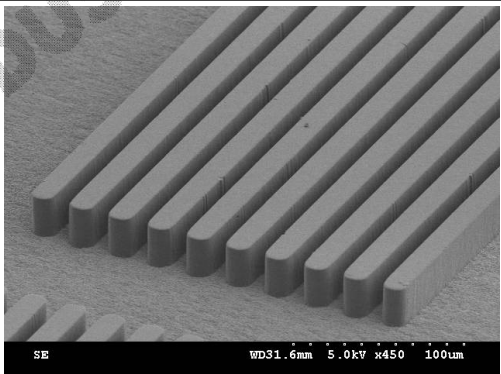
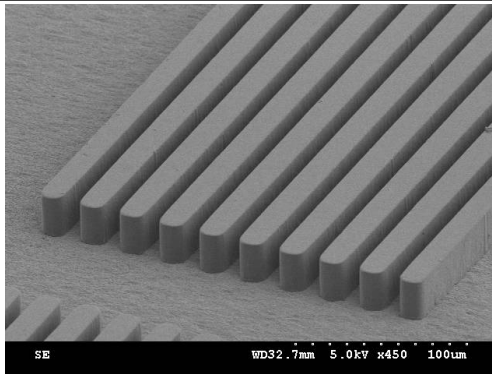
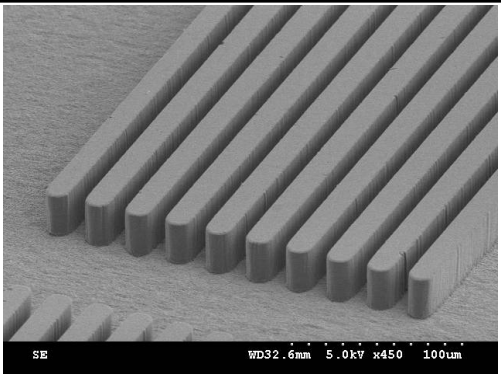
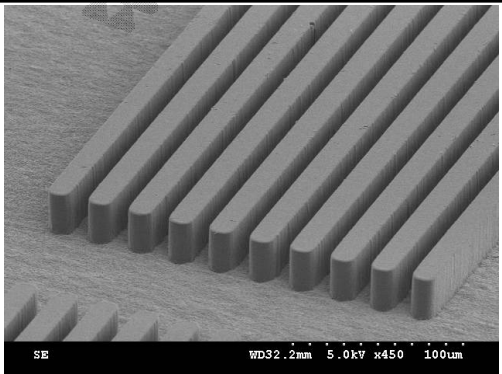
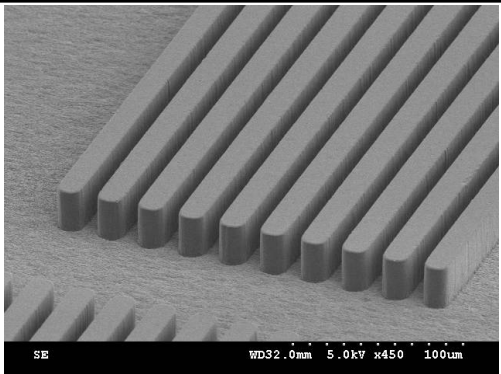
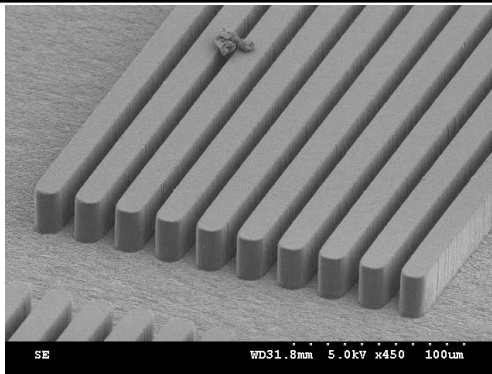
< CONFIDENTIAL >

Item		LS-9029		LS-9025		A (25 μ m)	
	Point	Top	Bottom	Top	Bottom	Top	Bottom
Line Width (μ m (measured value/12 μ m)) L/S=12 μ m/12 μ m	40 mJ/cm ²	14.7 (1.22)	14.5 (1.21)	13.8 (1.15)	14.1 (1.17)	15.6 (1.30)	15.5 (1.29)
	50 mJ/cm ²	15.8 (1.32)	15.6 (1.30)	15.4 (1.28)	15.8 (1.32)	16.5 (1.37)	16.1 (1.34)
	62 mJ/cm ²	16.2 (1.35)	16.2 (1.35)	15.7 (1.31)	15.8 (1.32)	16.7 (1.39)	16.6 (1.39)
	75 mJ/cm ²	16.5 (1.37)	16.6 (1.38)	16.3 (1.36)	16.4 (1.36)	17.2 (1.44)	17.3 (1.44)
	Resist Foot (μ m)	50 mJ/cm ²	0.47		0.23		0.56
Development	Minimum develop Time (sec.)	25		21		20	
	Form Height (cm)	-		1.9		-	
	Scum	-		None		-	
	Sludge (g)	-		0.21		-	
Stipping (R-100S)	40 mJ/cm ²	33 SS		30 SS		48 SS	
	50 mJ/cm ²	34 SS		31 SS		49 SS	
	62 mJ/cm ²	36 SS		33 SS		51 SS	
	75 mJ/cm ²	39 SS		37 SS		55 SS	
Plating	Hull Cell test	Normal		Normal		Normal	
	TOC	337 (Blank 197)		337 (Blank 197)		348 (Blank 197)	
Cross hatch test (X/5)		1		1		1	
Hardness test (μ m)		62.0		58.0		78.5	

2. Test Condition

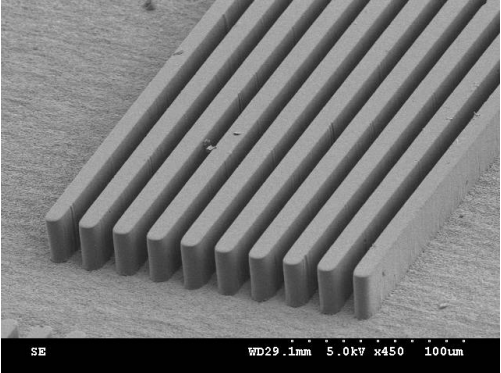
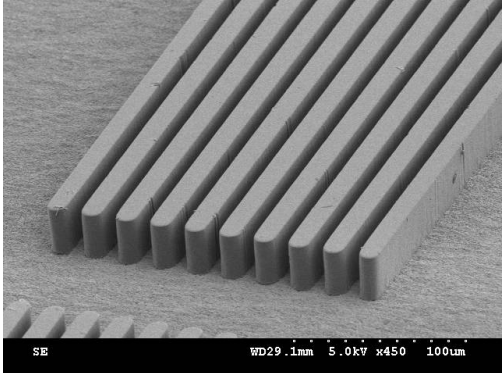
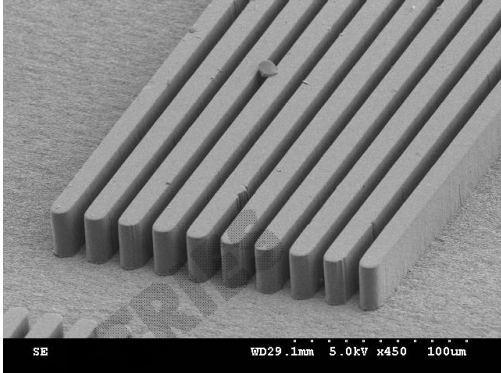
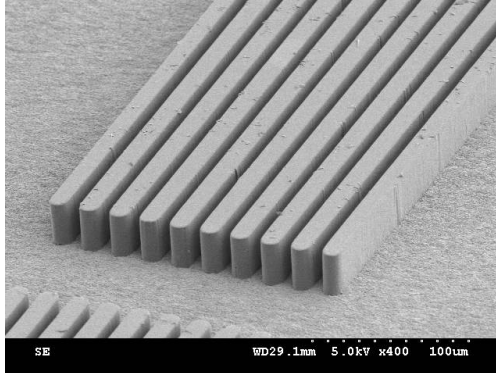
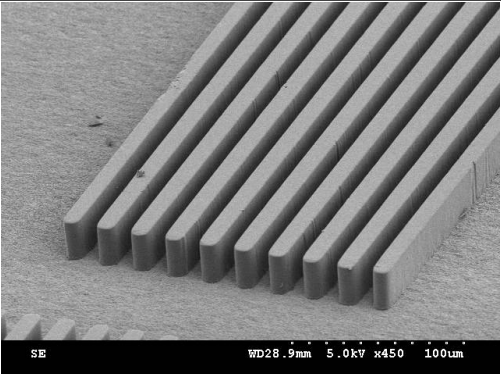
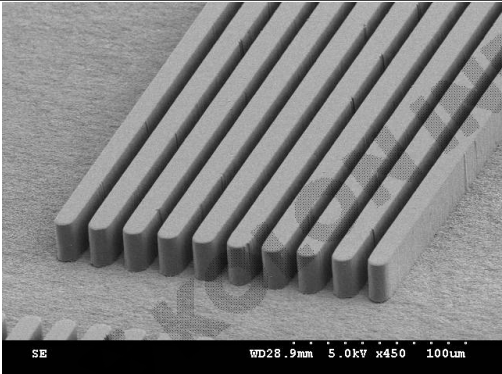
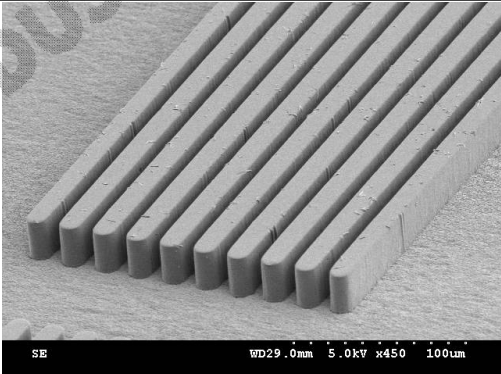
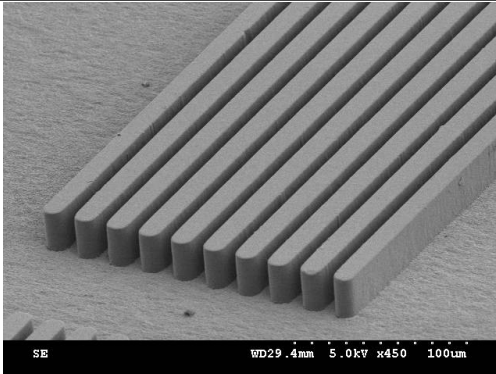
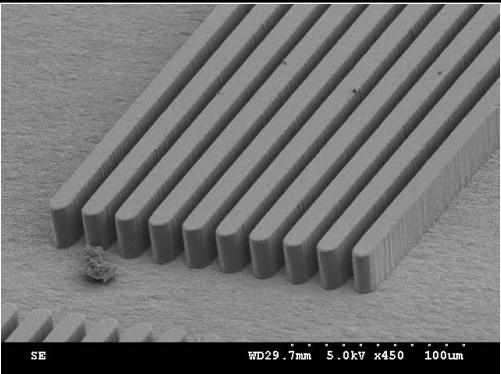
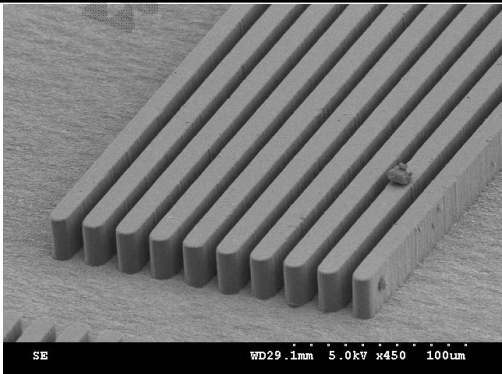
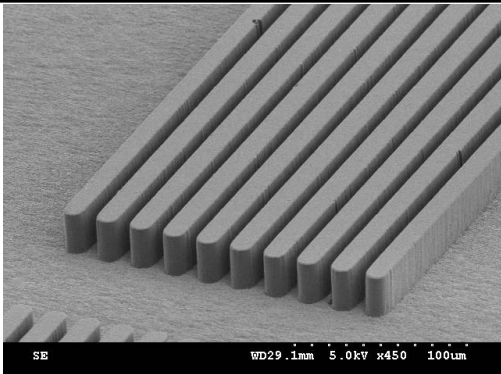
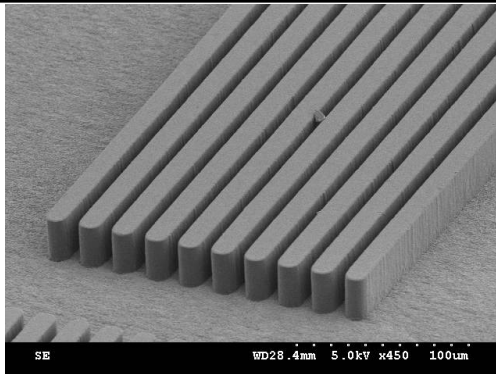
Process	Condition
Pretreatment	① 1/3 Oz CCL (DS-7409HG, T/T 0.4) - 1 μ m soft etching, etchant : LSE803 (leadchem), Ra 0.26 μ m ② Ubl Flex-DL (DL-2512-R) → Mandrel test - PI 25 μ m, Cu 12 μ m - No Substrate Pretreatment
Lamination	- Hakuto 610i - Temp. 110°C, Speed 1.5m/min, Pressure 5Kgf/cm ²
Holding	- 30 min
Exposure	- Hitachi Via Mechanics DE-1UH, 405nm DI, Correction Value 2.0 μ m - Circuit property and Stripping : Exposure Energy 40, 50, 62, 75 mJ/cm ² - Other property : 50 mJ/cm ²
Holding	- 30 min
Development	- 1.0wt% Na ₂ CO ₃ , Temp. 30 °C, Spray Pressure 1.5kg/cm ² - Circuit Property : Break Point 50% - Other Property : Break point 50%

3-1. 1/1 Resolution (L/S = 12 μ m/12 μ m) < CONFIDENTIAL >

	40 mJ/cm ²	50 mJ/cm ²	62 mJ/cm ²	75 mJ/cm ²
LS 9029				
LS 9025				
A (25 μ m)				

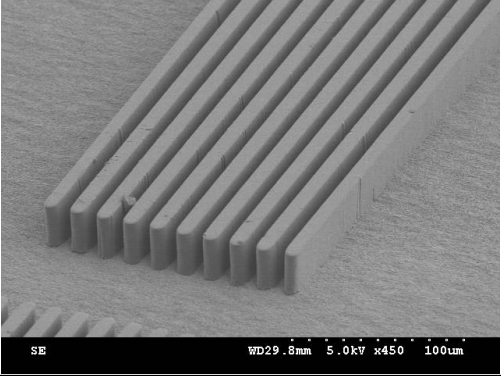
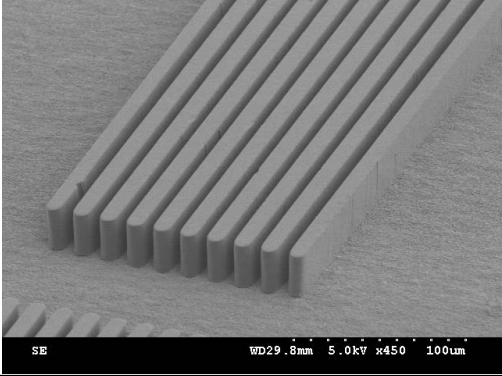
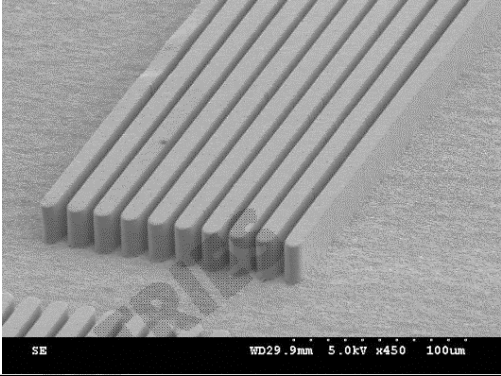
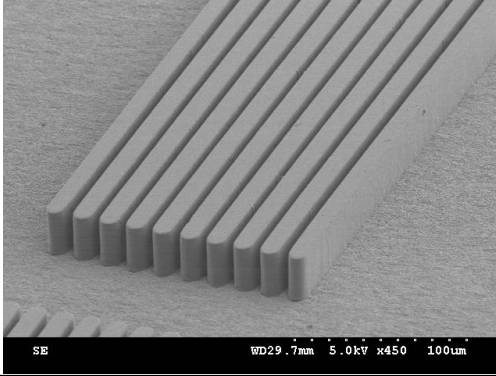
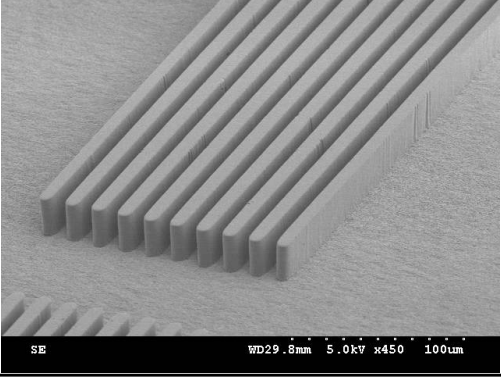
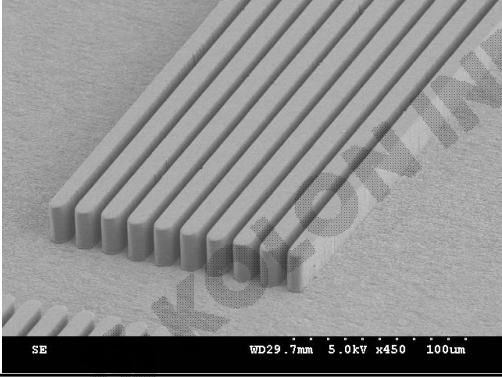
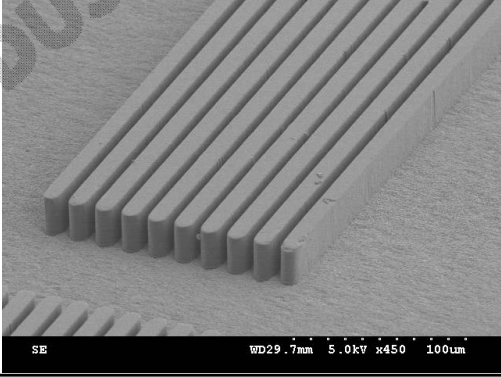
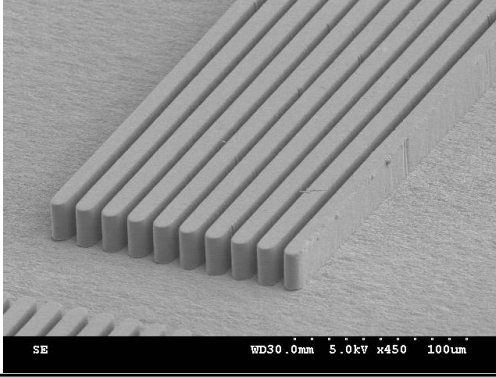
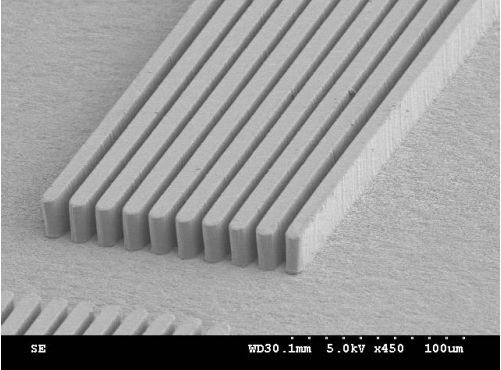
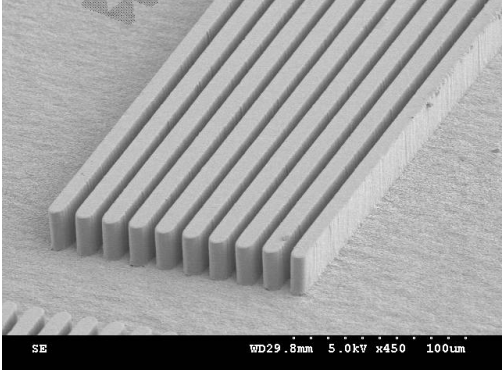
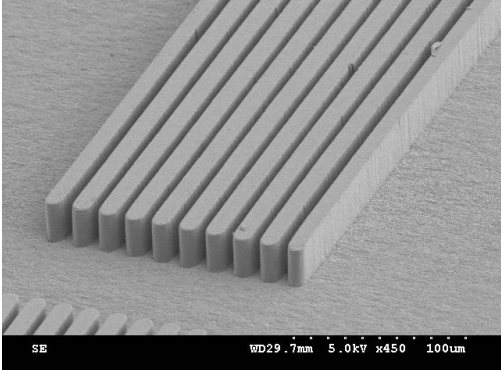
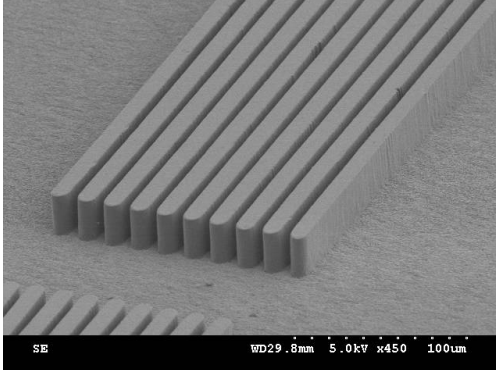
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3-1. 1/1 Resolution (L/S = 10 μ m/10 μ m) < CONFIDENTIAL >

	40 mJ/cm ²	50 mJ/cm ²	62 mJ/cm ²	75 mJ/cm ²
LS 9029	 SE WD29.1mm 5.0kV x450 100um	 SE WD29.1mm 5.0kV x450 100um	 SE WD29.1mm 5.0kV x450 100um	 SE WD29.1mm 5.0kV x400 100um
LS 9025	 SE WD28.9mm 5.0kV x450 100um	 SE WD28.9mm 5.0kV x450 100um	 SE WD29.0mm 5.0kV x450 100um	 SE WD29.4mm 5.0kV x450 100um
A (25 μ m)	 SE WD29.7mm 5.0kV x450 100um	 SE WD29.1mm 5.0kV x450 100um	 SE WD29.1mm 5.0kV x450 100um	 SE WD28.4mm 5.0kV x450 100um

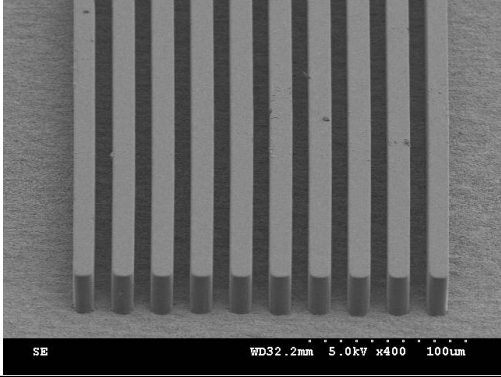
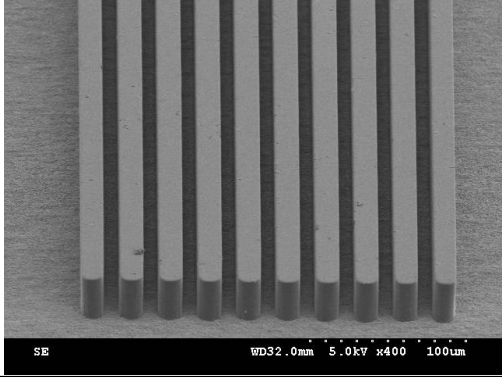
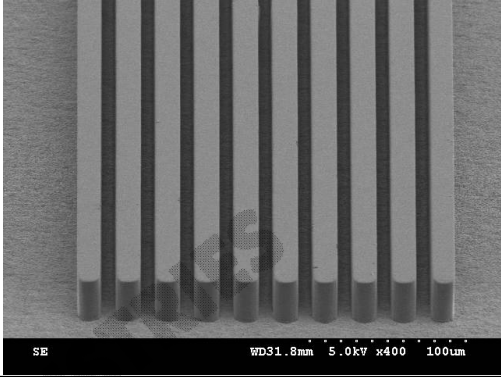
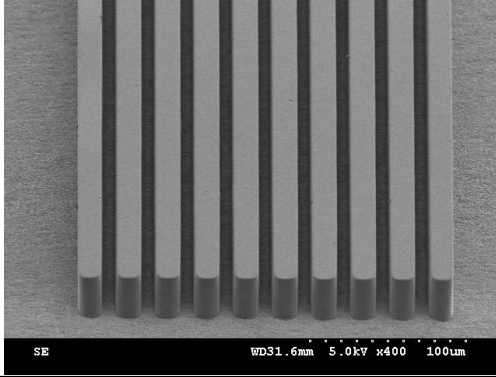
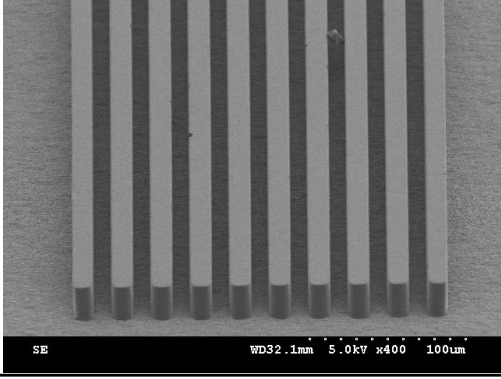
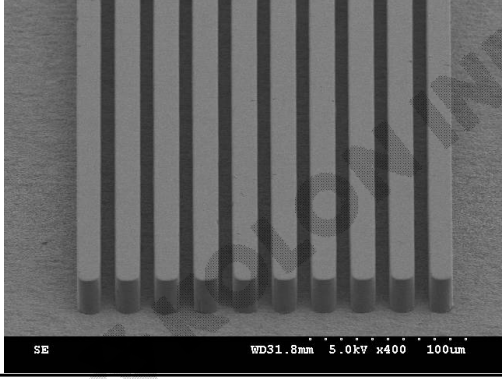
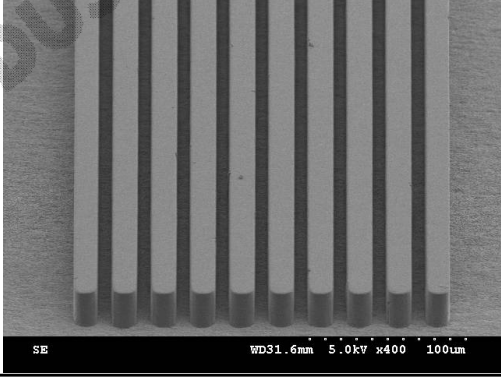
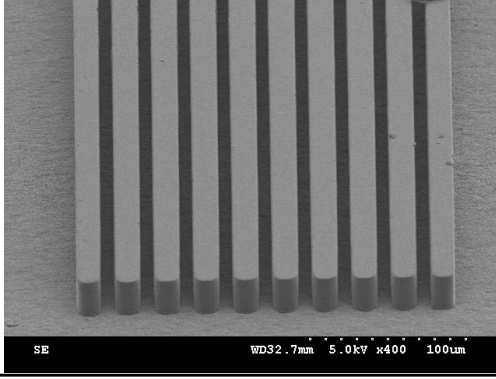
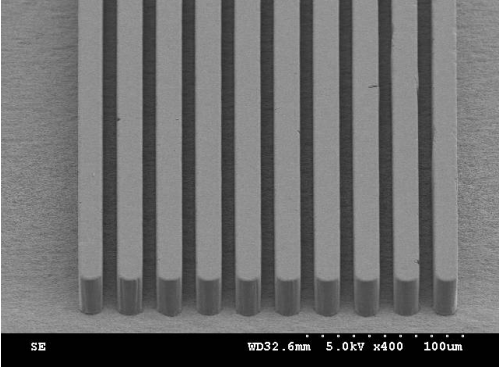
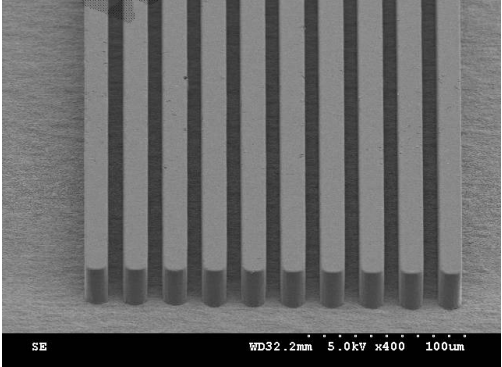
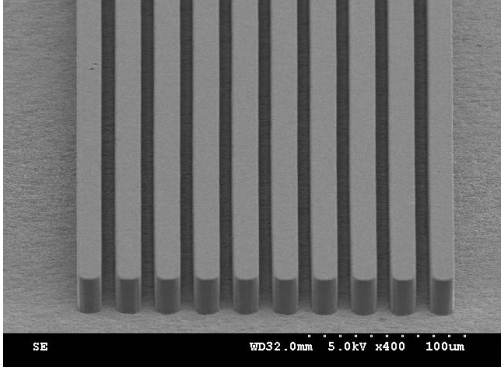
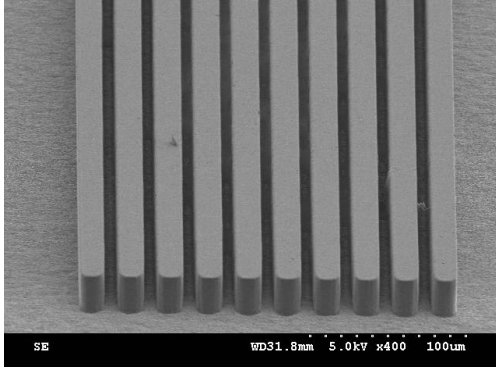
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3-1. 1/1 Resolution (L/S = $8\mu\text{m}/8\mu\text{m}$) < CONFIDENTIAL >

	40 mJ/cm ²	50 mJ/cm ²	62 mJ/cm ²	75 mJ/cm ²
LS 9029	 SE WD29.8mm 5.0kV x450 100um	 SE WD29.8mm 5.0kV x450 100um	 SE WD29.9mm 5.0kV x450 100um	 SE WD29.7mm 5.0kV x450 100um
LS 9025	 SE WD29.8mm 5.0kV x450 100um	 SE WD29.7mm 5.0kV x450 100um	 SE WD29.7mm 5.0kV x450 100um	 SE WD30.0mm 5.0kV x450 100um
A (25 μm)	 SE WD30.1mm 5.0kV x450 100um	 SE WD29.8mm 5.0kV x450 100um	 SE WD29.7mm 5.0kV x450 100um	 SE WD29.8mm 5.0kV x450 100um

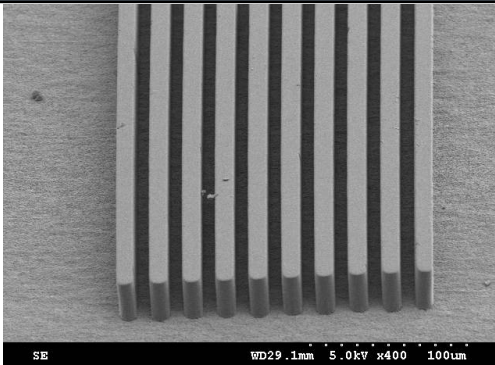
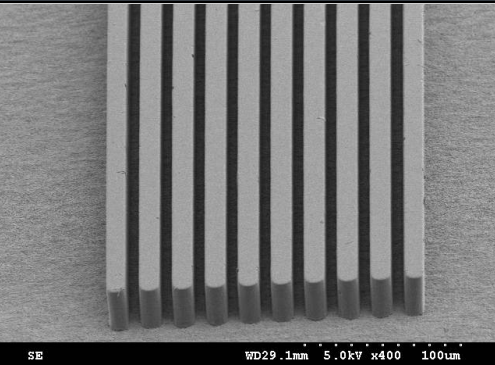
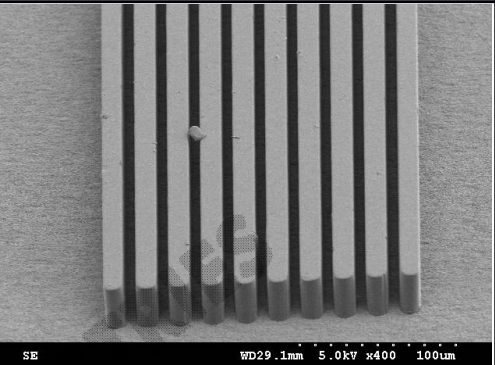
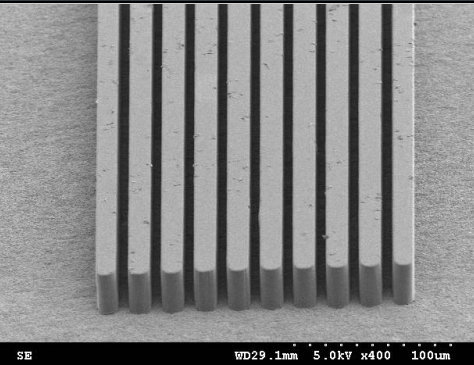
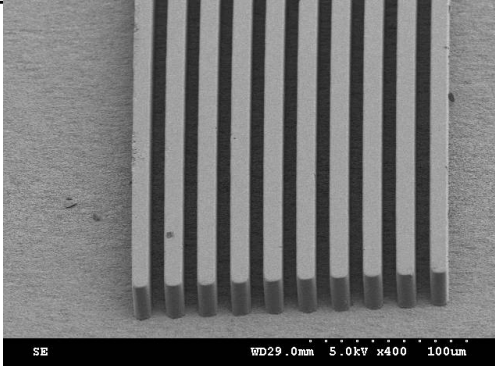
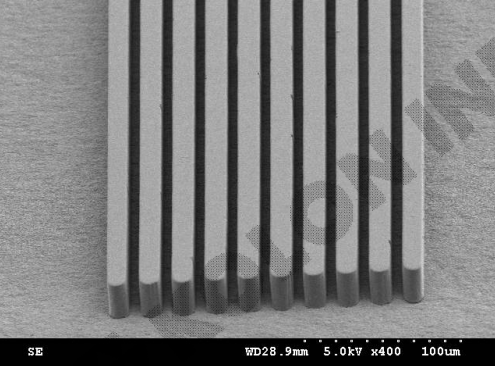
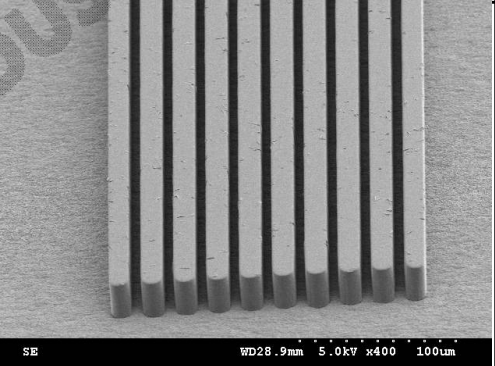
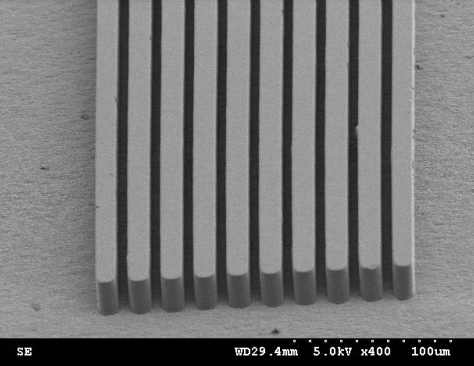
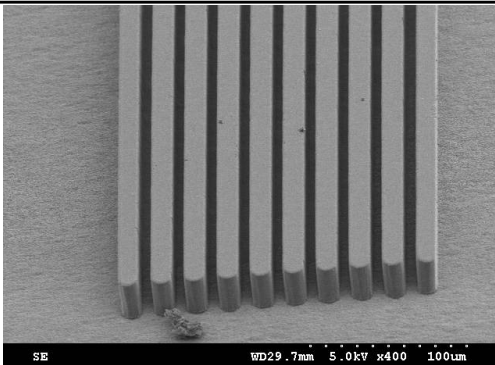
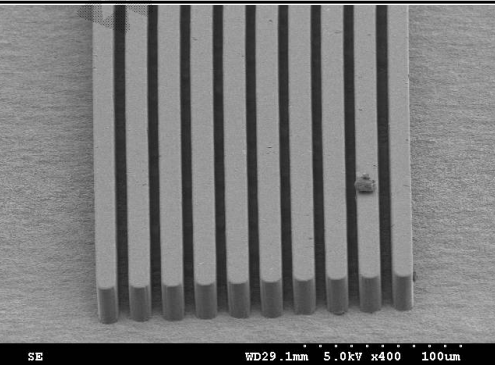
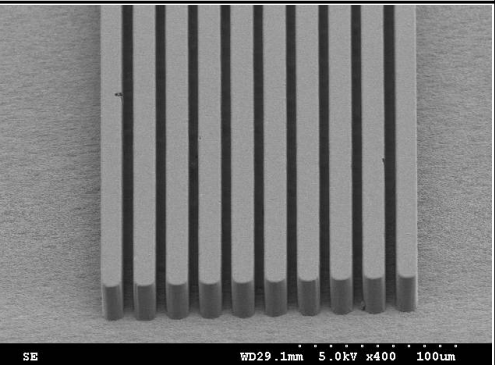
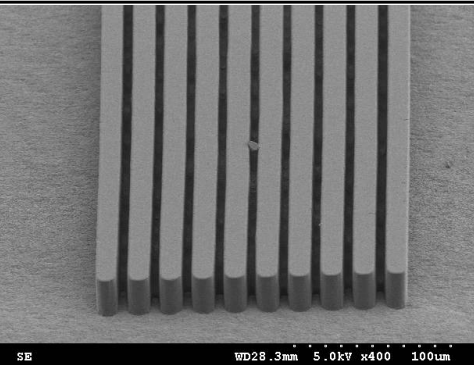
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3-1. 1/1 Resolution (L/S = 12 μ m/12 μ m) < CONFIDENTIAL >

	40 mJ/cm ²	50 mJ/cm ²	62 mJ/cm ²	75 mJ/cm ²
LS 9029	 SE WD32.2mm 5.0kV x400 100um	 SE WD32.0mm 5.0kV x400 100um	 SE WD31.8mm 5.0kV x400 100um	 SE WD31.6mm 5.0kV x400 100um
LS 9025	 SE WD32.1mm 5.0kV x400 100um	 SE WD31.8mm 5.0kV x400 100um	 SE WD31.6mm 5.0kV x400 100um	 SE WD32.7mm 5.0kV x400 100um
A (25 μ m)	 SE WD32.6mm 5.0kV x400 100um	 SE WD32.2mm 5.0kV x400 100um	 SE WD32.0mm 5.0kV x400 100um	 SE WD31.8mm 5.0kV x400 100um

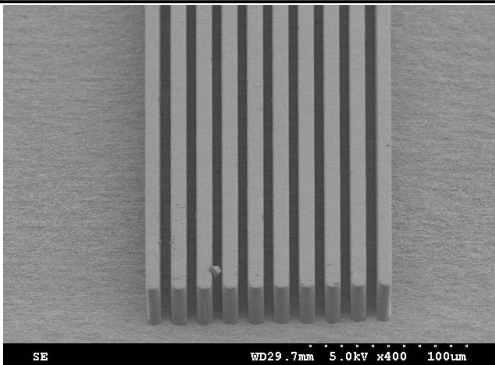
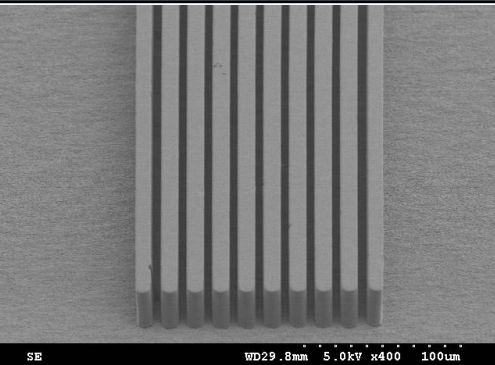
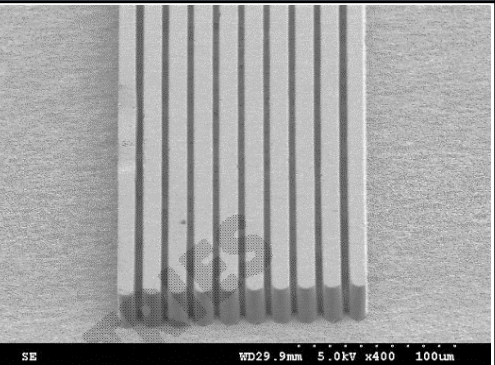
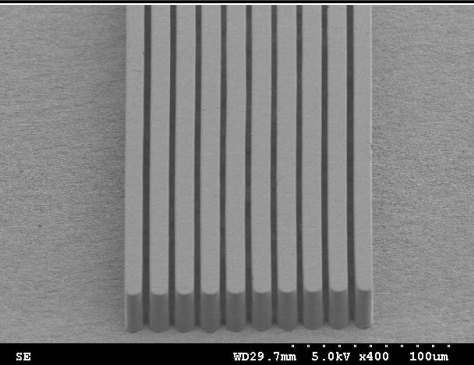
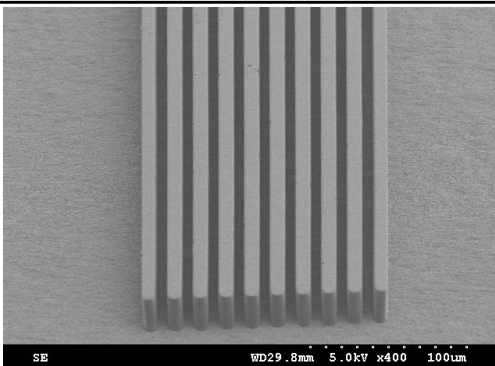
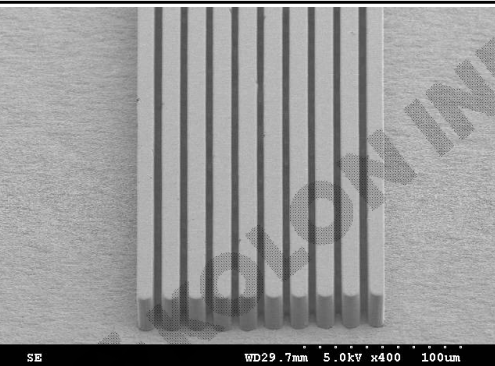
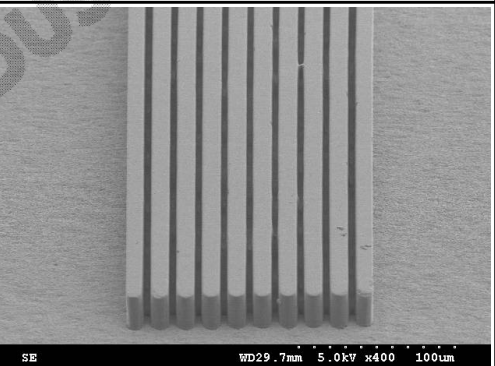
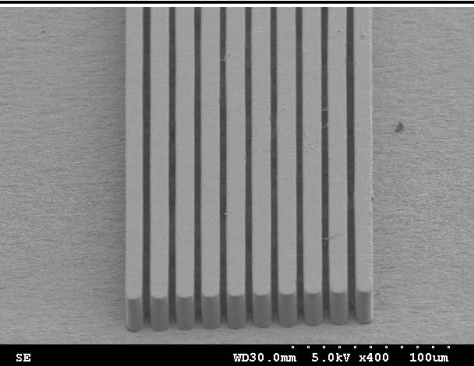
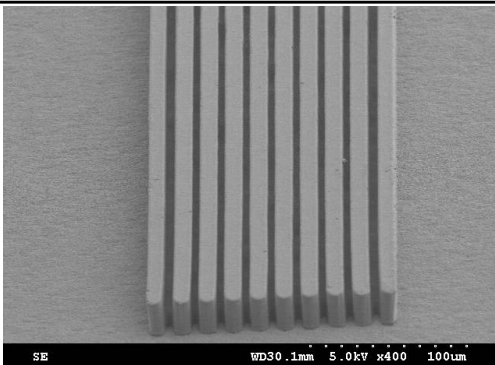
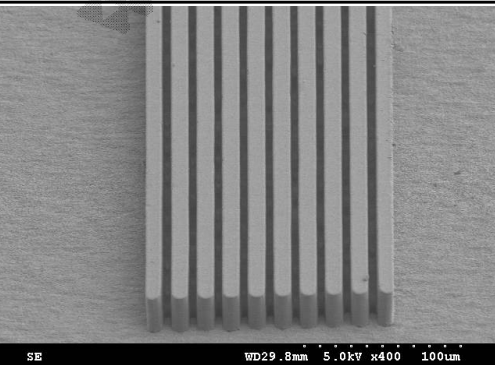
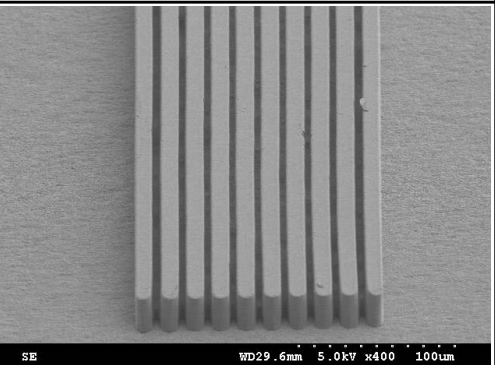
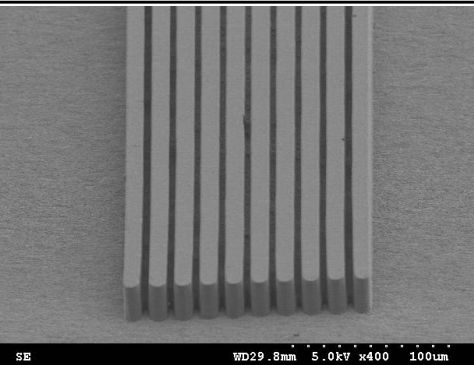
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3-1. 1/1 Resolution (L/S = 10 μ m/10 μ m) < CONFIDENTIAL >

	40 mJ/cm ²	50 mJ/cm ²	62 mJ/cm ²	75 mJ/cm ²
LS 9029	 SE WD29.1mm 5.0kV x400 100um	 SE WD29.1mm 5.0kV x400 100um	 SE WD29.1mm 5.0kV x400 100um	 SE WD29.1mm 5.0kV x400 100um
LS 9025	 SE WD29.0mm 5.0kV x400 100um	 SE WD29.9mm 5.0kV x400 100um	 SE WD29.9mm 5.0kV x400 100um	 SE WD29.4mm 5.0kV x400 100um
A (25 μ m)	 SE WD29.7mm 5.0kV x400 100um	 SE WD29.1mm 5.0kV x400 100um	 SE WD29.1mm 5.0kV x400 100um	 SE WD29.3mm 5.0kV x400 100um

본 문서는 영업상 주요 자산으로서 부정경쟁방지 및 영업비밀보호에 관한 법률을 포함하여 관련 법령에 따라 보호되는 중요한 정보를 포함하고 있으므로, 그 전부 또는 일부를 무단으로 열람하거나 공개, 사용, 복제, 유출 등은 하는 행위는 엄격히 금지됩니다.

3-1. 1/1 Resolution (L/S = $8\mu\text{m}/8\mu\text{m}$) < CONFIDENTIAL >

	40 mJ/cm ²	50 mJ/cm ²	62 mJ/cm ²	75 mJ/cm ²
LS 9029	 SE WD29.7mm 5.0kV x400 100um	 SE WD29.8mm 5.0kV x400 100um	 SE WD29.9mm 5.0kV x400 100um	 SE WD29.7mm 5.0kV x400 100um
LS 9025	 SE WD29.8mm 5.0kV x400 100um	 SE WD29.7mm 5.0kV x400 100um	 SE WD29.7mm 5.0kV x400 100um	 SE WD30.0mm 5.0kV x400 100um
A (25 μm)	 SE WD30.1mm 5.0kV x400 100um	 SE WD29.8mm 5.0kV x400 100um	 SE WD29.6mm 5.0kV x400 100um	 SE WD29.8mm 5.0kV x400 100um

본 문서는 영업상 주요 자산으로서 부정경쟁방지 및 영업비밀보호에 관한 법률을 포함하여 관련 법령에 따라 보호되는 중요한 정보를 포함하고 있으므로, 그 전부 또는 일부를 무단으로 열람하거나 공개, 사용, 복제, 유출 등은 하는 행위는 엄격히 금지됩니다.

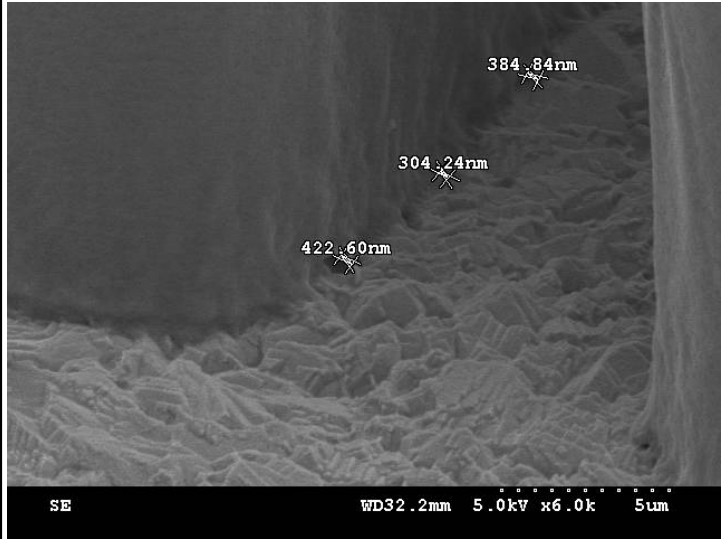
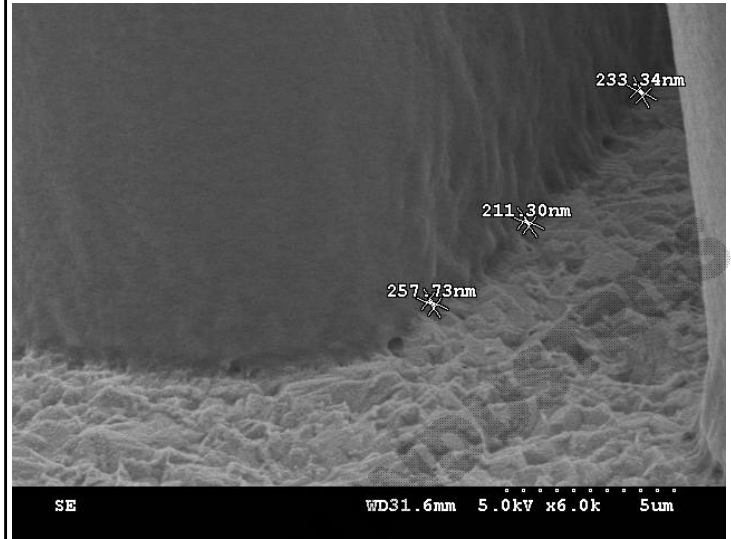
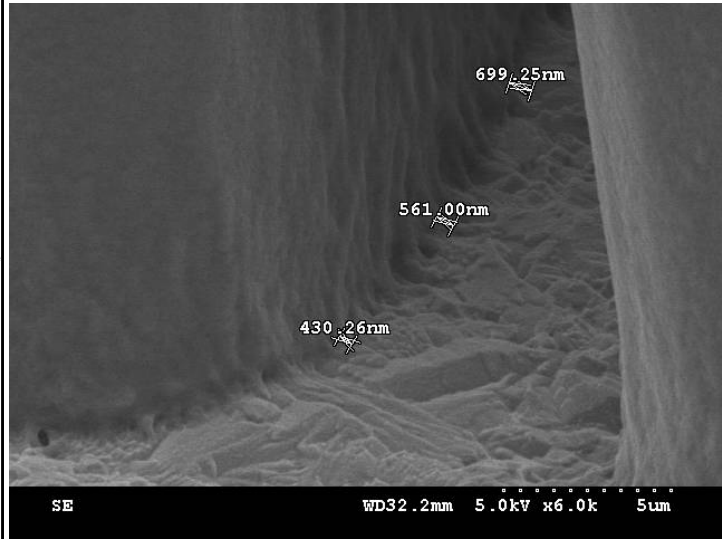
3-2. Line Width (L/S = 12 μ m/12 μ m) < CONFIDENTIAL >

	40 mJ/cm ²	50 mJ/cm ²	62 mJ/cm ²	75 mJ/cm ²
LS 9029	<p>T=14.7μm, B=14.5 μm</p>	<p>T=15.8μm, B=15.6 μm</p>	<p>T=16.2μm, B=16.2 μm</p>	<p>T=16.5μm, B=16.6 μm</p>
LS 9025	<p>T=13.8μm, B=14.1 μm</p>	<p>T=15.4μm, B=15.8 μm</p>	<p>T=15.7μm, B=15.8 μm</p>	<p>T=16.3μm, B=16.4 μm</p>
A (25μm)	<p>T=15.6μm, B=15.5 μm</p>	<p>T=16.5μm, B=16.1 μm</p>	<p>T=16.7μm, B=16.6 μm</p>	<p>T=17.2μm, B=17.3 μm</p>

본 문서는 영업상 주요 자산으로서 부정경쟁방지 및 영업비밀보호에 관한 법률을 포함하여 관련 법령에 따라 보호되는 중요한 정보를 포함하고 있으므로, 그 전부 또는 일부를 무단으로 열람하거나 공개, 사용, 복제, 유출 등을 하는 행위는 엄격히 금지됩니다.

3-3. Resist Foot (L/S = 12 μ m/12 μ m, 50mJ/cm²)

< CONFIDENTIAL >

LS-9029	LS-9025	A (25 μ m)
		
Resist foot : 0.47 μ m	Resist foot : 0.23 μ m	Resist foot : 0.56 μ m

KOLON

3-4. Development

	Minimum Develop Time (sec.)	Form	Scum/Sludge			
		Height (cm)	Filter Time (50ml)	Filter Time (100ml)	Scum	Sludge (g)
LS-9025	21	1.9	22 sec.	36 sec.	None	0.21

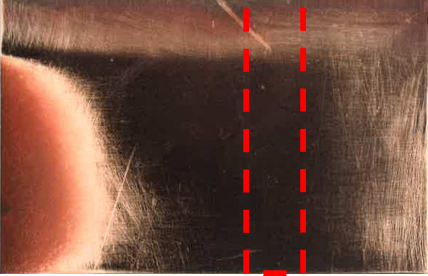
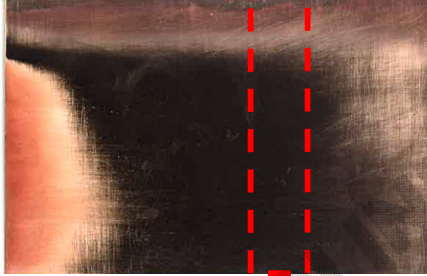

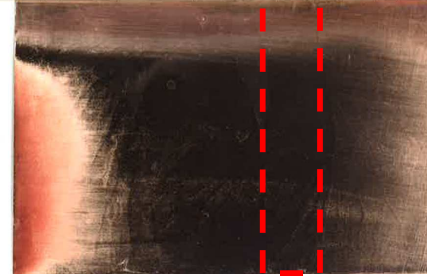
Test Category	Condition
1. Minimum Develop Time	- 1.0wt% Na ₂ CO ₃ , Temp. 30 °C, Spray Pressure 1.5kg/cm ² - Break Point 100%
2. Form test	- Na ₂ CO ₃ 1.0 wt% , 1.3L , <u>DFR 0.5m²/L</u> , 30 °C - Injection Pressuere of Nozzle 1.0~0.8kg.f
3. Scum/sludge	- Na ₂ CO ₃ 1.0 wt% , 400mL , <u>DFR 1.0m²/L</u> , 30 °C, 2500rpm, After Stirring 4hr, leave 24hrs - Filter paper : ADVANTEC-5A - Filtering Time : Time of Filter each condition (50ml, 100ml)

3-5. Stripping

		NaOH (2.5 wt%)	R-100S
LS-9029	40 mJ/cm ²	41 LL	33 SS
	50 mJ/cm ²	43 LL	34 SS
	62 mJ/cm ²	45 LL	36 SS
	75 mJ/cm ²	48 LL	39 SS
LS-9025	40 mJ/cm ²	37 LL	30 SS
	50 mJ/cm ²	39 LL	31 SS
	62 mJ/cm ²	41 LL	33 SS
	75 mJ/cm ²	43 LL	37 SS
A (25μm)	40 mJ/cm ²	57 LL	48 SS
	50 mJ/cm ²	60 LL	49 SS
	62 mJ/cm ²	62 LL	51 SS
	75 mJ/cm ²	67 LL	55 SS
Test Category	Condition		
1. Stripping Test	- Temp. 50 °C, Dipping Method - Break Point 100% - NaOH 2.5wt%, R-100S 8% - Stripped Particle Size : SS(Under 0.2cm), S(Under 0.5cm), M(0.5~2.0cm), L(2.0~5.0cm), LL(Over 5.0cm)		

3-6. Plating _ LS-9025

< CONFIDENTIAL >

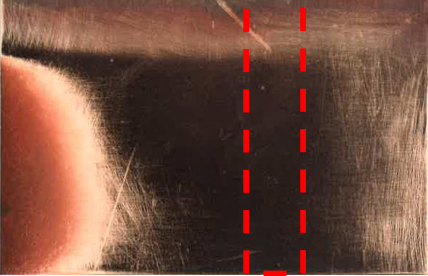
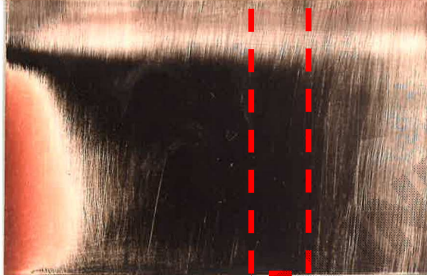

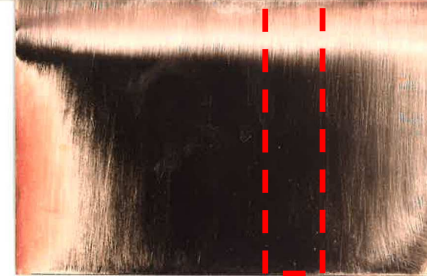
구분	Blank	Leaching out 0.1m ² /ℓ	Leaching out 0.2m ² /ℓ	Leaching out 0.3m ² /ℓ
TOC	197 mg/L	315 mg/L	337 mg/L	337 mg/L
Hull Cell				

Test Category	Condition
1. TOC (Total Organic Carbon)	<ul style="list-style-type: none"> - Plating Solution : CuBrite TF4 (Maker : JCU) - Exposure : ST=15/41, DFR Loading 0.1, 0.2, 0.3m²/L, Leaching out Time : 22°C, 72hr - Analysis instrument : Shimadzu社 TOC-VCSN (Korea Laboratory Accreditation Scheme)
2. Hull Cell	<ul style="list-style-type: none"> - Plating Solution : CuBrite TF4 (Maker : JCU) - Exposure : ST=15/41, DFR Loading 0.1, 0.2, 0.3m²/L, Leaching out 시간 : 22°C, 72hr - Analysis instrument : Room Temperature, 2A, 10min, Air 1.0LPM, 1.5~2.0ASD Confirm

본 문서는 영업상 주요 자산으로서 부정경쟁방지 및 영업비밀보호에 관한 법률을 포함하여 관련 법령에 따라 보호되는 중요한 정보를 포함하고 있으므로, 그 전부 또는 일부를 무단으로 열람하거나 공개, 사용, 복제, 유출 등은 하는 행위는 엄격히 금지됩니다.

3-6. Plating _ A (25 μ m)

< CONFIDENTIAL >

구분	Blank	Leaching out 0.1m ² /ℓ	Leaching out 0.2m ² /ℓ	Leaching out 0.3m ² /ℓ
TOC	197 mg/L	307 mg/L	270 mg/L	348 mg/L
Hull Cell				

Test Category	Condition
1. TOC (Total Organic Carbon)	<ul style="list-style-type: none"> - Plating Solution : CuBrite TF4 (Maker : JCU) - Exposure : ST=15/41, DFR Loading 0.1, 0.2, 0.3m²/L, Leaching out Time : 22°C, 72 hr - Analysis instrument : Shimadzu社 TOC-VCSN (Korea Laboratory Accreditation Scheme)
2. Hull Cell	<ul style="list-style-type: none"> - Plating Solution : CuBrite TF4 (Maker : JCU) - Exposure : ST=15/41, DFR Loading 0.1, 0.2, 0.3m²/L, Leaching out Time : 22°C, 72 hr - Analysis instrument : Room Temperature, 2A, 10min, Air 1.0LPM, 1.5~2.0ASD Confirm

3-7. Sulfuric acid tolerance

1. Purpose

(1) Test of Dry film acid resistance

- SEM observe about Surface of Dry film, Side wall, Foot, Delamination

2. Test condition

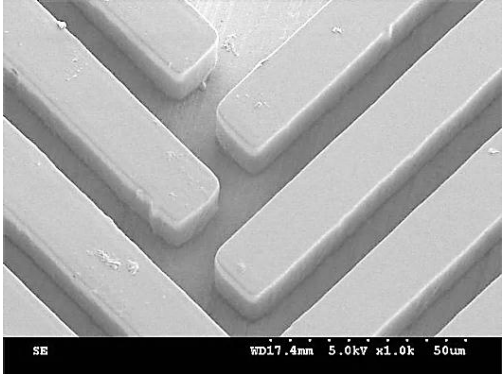
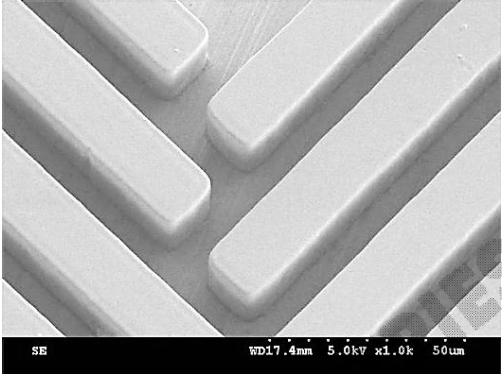
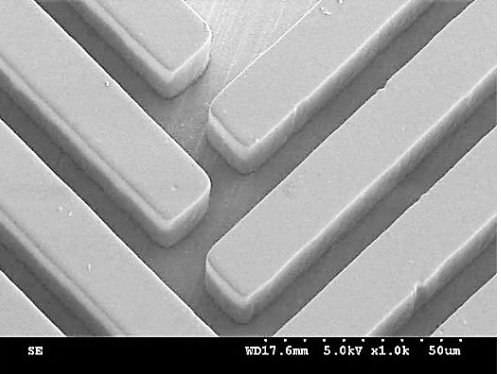
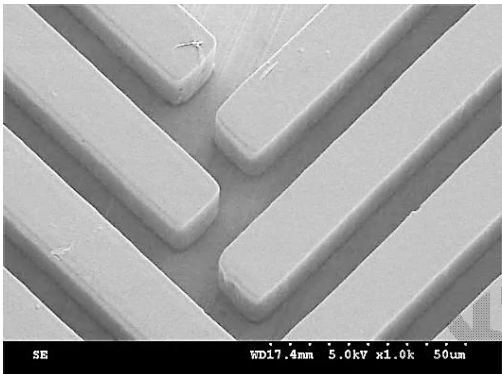
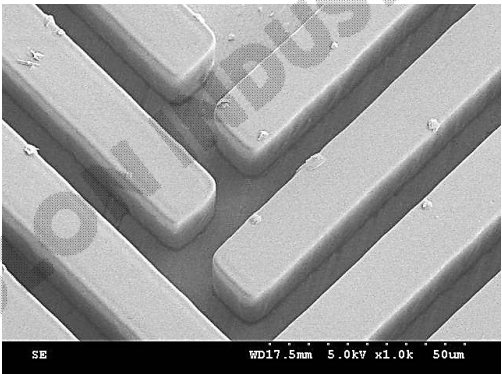
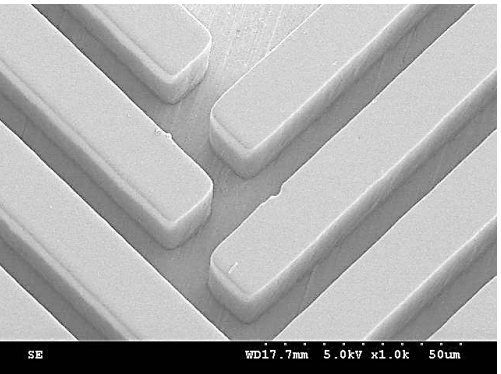
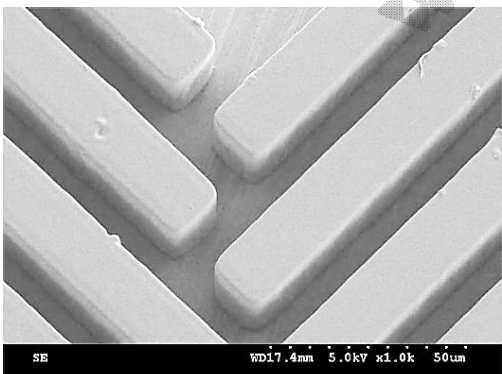
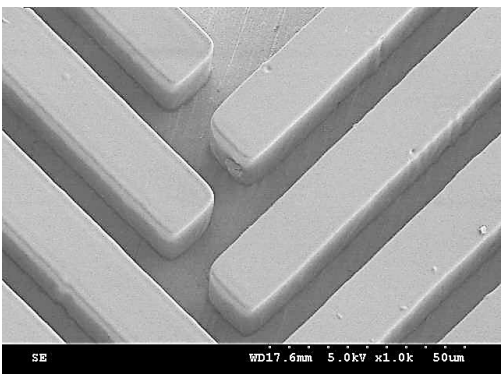
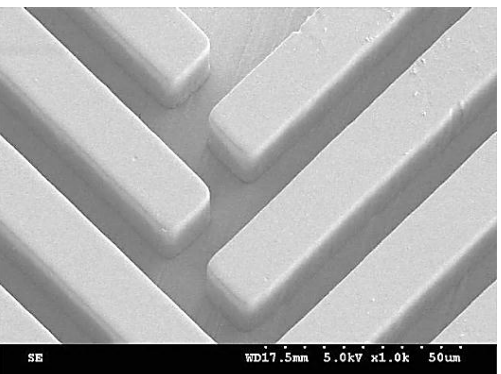
Dipping time (sec)	Sulfuric Acid Concentration (%)		
	3	20	60
40	Condition 1	Condition 4	Condition 7
80	Condition 2	Condition 5	Condition 8
120	Condition 3	Condition 6	Condition 9

- Test pattern : KOLON test pattern
- Substrate : 0.4t FR4 1oz
- Lamination : Hakuto 610i, 110°C, Speed 2.0m/min, Pressure 5Kgf/cm2
- Exposure : Hitachi Via Mechanics DE-1UH, 405nm DI
- Develop : 1.0wt% Na2CO3, Temp. 30 °C, Break Point 50%, Spray Pressure 1.5kg/cm2

3-7. Sulfuric acid tolerance _ LS-9025

CONFIDENTIAL >

Line/space : 14/14 μ m

	3% Sulfuric acid tolerance	20% Sulfuric acid tolerance	60% Sulfuric acid tolerance
40 sec			
80 sec			
120 sec			

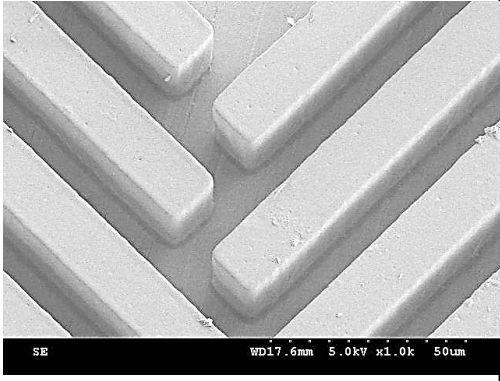
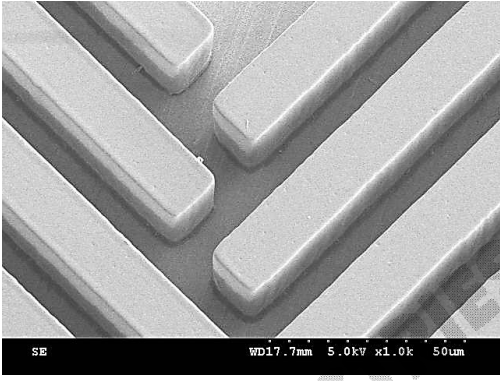
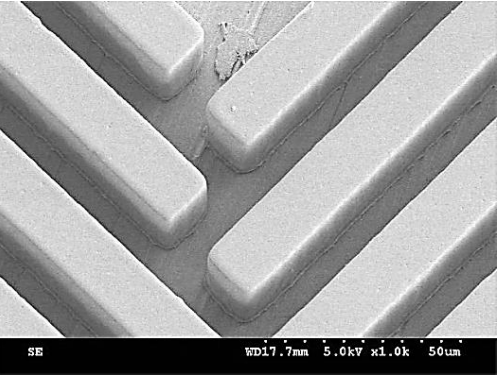
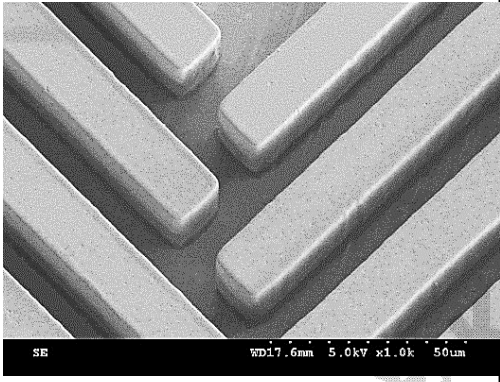
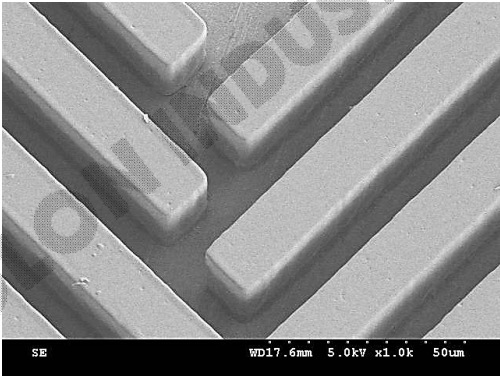
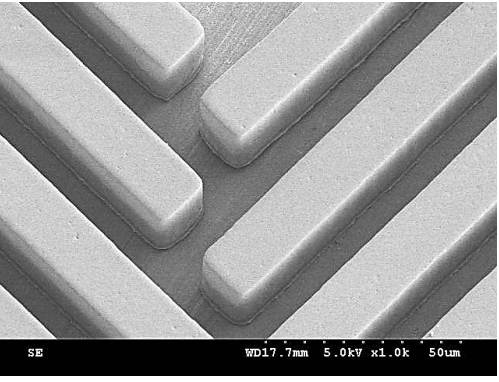
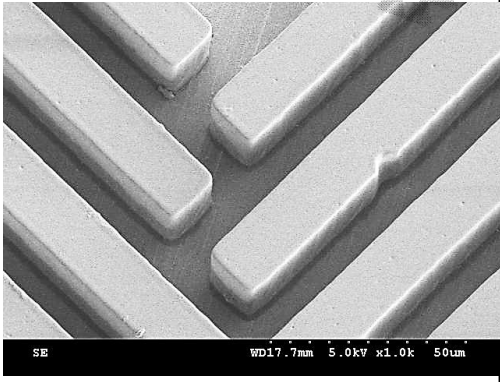
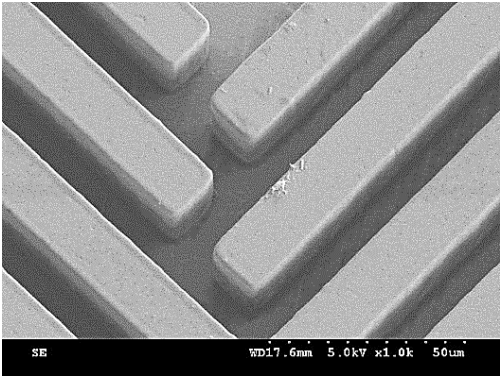
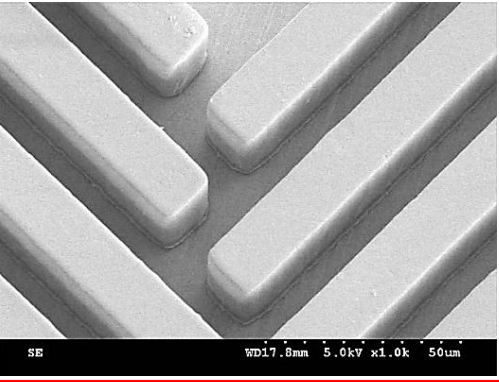
본 문서는 영업상 주요 자산으로서 부정경쟁방지 및 영업비밀보호에 관한 법률을 포함하여 관련 법령에 따라 보호되는 중요한 정보를 포함하고 있으므로, 그 전부 또는 일부를 무단으로 열람하거나 공개, 사용, 복제, 유출 등은 하는 행위는 엄격히 금지됩니다.



3-7. Sulfuric acid tolerance _ A (25 μ m)

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Line/space : 14/14 μ m

	3% Sulfuric acid tolerance	20% Sulfuric acid tolerance	60% Sulfuric acid tolerance
40 sec			
80 sec			
120 sec			

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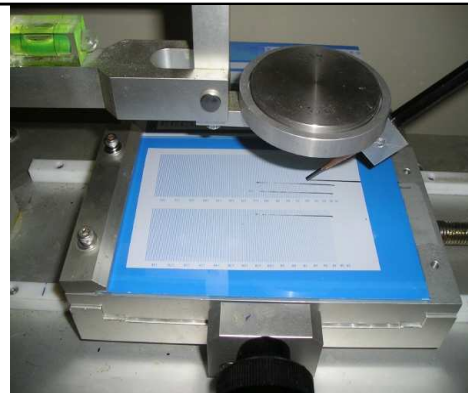
3-8. Hardness (Pencil Longitude Test, 50mJ/cm2)

	1次(μm)	2次(μm)	3次(μm)	4次(μm)	5次(μm)	Average(μm)
LS-9029	50	70	70	60	60	62.0
LS-9025	70	50	60	70	40	58.0
A (25μm)	80	80	80	80	70	78.5

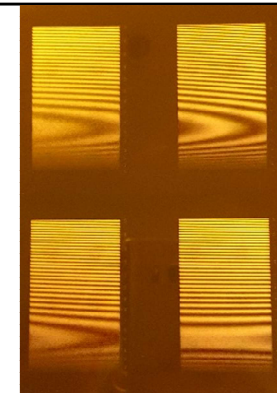
Test Category	Condition
1. Hardness test	<ul style="list-style-type: none"> - Lamination → Exposure → Developing → Pencil Longitude test - Sample pattern : 10, 20, 30, 40, 50.....200μm - Speed : 28 rpm/min, Load : 100g, Pencil : 2H - When scratch once, confirm remained smallest line width (average of five measurement)



Pencil Longitude Machine



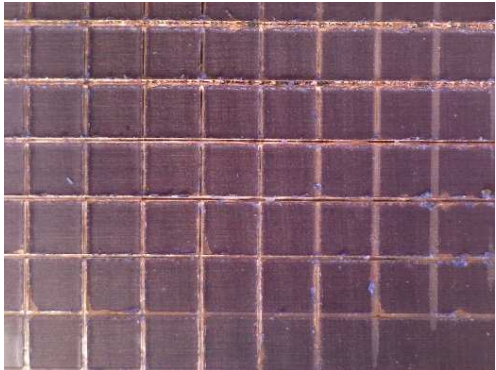

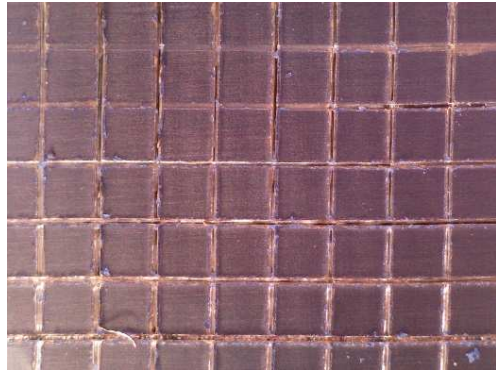
Pencil Longitude test



Evaluation Pattern

3-9. Cross hatch Test

< CONFIDENTIAL >

	LS-9029	LS-9025	A (25 μ m)
Circuit Board			
Result	1	1	1

Test Category	Condition
1. Cross hatch test	- Lamination → Exposure → Test - ISO Class (Cross-cut area) : 0(0%), 1(5%), 2(15%), 3(35%), 4(65%), 5(>65%)