AZ® 15nXT (450 CPS) Photoresist

Negative Acting Thick Resist for Cu RDL, TSV, and other plating & etch applications

Lithographic and Plating Performance Comparison at 10 µm FT on Cu wafers

January 2009

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AZ's Thick Film Photoresist Roadmap

	Lift-off FT: 2-10 µm	TSV / Etch Implant, Plating FT: 3-15 µm	Copper/UBM Plating FT: 5-30 µm	Gold Plating FT: 10-30 µm	Solder / Metal Plating FT: >30 µm	MEMS / Ink Jet FT: >30 µm	DUV TFRH/Implant FT: 3 - 8 µm
Commercialized materials	AZ® nLOF Series	<------------ AZ® 10XT ------------> <------------ AZ® 9200 ------------> AZ® N4000	<------------------------ P4620 ------------------------> AZ® 4562	AZ® PLP30/PLP40	<------------ AZ® 50XT ----------> <---------AZ® 40XT-11D-------->		AZ® TX 1311 AZ® VS-01HJ
Materials in sampling (all products)		<---AZ® 12XT Series---> <---AZ® 15nXT--->	<------------------------ AZ® 125nXT Series ------------------------>				AZ® TX VS-02HJ
Materials under development			<--------- AZ® EXP 100 -------->				AZ® LExp 600

Red=Neg, Blue =Pos; nLOF, N4000, 5nXT/15nXT, 12XT, 40XT = chemically amplified; 125nXT = photopolymer; 10XT, 9200, P4620, PLP, 50XT, 4500 = DNQ

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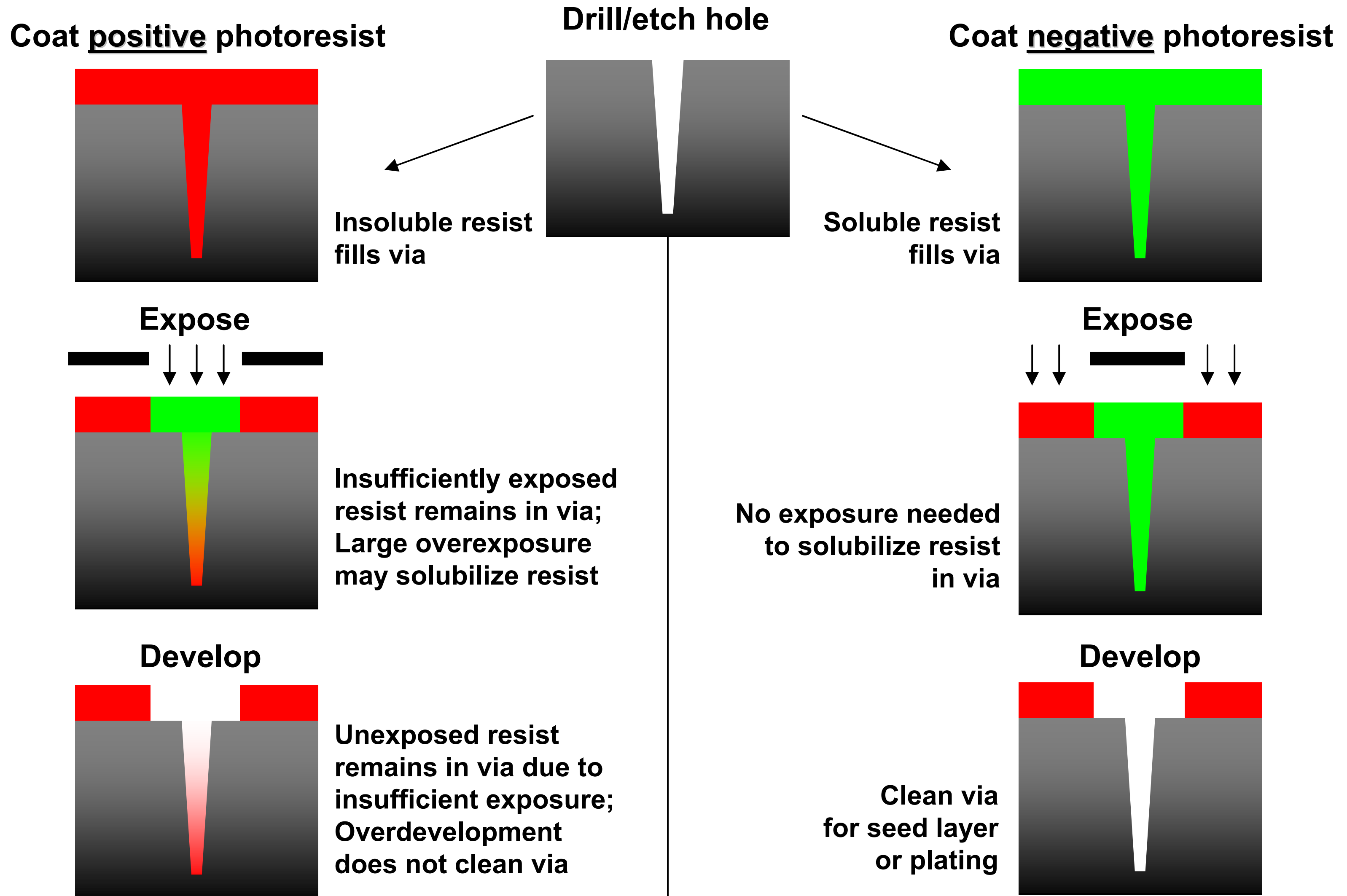
Through-Silicon-Via (TSV)
Advantages to Use a Negative Photoresist



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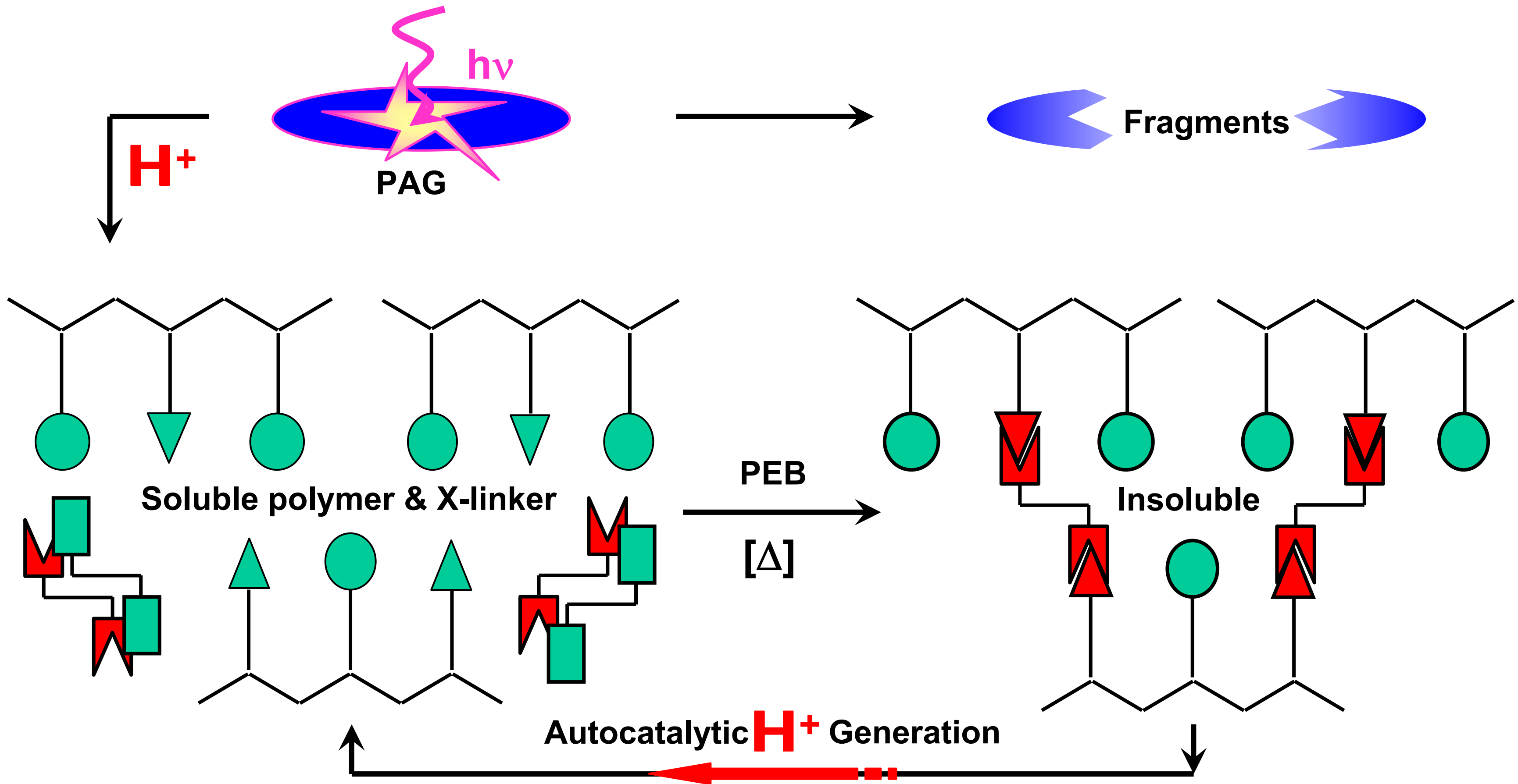
Chemically Amplified Negative Resist

The original photo-event generates a catalyst for crosslinking (typically a proton). The photo-event is amplified by the number of cycles each proton catalyzes.



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AZ® 15nXT (450 CPS)
Process Conditions

Substrate:	Si wafer for photospeed testing Cu wafer for images
Film Thickness:	10µm by single coat
Softbake:	110°C / 180 seconds
Exposure tool:	ASML (i-line) Dose = 400 ± 50 mJ/cm^2; Focus: 1 ± 0.5 µm
PEB:	120°C / 60 seconds
Develop:	AZ 300 MIF (2.38% TMAH); 3 x 50 second puddles

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AZ® 15nXT (450 CPS)
Optical Parameters

n & k Values at different wavelength

365 nm: n = 1.6807 k = 0.0027
633 nm: n = 1.6063 k = 0.0034

Cauchy coefficients (A, B, C) fit the following Cauchy equation: $n = A + B/\lambda^2 + C/\lambda^4$

A = 1.5754
B = 0.013242 μm^2
C = 0 μm^4

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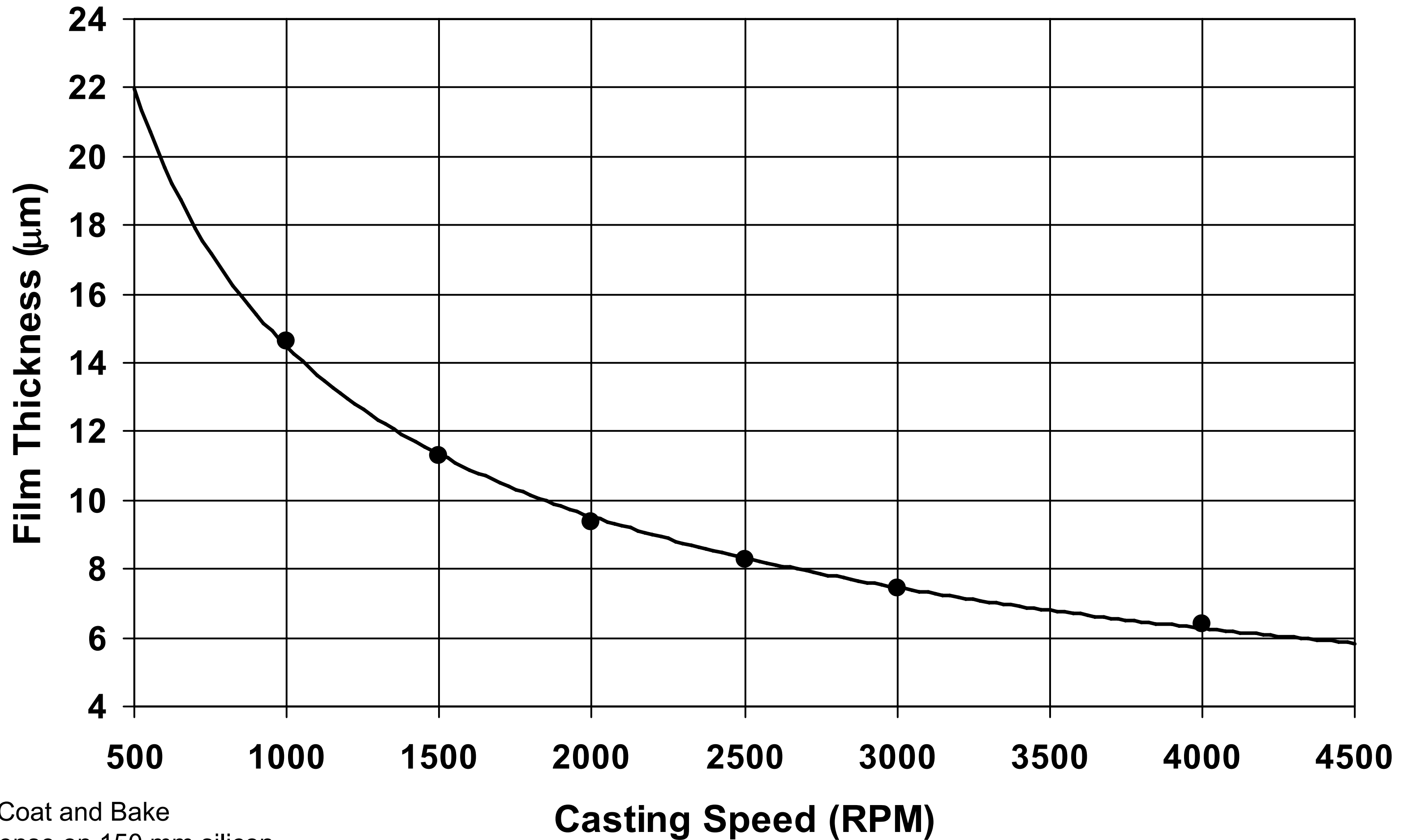
AZ® 15nXT (450 CPS)

Spin Speed Curve



Opti-Trak Coat and Bake
Hand dispense on 150 mm silicon
Spin 1000-4000 rpm for 30 sec
SB: 110°C/ 3 minutes

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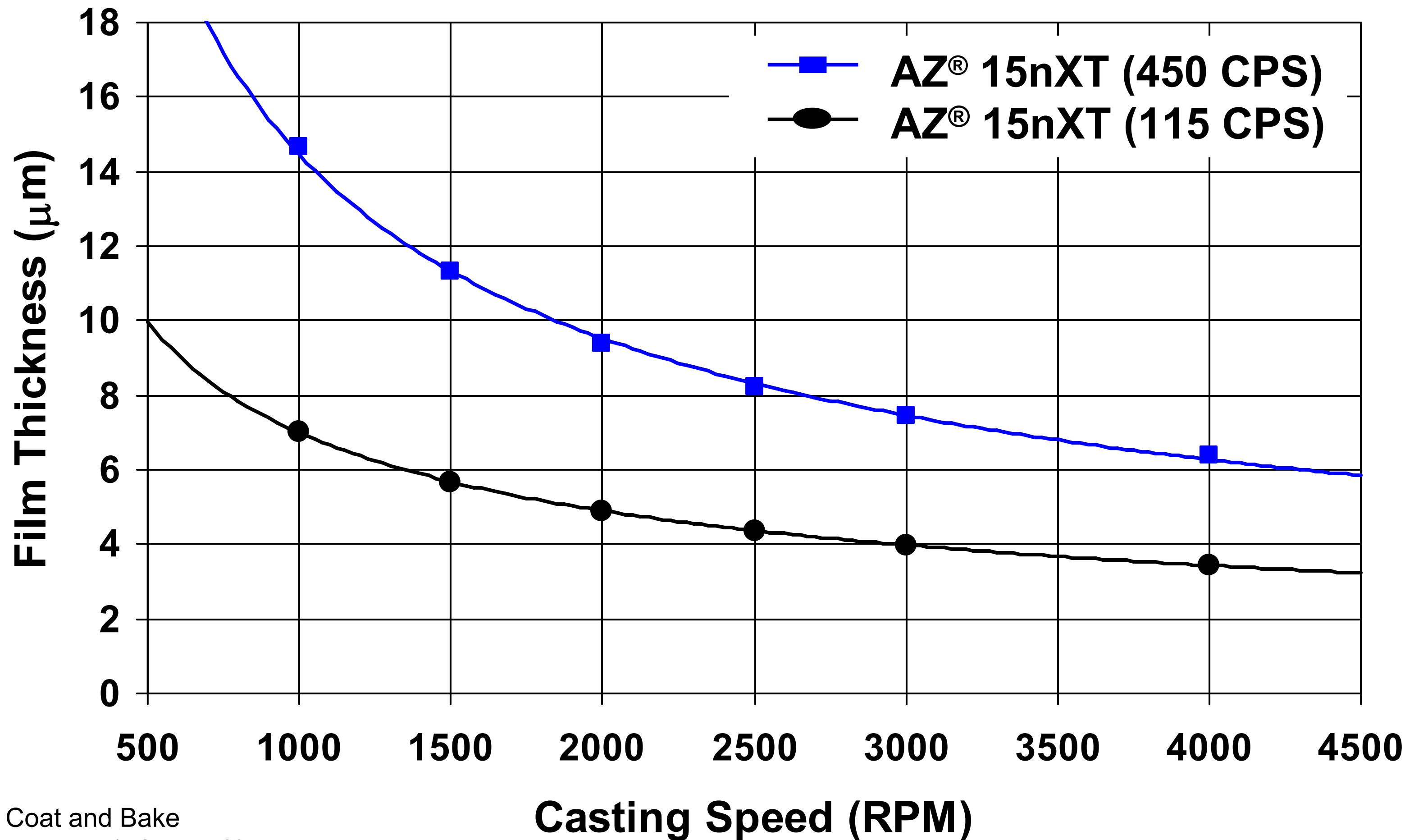
AZ® 15nXT (115 CPS) and AZ® 15nXT (450 CPS)
Spin Speed Curves



Opti-Trak Coat and Bake
Hand dispense on 150 mm silicon
Spin 1000-4000 rpm for 30 sec
SB: 110°C/ 3 min for 15nXT
110°C/2 min for 5nXT

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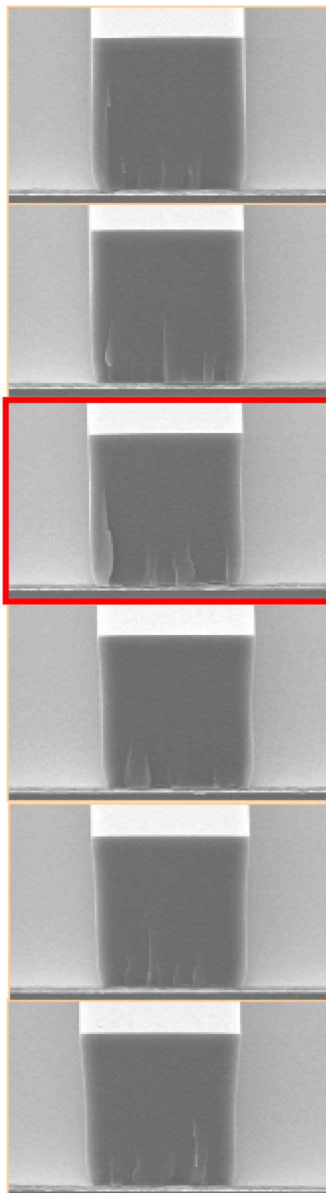
AZ® 15nXT (450 CPS)

Depth of Focus



0.0 µm

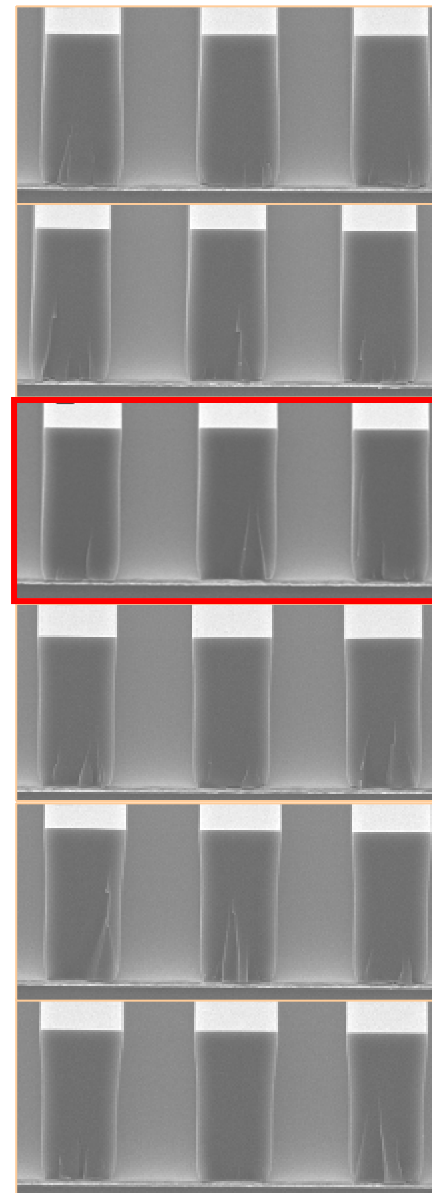
0.5 µm

1.0 µm

1.5 µm

2.0 µm

2.5 µm



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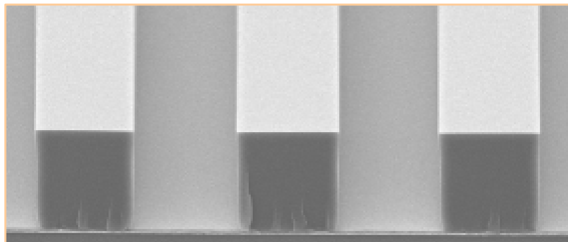
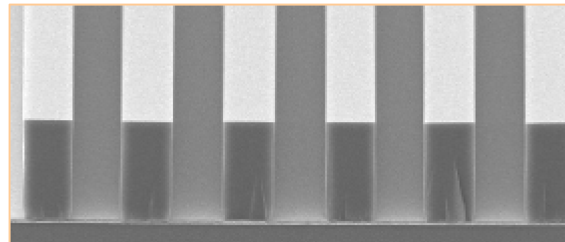
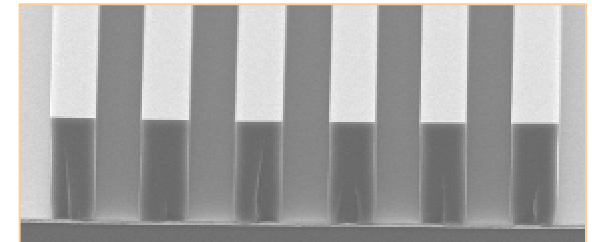
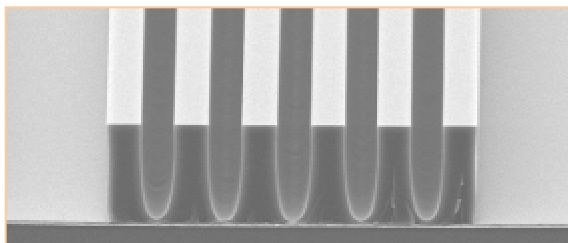
AZ® 15nXT (450 CPS)
Linearity, Resolution

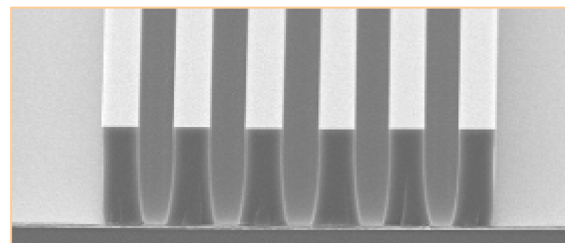
400 mJ/cm², F = 1 µm

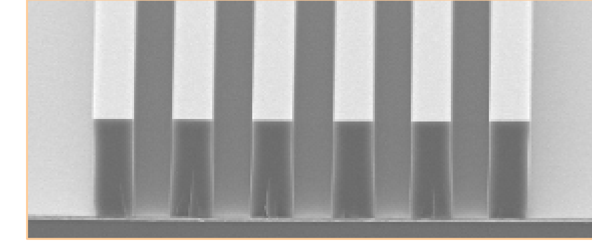

10 µm


5 µm


4.5 µm


3.4 µm


3.6 µm


4 µm

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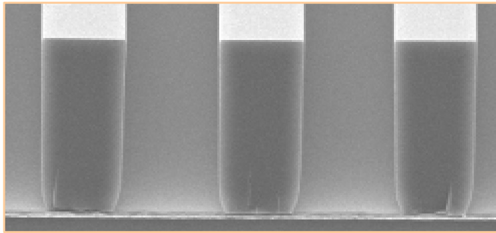
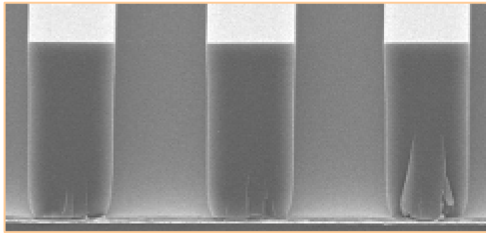
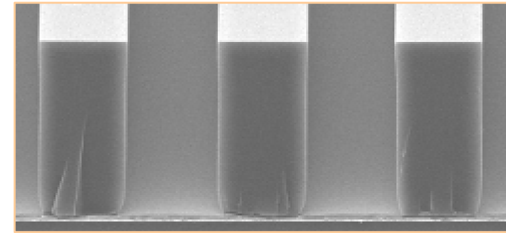
AZ® 15nXT (450 CPS) - Exposure Latitude
FT = 10 μm, Focus = 1.0 μm, 5.0 μm L/S on Cu Wafers



250 mJ/cm²

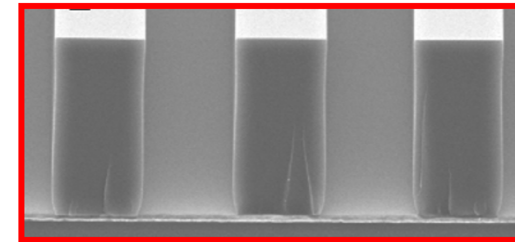


300 mJ/cm²

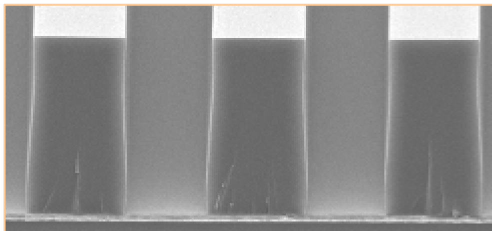


350 mJ/cm²

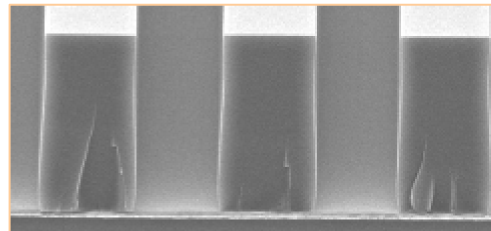
Film Thickness: 10μm
Opti Track Coat and Bake
SB: 110°C/3 minutes
ASML i-Line Stepper, F= +1.0μm
Opti Track PEB/Develop
PEB: 120°C/ 60 Seconds
AZ 300 MIF/ 3x50sec Spray/Puddle @23°C



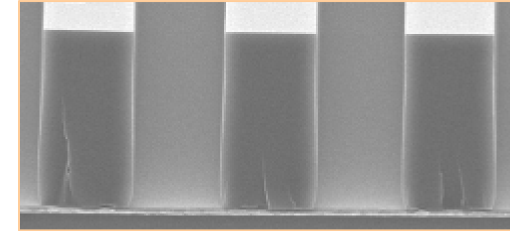
400 mJ/cm²



550 mJ/cm²



500 mJ/cm²



450 mJ/cm²

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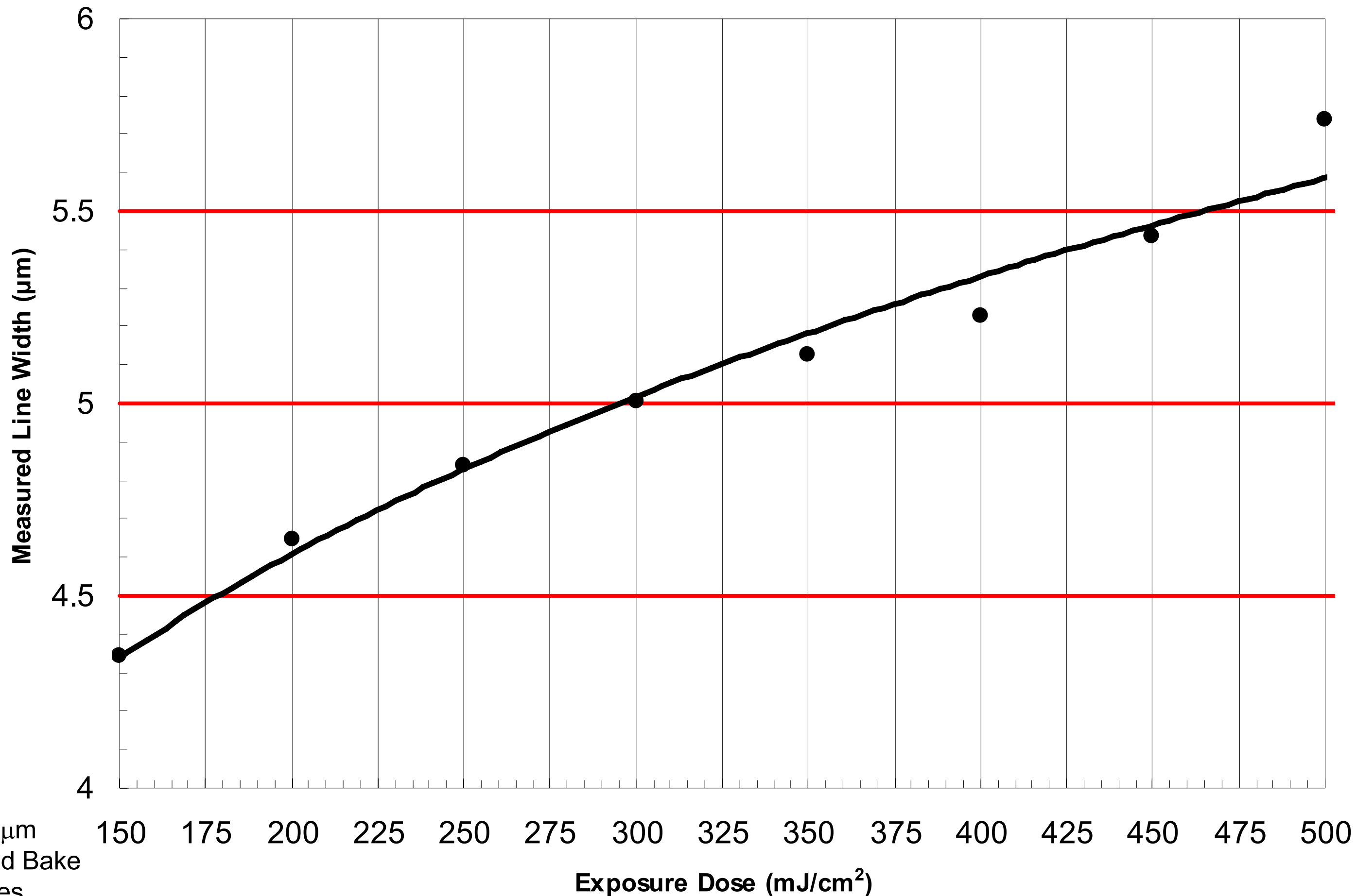
AZ® 15nXT (450 CPS) - Exposure Latitude
FT = 10 μm, Focus = 1.0 μm, 5.0 μm L/S on Cu Wafers



Film Thickness: 10μm
Opti Track Coat and Bake
SB: 110°C/3 minutes
ASML i-Line Stepper, F= +1.0μm
Opti Track PEB/Develop
PEB: 120°C/ 60 Seconds
AZ 300 MIF/ 3x50sec Spray/Puddle @23°C

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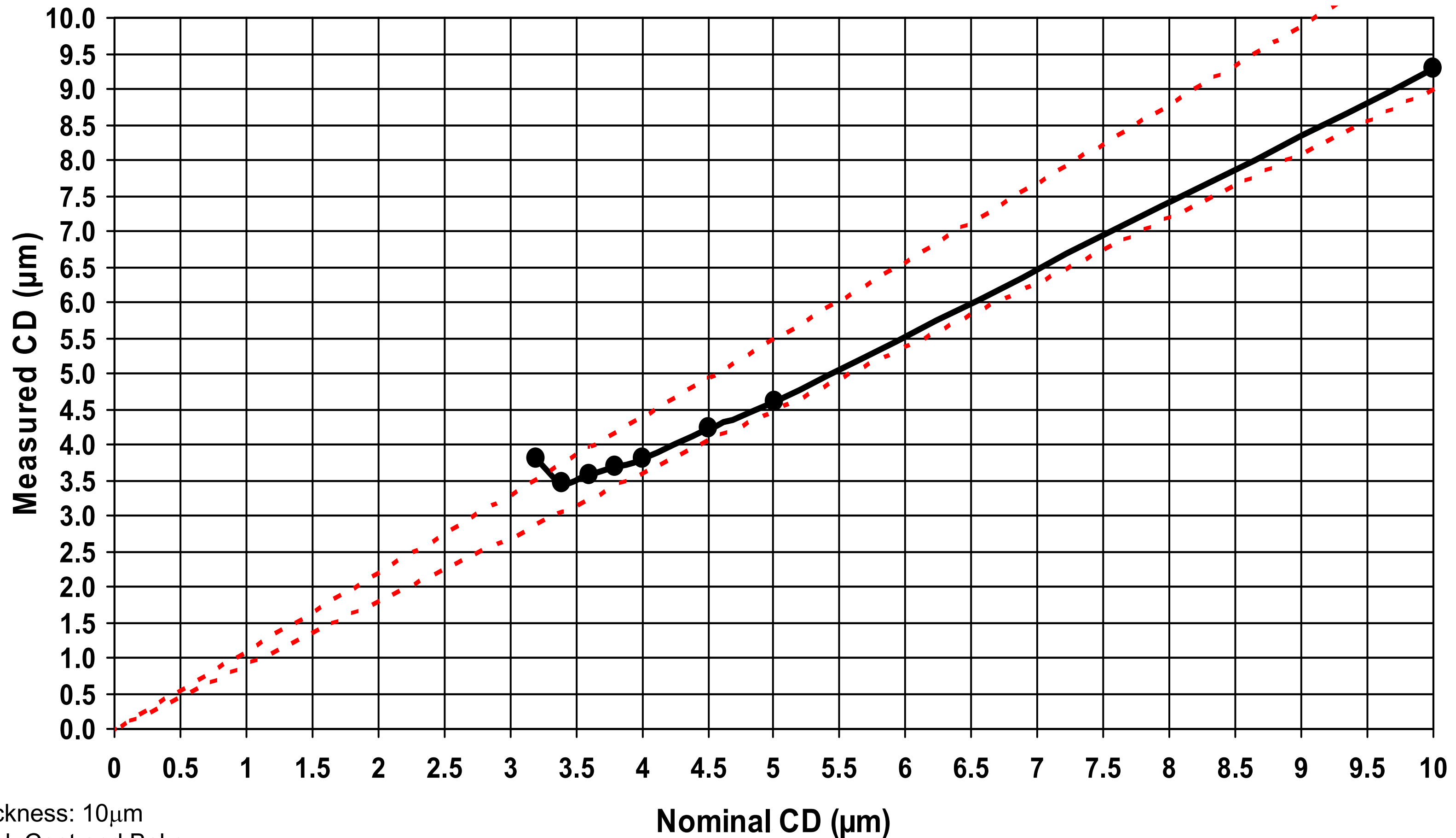
AZ® 15nXT (450 CPS)

L/S Linearity @ 300 mJ/cm², F = +1.0 μm



Film Thickness: 10µm
Opti Track Coat and Bake
SB: 110°C/3 minutes
ASML i-Line Stepper, F= +1.0µm
Opti Track PEB/Develop
PEB: 120°C/ 60 Seconds
AZ 300 MIF/ 3x50sec Spray/Puddle @23°C

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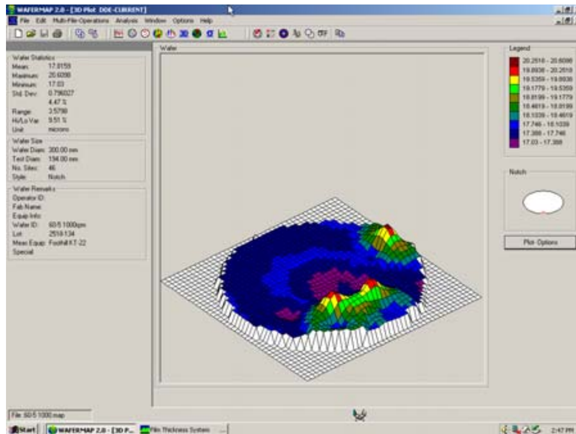
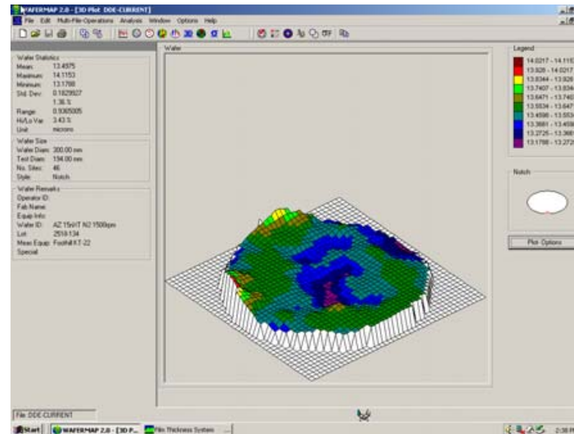
AZ® 15nXT (450 CPS)

Coating Uniformity Wafer Maps (3 mm Edge Exclusion)

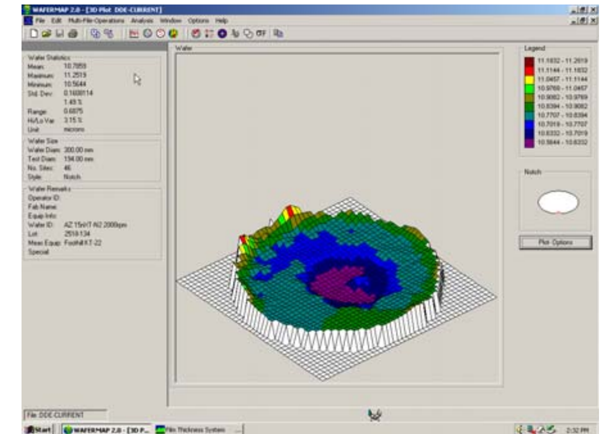
1000 rpm 17.8μm/4.49%RSD



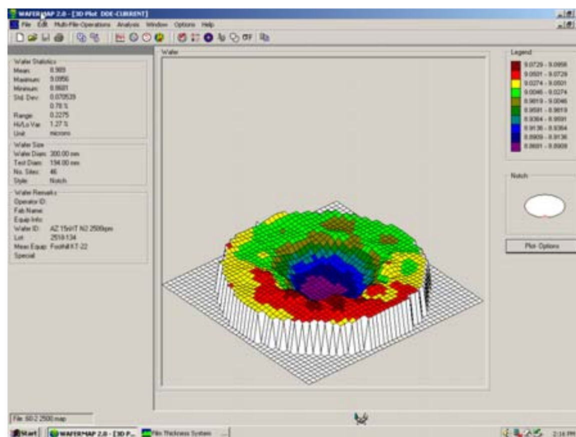
1500 rpm 13.5μm/1.36%RSD



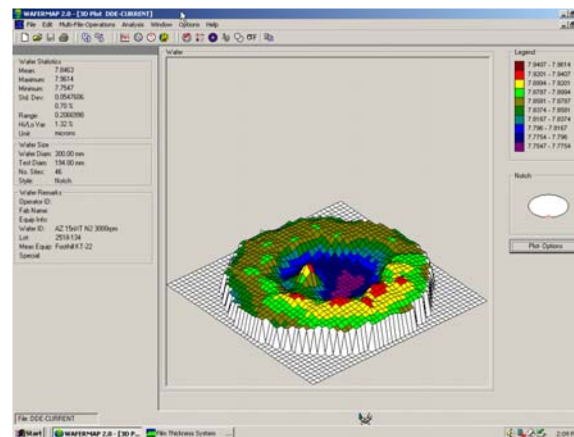
2000 rpm 10.8μm/1.49%RSD



2500 rpm 9.0μm/0.78%RSD



3000 rpm 7.8μm/0.70%RSD



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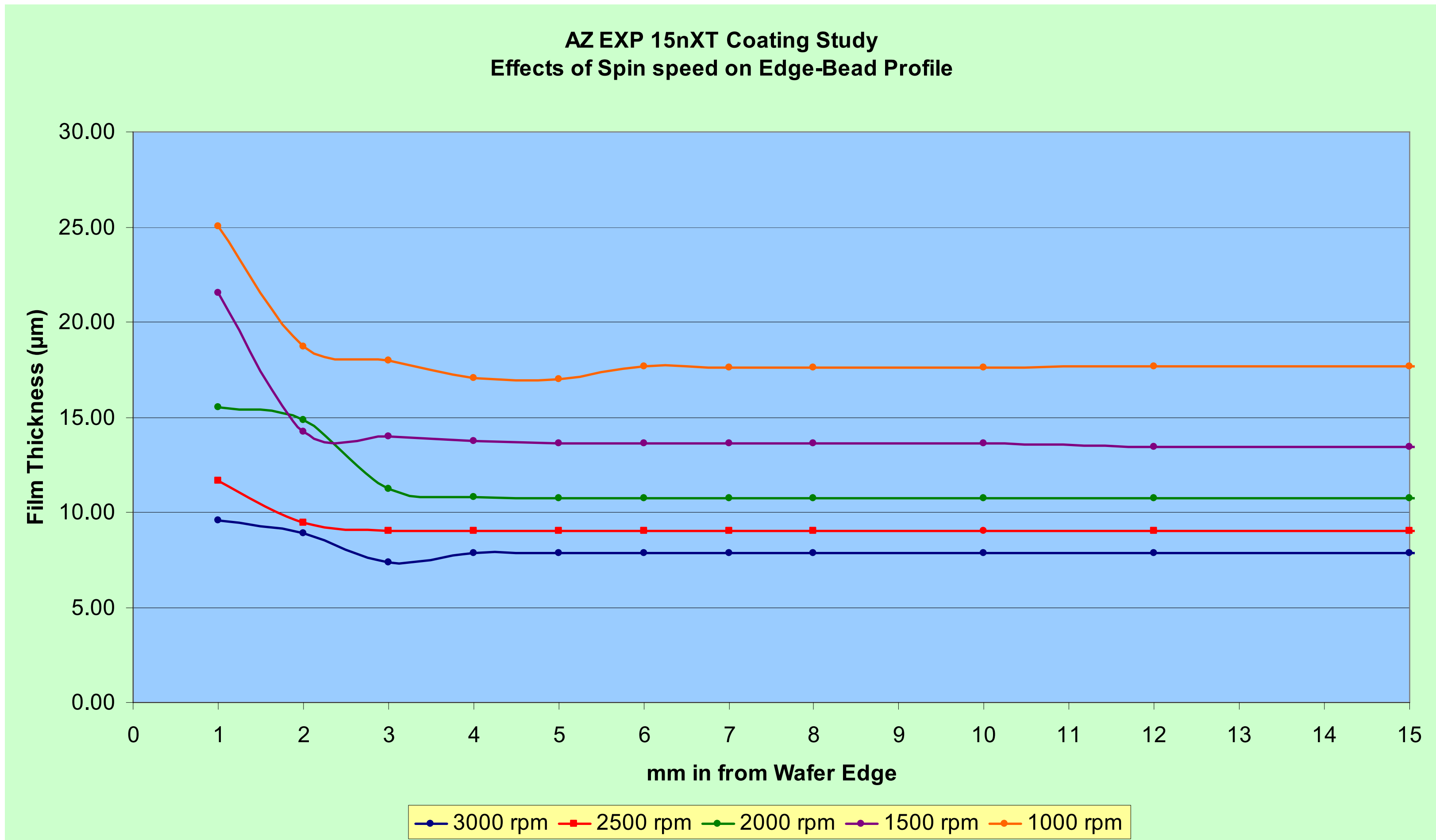
AZ® 15nXT (450 CPS)
Edge-Bead Coating Study (200 mm wafer)



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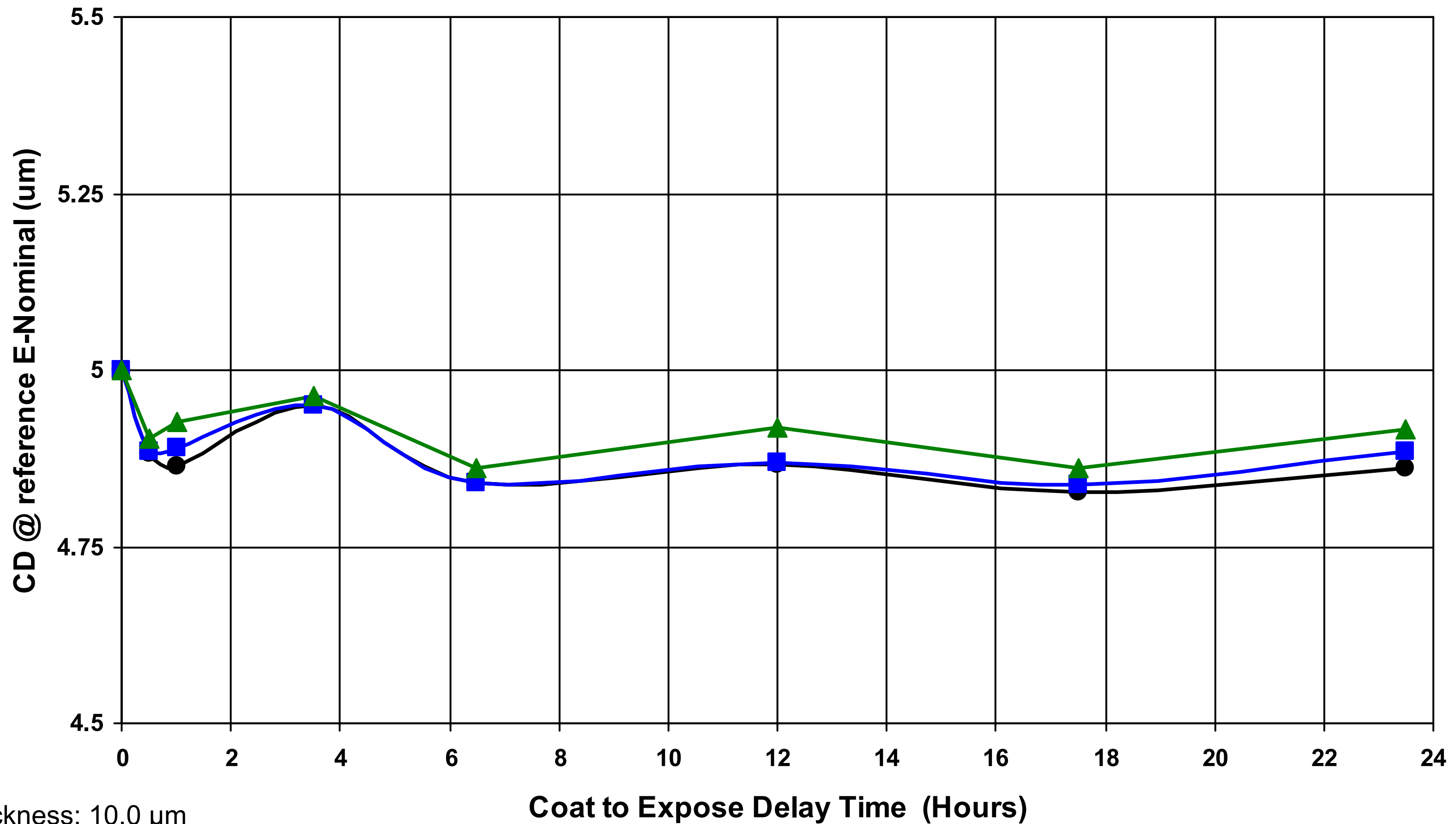
AZ® 15nXT (450 CPS), FT=10.0 µm

Coat to Exposure Delay on Copper; 5 µm L/S



Film Thickness: 10.0 µm
Optitrac coat and Bake
SB: 110°C/ 180 sec Contact
ASML 0.48 NA 0.55 σ i-Line
PEB: 120°C/ 60 sec Contact
AZ 300 MIF 3x50 sec spray puddles @ 23 °C

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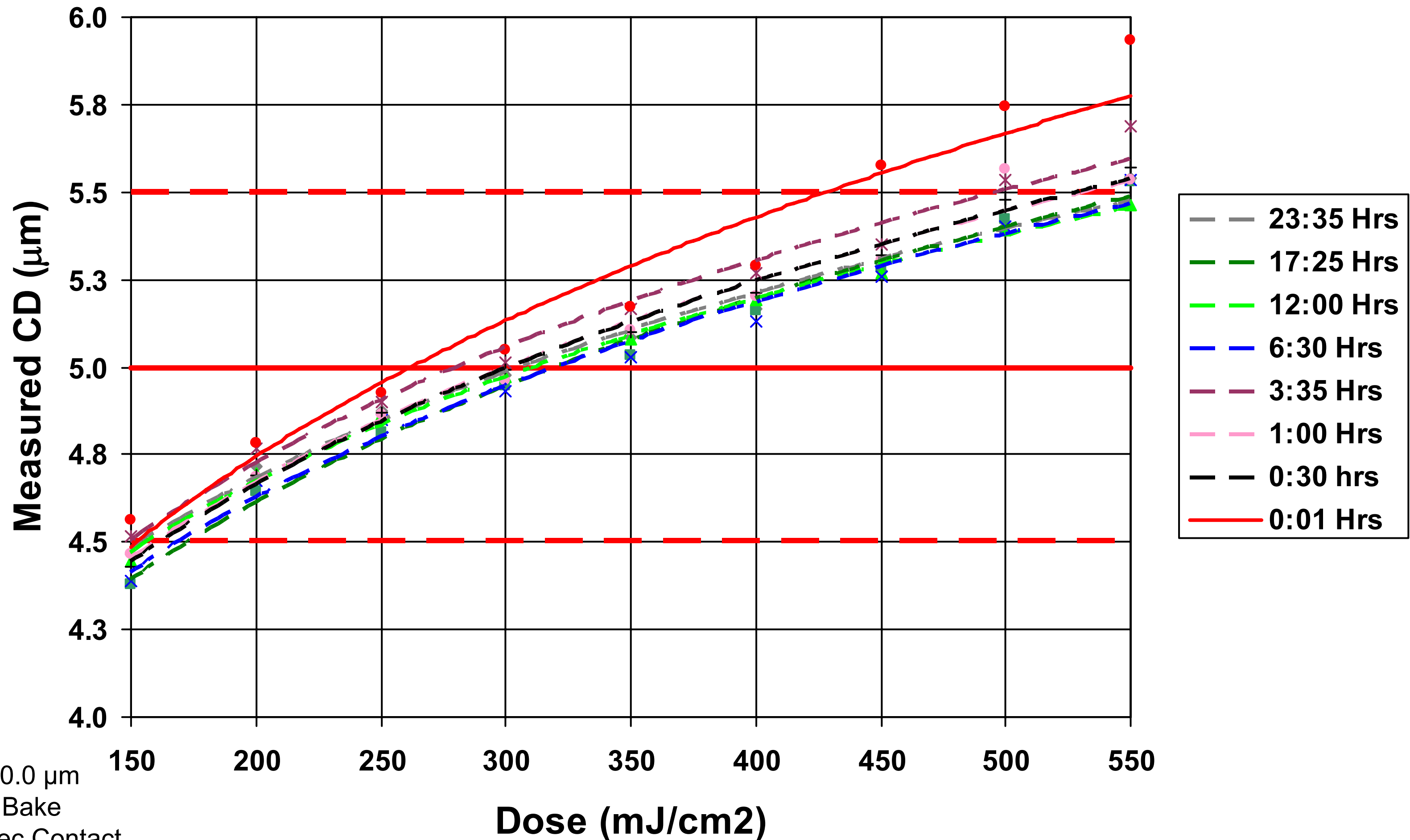
AZ® 15nXT (450 CPS) , F = +1.0 µm, FT=10.0 µm
Coat to Exposure Delay on Copper (hr:mm); 5 µm L/S



Film Thickness: 10.0 µm
Optitrac coat and Bake
SB: 110°C/ 180 sec Contact
ASML 0.48 NA 0.55 σ i-Line
PEB: 120°C/ 60 sec Contact
AZ 300 MIF 3x50 sec spray puddles @ 23 °C

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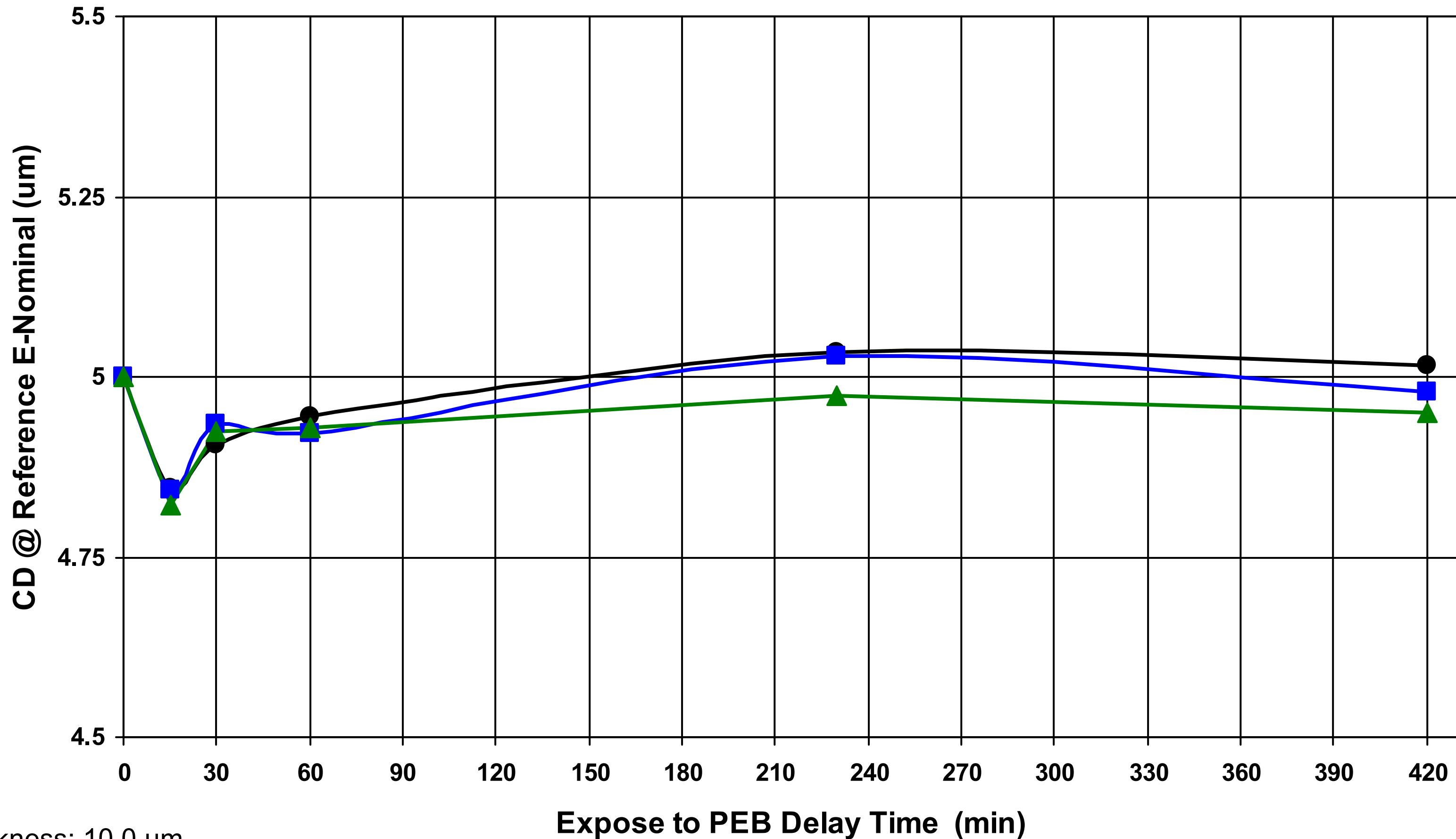
AZ® 15nXT (450 CPS) , FT=10.0 µm

Exposure to PEB Delay on Cu Wafers; 5 µm L/S



Film Thickness: 10.0 µm
Optitrac coat and Bake
SB: 110°C/ 180 sec Contact
ASML 0.48 NA 0.55 σ i-Line
PEB: 120°C/ 60 sec Contact
AZ 300 MIF 3x50 sec spray puddles @ 23 °C

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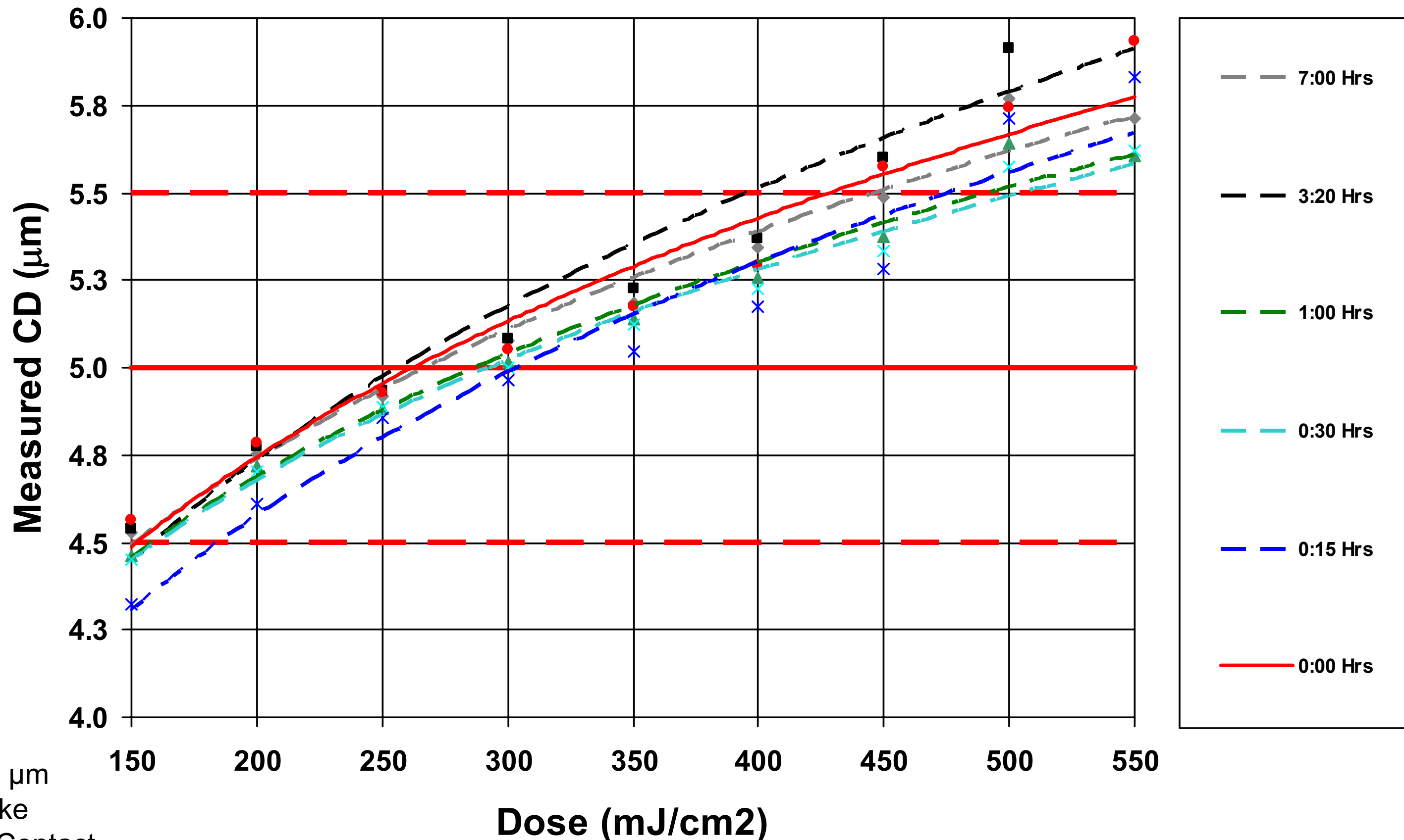
AZ® 15nXT (450 CPS), F = +1.0 µm, FT=10.0 µm

Exposure to PEB Delay on Cu Wafers (Hr:mm); 5 µm L/S



Film Thickness: 10.0 µm
Optitrac coat and Bake
SB: 110°C/ 180 sec Contact
ASML 0.48 NA 0.55 σ i-Line
PEB: 120°C/ 60 sec Contact
AZ 300 MIF 3x50 sec spray puddles @ 23 °C

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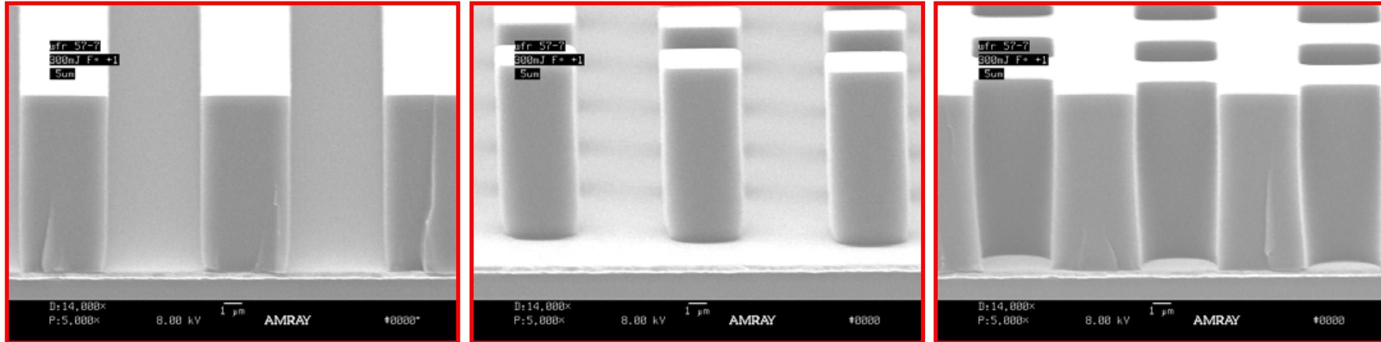
AZ® 15nXT (450 CPS)

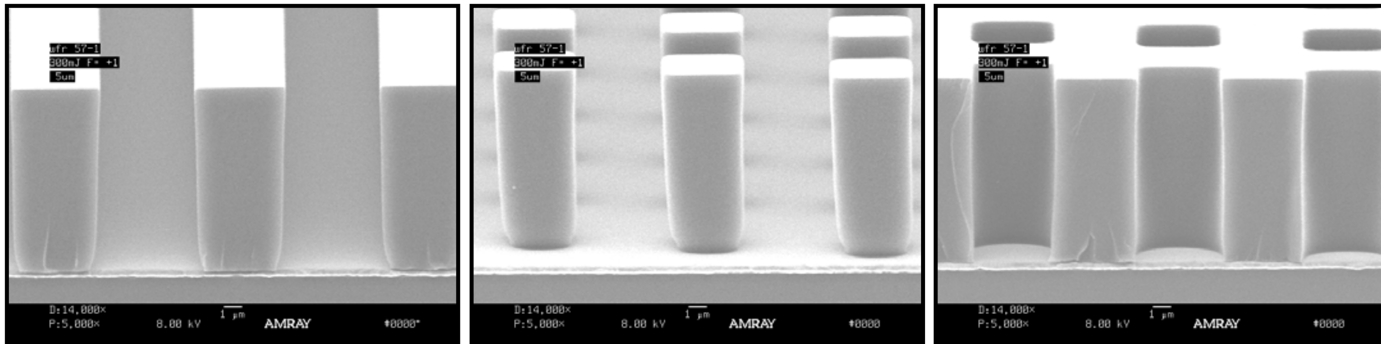
Exposure and PEB Delays on Cu Wafers

300 mJ/cm^2 , FT=10.0 µm, 5µm Features @ F= +1.0

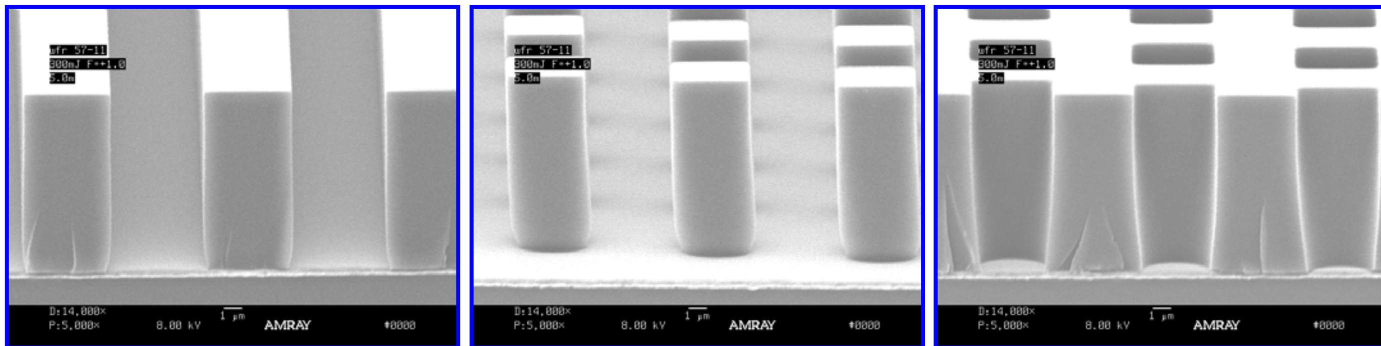
No Delays



Exposure + 23 Hours



PEB/Develop + 7 Hours



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AZ® 15nXT (450 CPS)

Ni/Cu Plating Compatibility

Ni Plating solution: Enthone Microfab Ni-100
Process condition:
- Electrical density: 3.2 ASD
- Plating current: 0.103 A
- Stirring rate: 120 rpm
- Temp: 50°C
- Plating time: 3 min 12 sec

Cu Plating solution: Enthone Microfab Cu 200
Process condition:
- Electrical density: 3.2 ASD
- Plating current: 0.103 A
- Stirring rate: 120 rpm
- Temp: 25°C (Room Temp)
- Plating time: 4 min 48 sec

Stripping: AZ® Kwik Strip at 70 °C for 3 min

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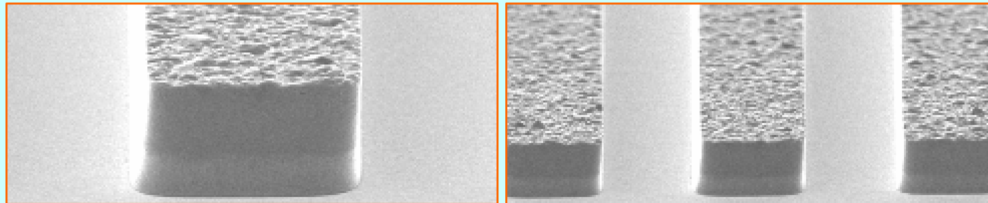
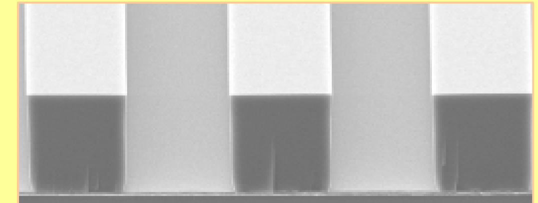
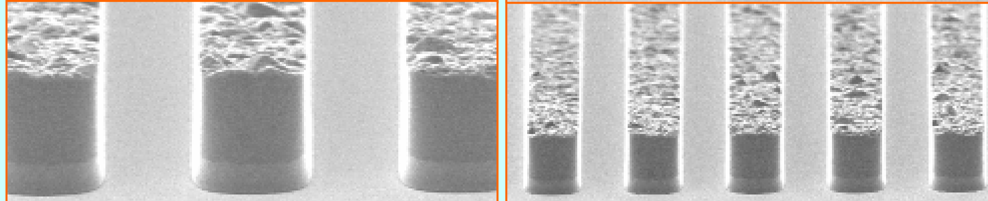
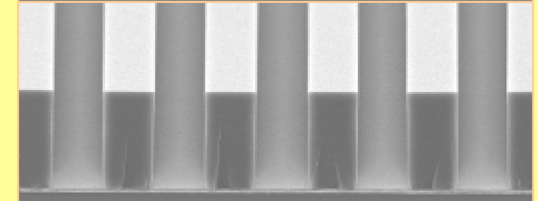
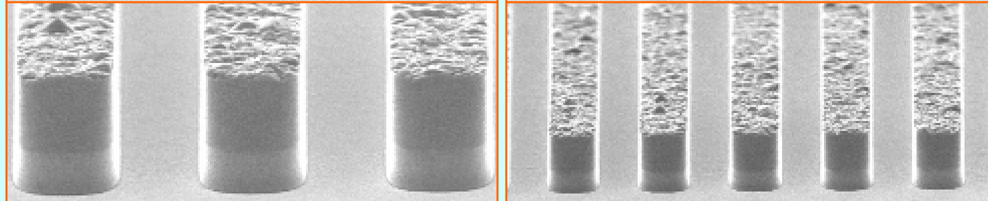
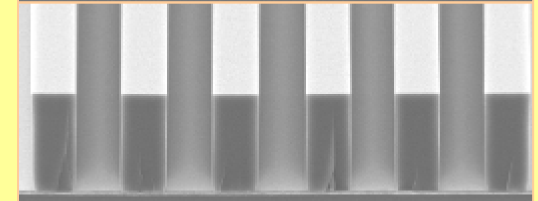
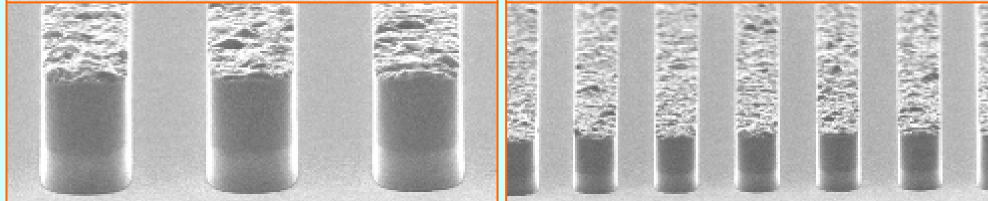
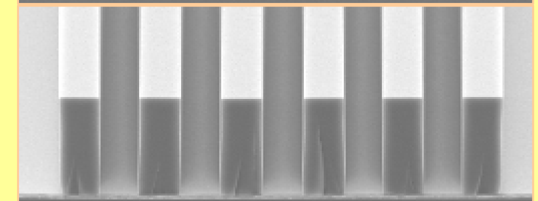
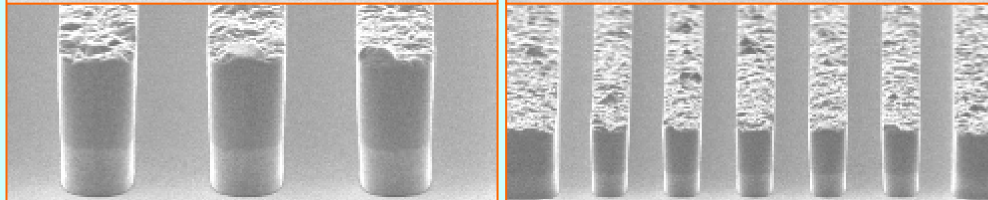
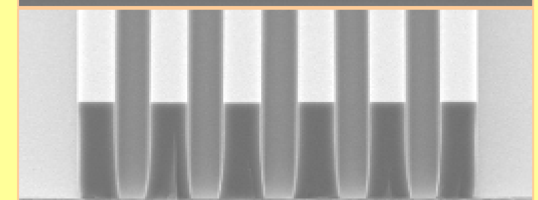
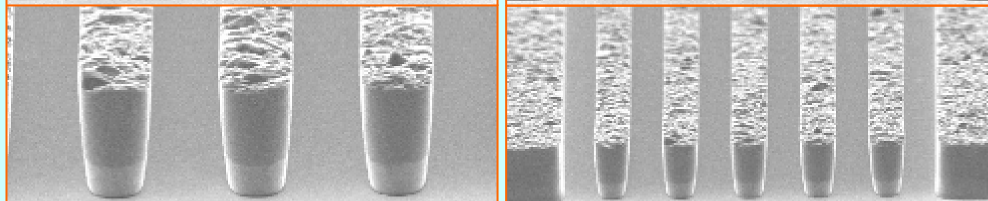
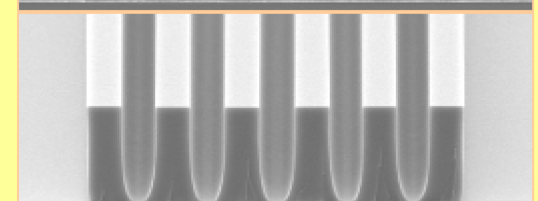
AZ® 15nXT (450 CPS) Plated Ni/Cu Lines			AZ® 15nXT (450 CPS) F=1µm; 400 mJ/cm^2
10 µm			
5 µm			
4.5 µm			
4 µm			
3.6 µm			
3.4 µm			

AZ® 15nXT (450 CPS)
Summary

- Compatible on Cu type substrates and other metals.
- Very good lithographic throughput; very competitive photospeed and develop time.
- Excellent adhesion, no underplating.
- Vertical sidewall profiles.
- Wide compatibility to plating solutions, including Cu, Ni, and Au.
- Easily strips after plating; stripped completely in AZ Kwik Strip at 70°C for 3 min.
- Very good stability and shelf life
- Thinner version available for lower FT range; 15nXT (115 CPS).

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