Negative Acting Thick Resist for
Cu RDL, TSV, and other plating & etch applications
Lithographic Performance Comparison at 6 µm FT on Cu wafers

October 2015

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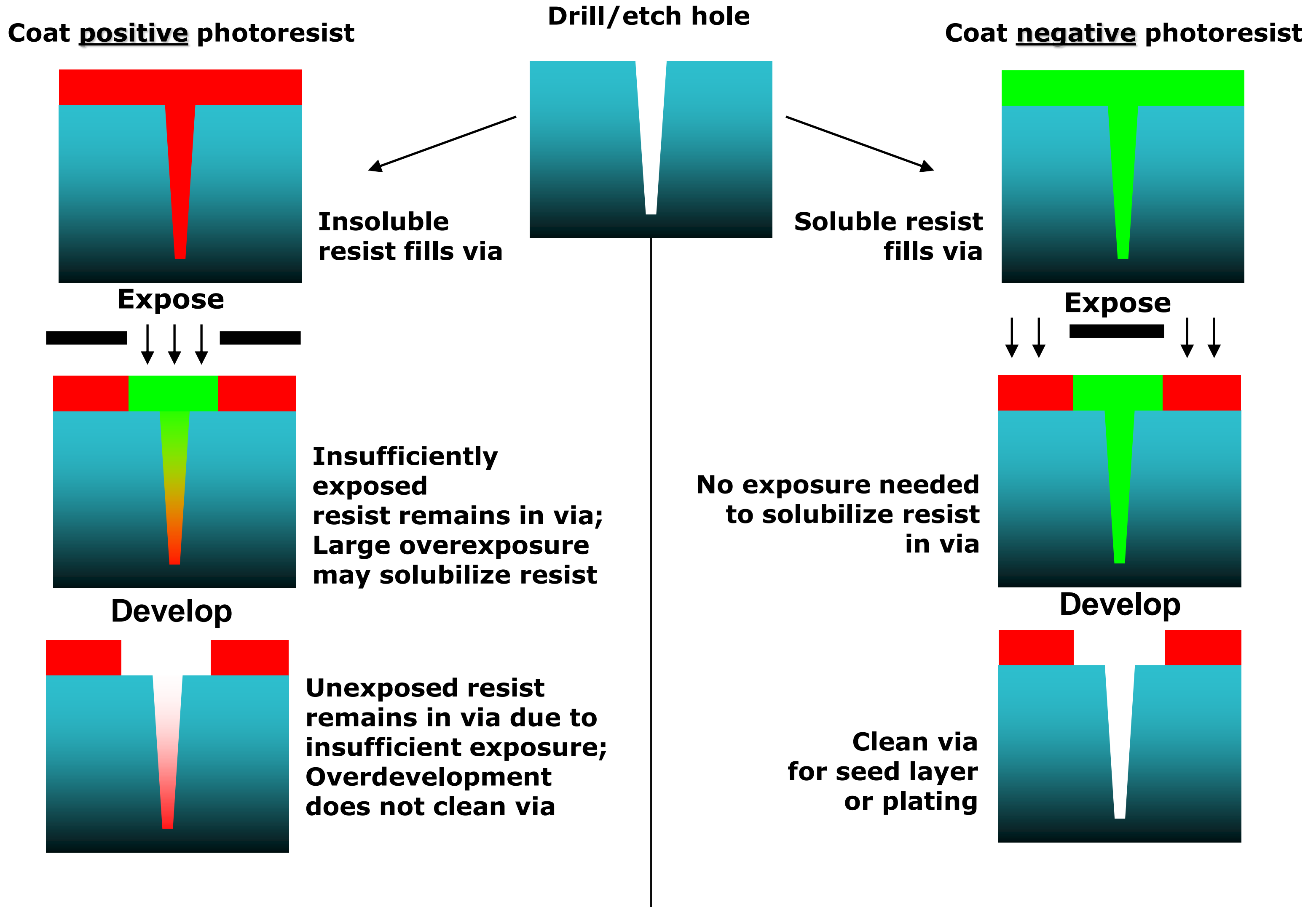
Through-Silicon-Via (TSV)
Advantages to Use a Negative Photoresist



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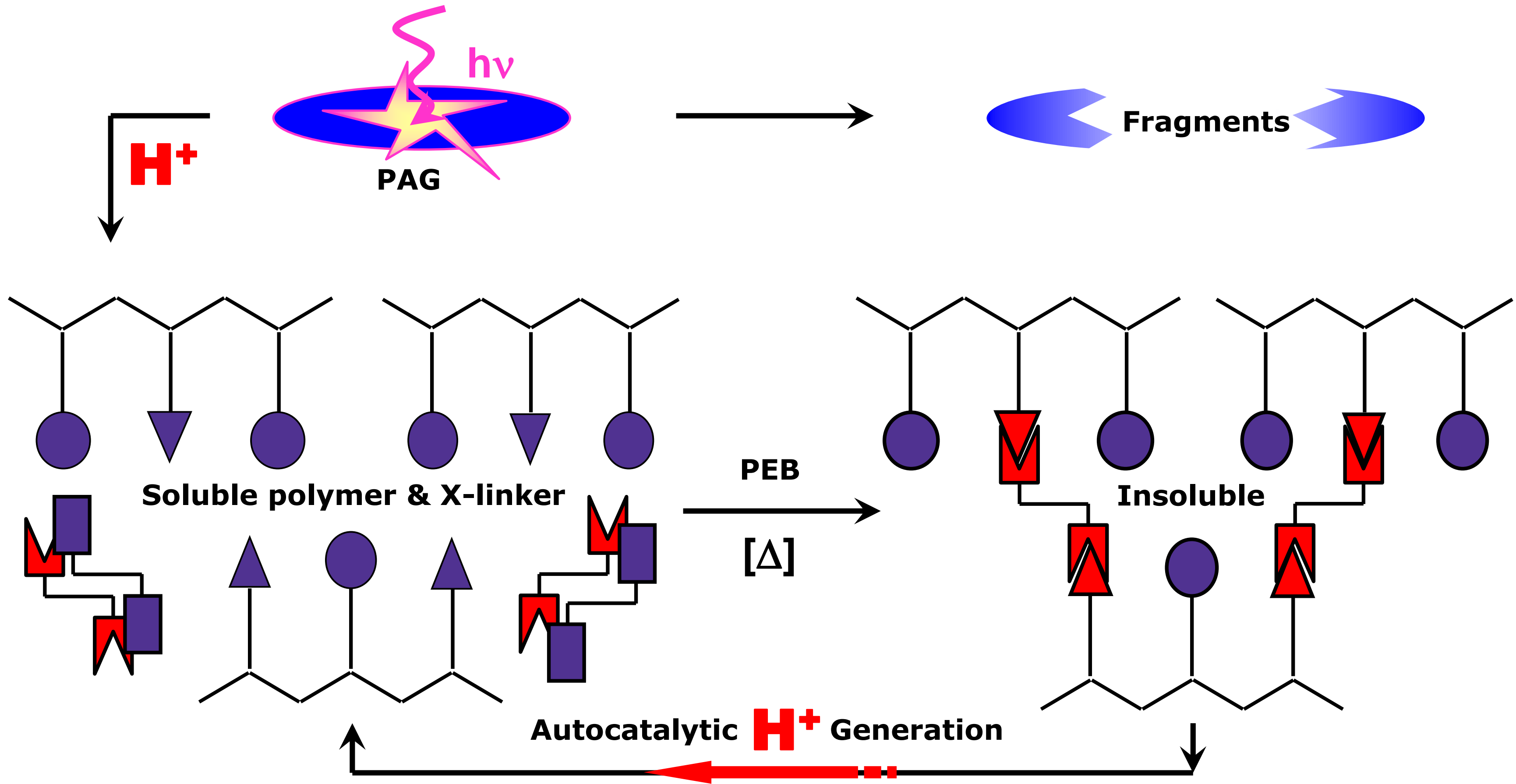
Chemically Amplified Negative Resist

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 (115 CPS)
Process Conditions

Substrate:	Si wafer for photospeed testing Cu wafer for images
Film Thickness:	6 µm by single coat
Softbake:	110°C / 120 seconds
Exposure tool:	ASML (i-line) Dose = 300 ± 50 mJ/cm^2; Focus: 1 ± 0.5 µm
PEB:	120°C / 60 seconds
Develop:	AZ 300 MIF (2.38% TMAH); 2 x 55 second puddles

AZ® 15nXT (115 CPS)
Optical Parameters

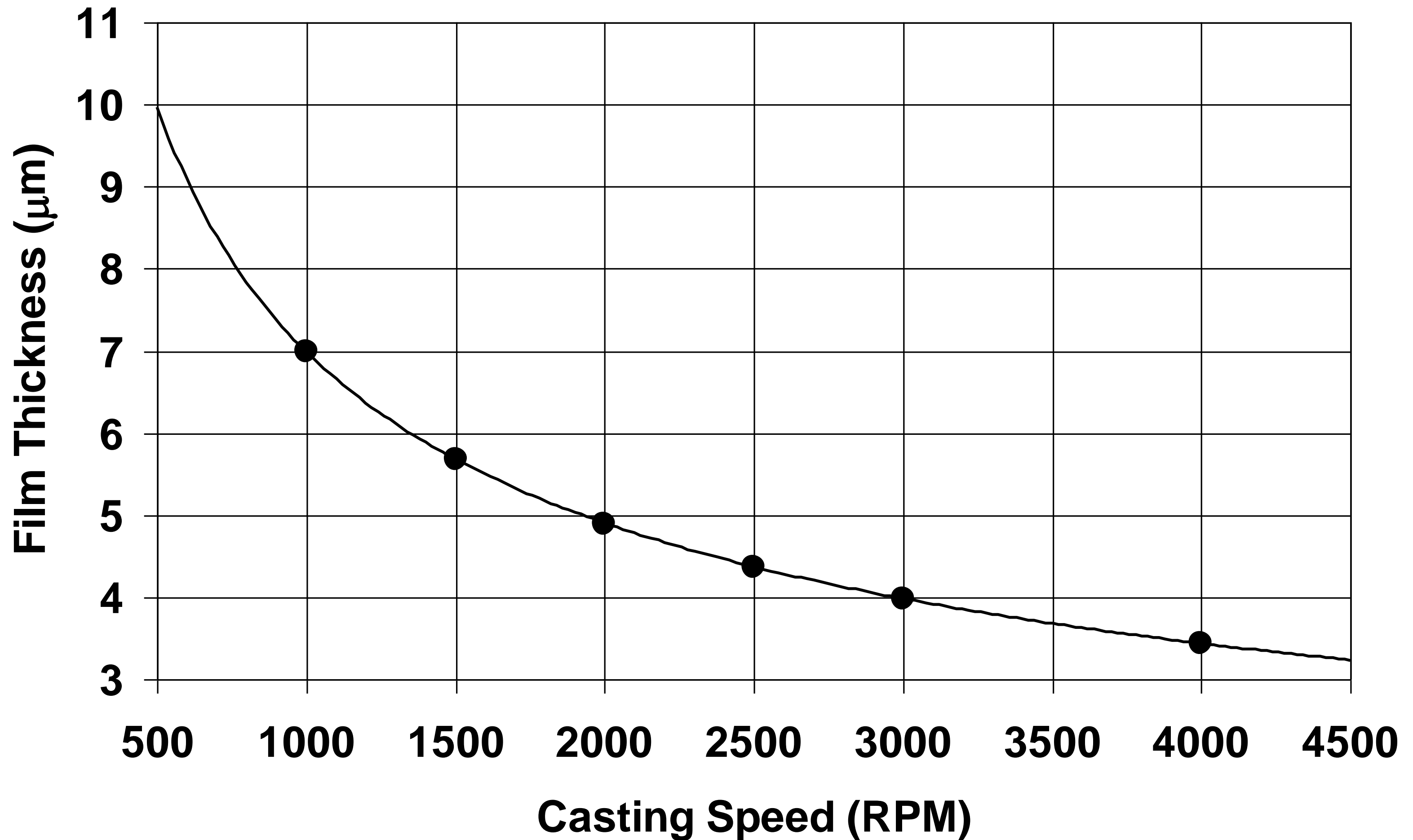
n & k Values at different wavelength

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: $n = A + B/\lambda^2 + C/\lambda^4$

$A = 1.5754$
$B = 0.013242\ mm^2$
$C = 0\ mm^4$

AZ® 15nXT (115 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/ 2 minutes

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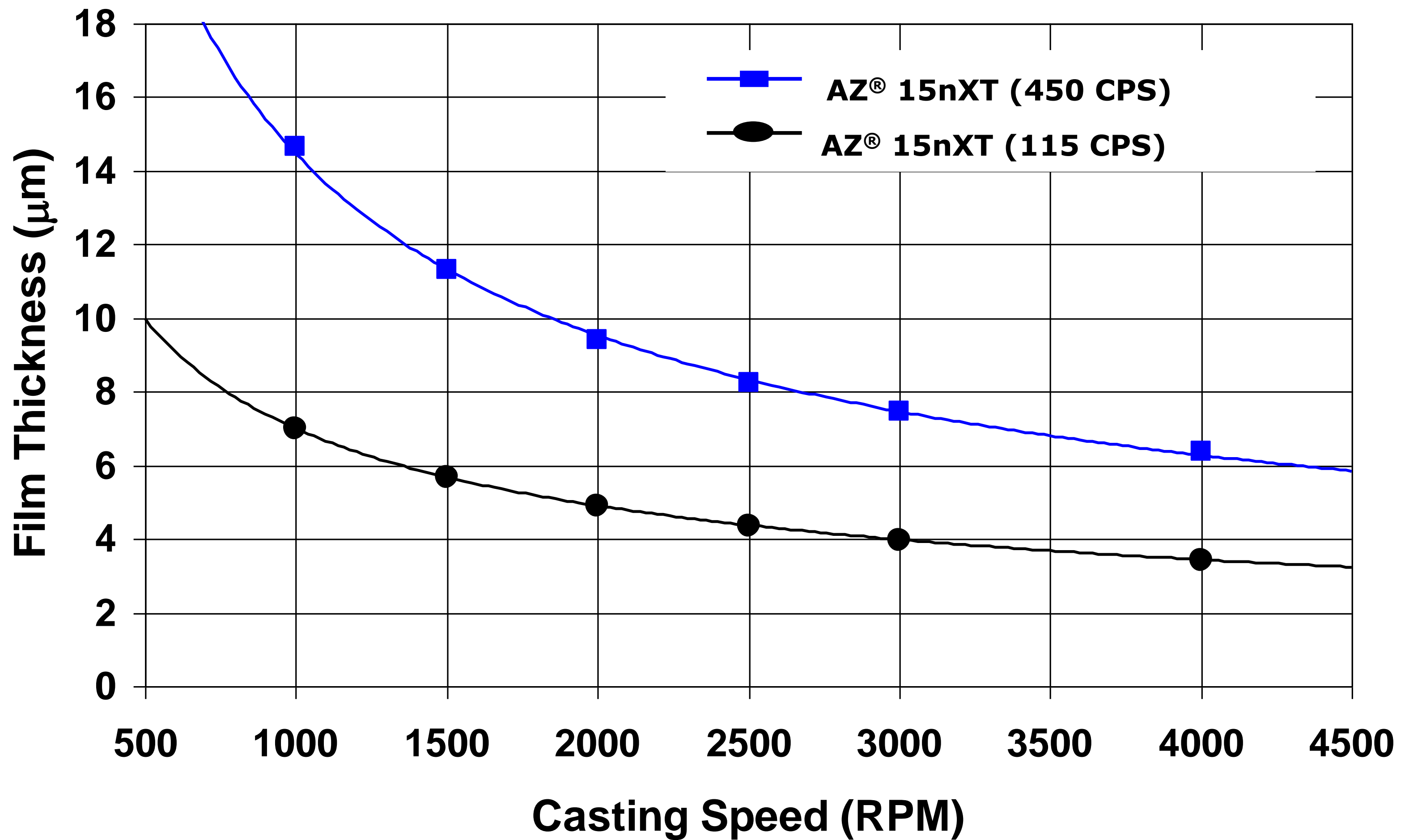
AZ® 15nXT (115 CPS) and AZ® 15nXT (450 CPS)
Spin Speed Curves



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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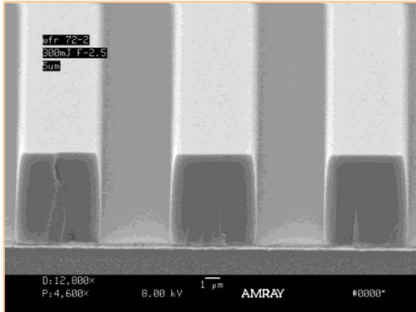
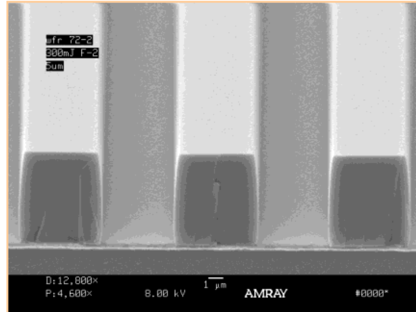
AZ® 15nXT (115 CPS)
DOF on Cu Wafer @ 300 mJ/cm²

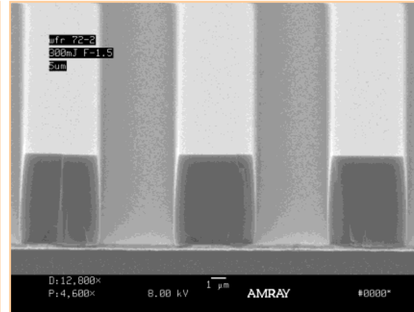
f -2.5



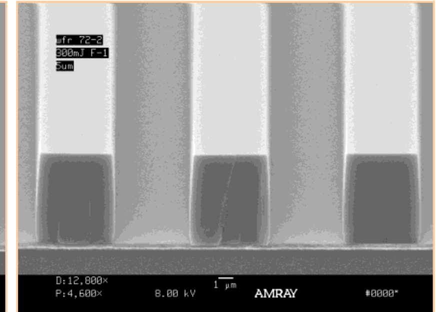
f -2.0



f -1.5

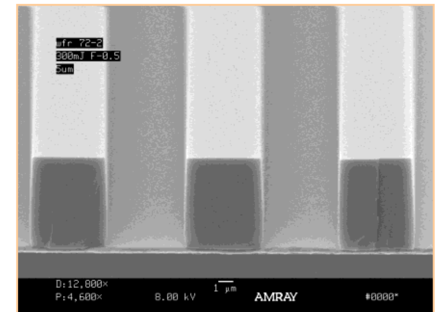


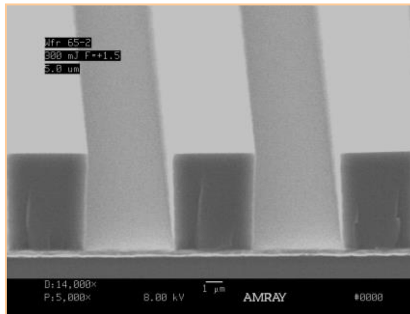
f -1.0



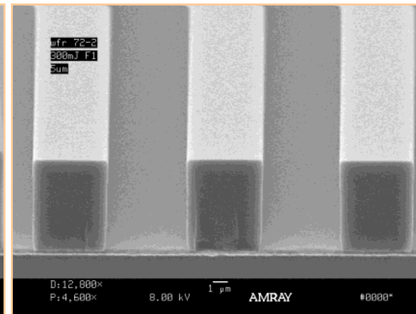
Film Thickness: 6.0mm
Opti Track Coat and Bake
SB: 110°C/2 minutes
ASML i-Line Stepper, 300mJ/cm²
Opti Track PEB/Develop
PEB: 120°C/ 60 Seconds
AZ 300 MIF/ 2x55sec Spray/Puddle @23°C

f -0.5

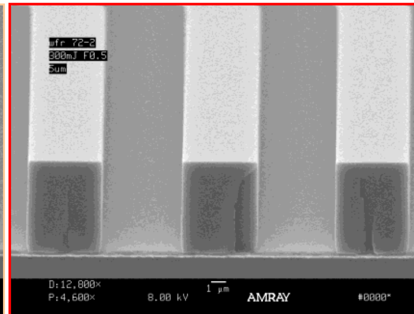




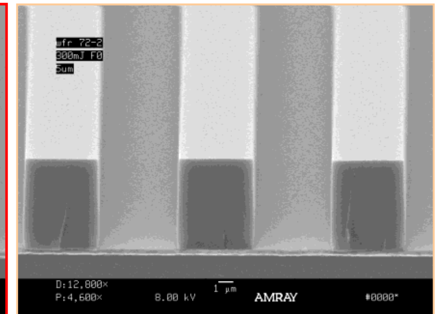
f +1.5



f +1.0



f +0.5



f 0.0

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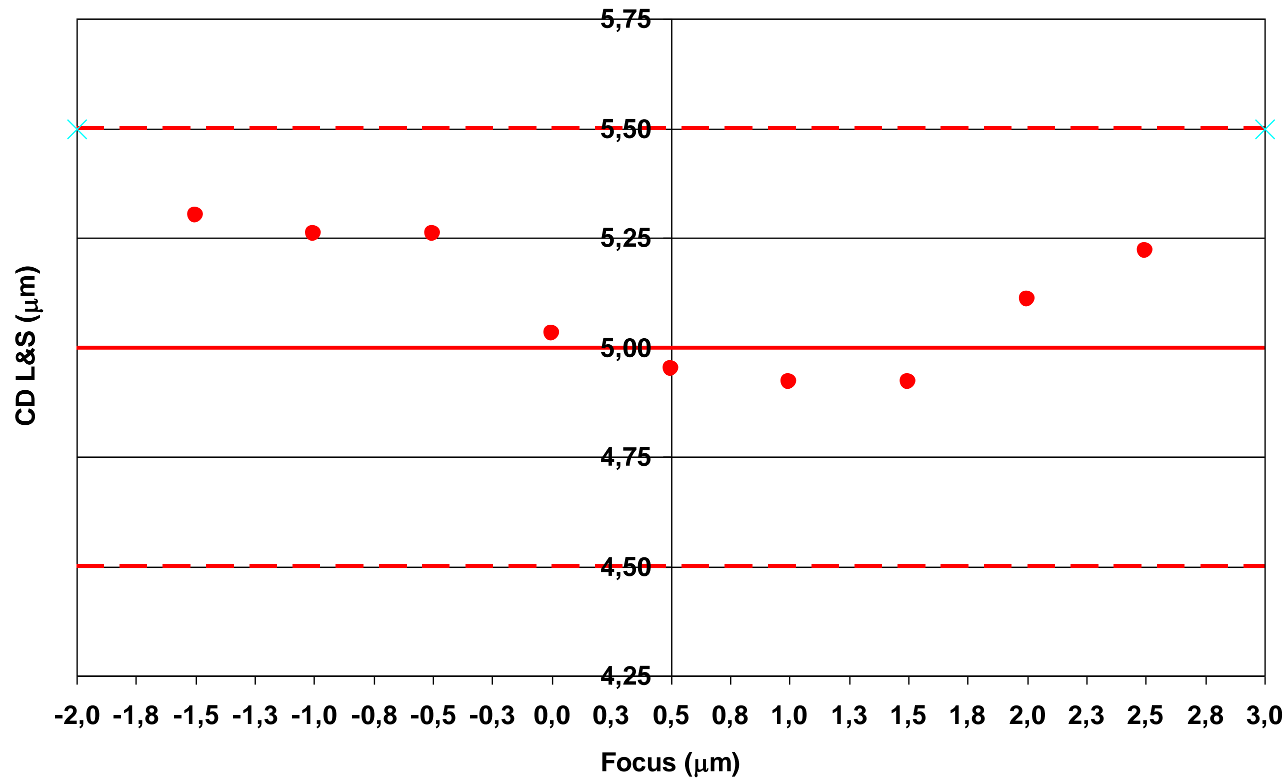
AZ® 15nXT (115 CPS)
DOF on Cu Wafer @ 300 mJ/cm2



Film Thickness: 6.0mm
Opti Track Coat and Bake
SB: 110°C/2 minutes
ASML i-Line Stepper, 300mJ/cm^2
Opti Track PEB/Develop
PEB: 120°C/ 60 Seconds
AZ 300 MIF/ 2x55sec Spray/Puddle @23°C

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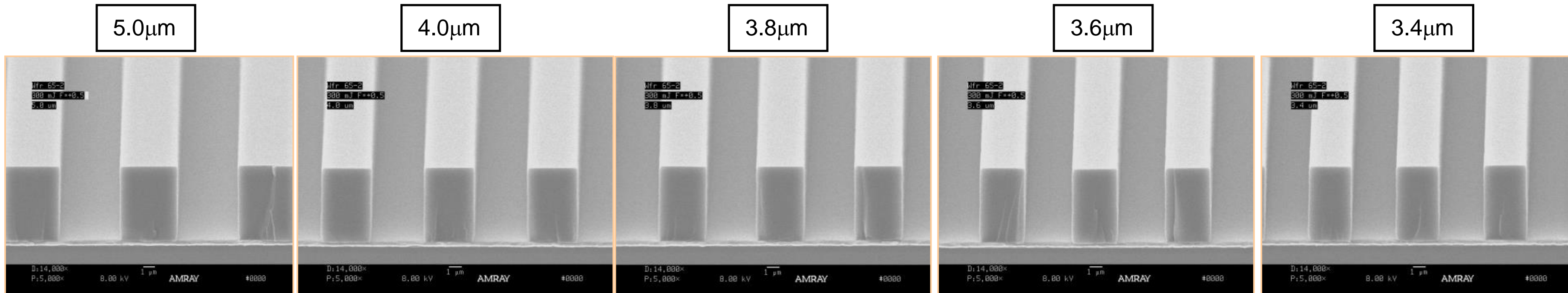
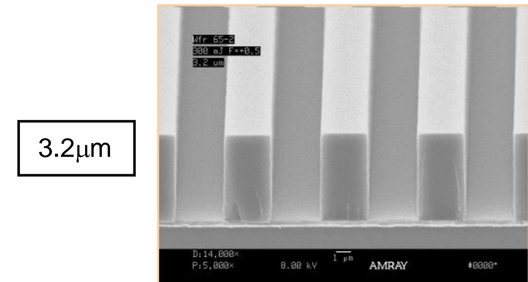
AZ® 15nXT (115 CPS)
Linearity @ 300 mJ/cm^2, F= + 0.5 mm

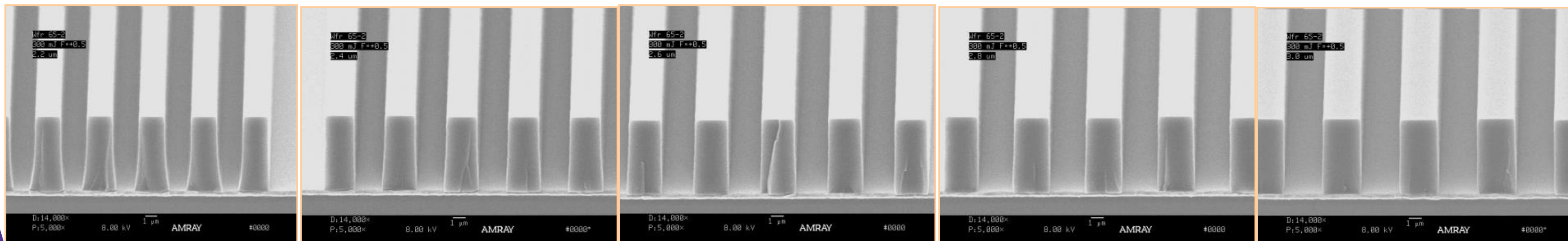
5.0µm | 4.0µm | 3.8µm | 3.6µm | 3.4µm



Film Thickness: 6.0mm
Opti Track Coat and Bake
SB: 110°C/2 minutes
ASML i-Line Stepper, F= +0.5mm
Opti Track PEB/Develop
PEB: 120°C/ 60 Seconds
AZ 300 MIF/ 2x55sec Spray/Puddle @23°C

3.2µm





2.2µm | 2.4µm | 2.6µm | 2.8µm | 3.0µm

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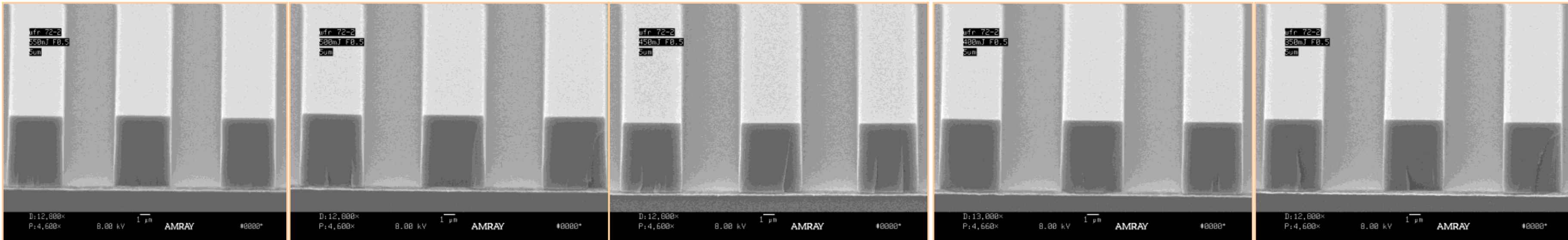
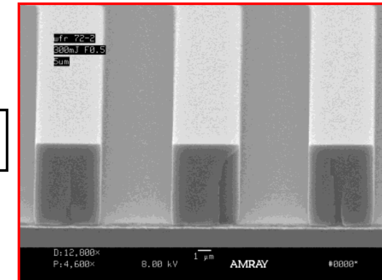
AZ® 15nXT (115 CPS)
Exposure Latitude @ F = 0.5 mm, FT = 6.0 mm, 5 mm L/S

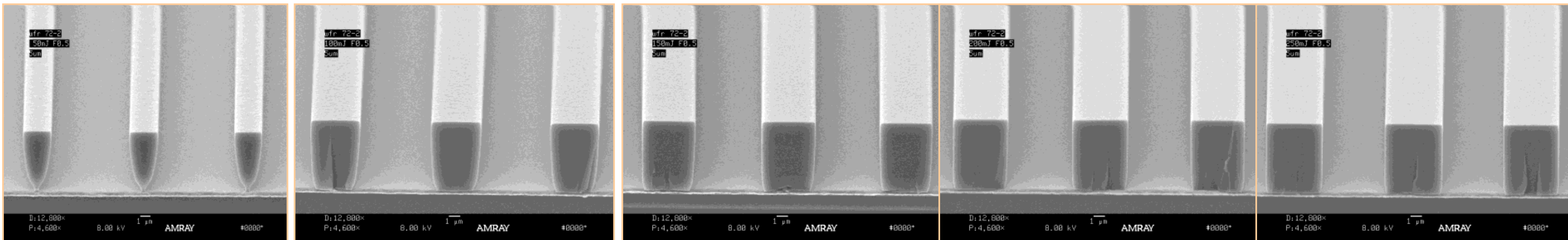
550 mJ/cm² | 500 mJ/cm² | 450 mJ/cm² | 400 mJ/cm² | 350 mJ/cm²



Film Thickness: 6.0mm
Opti Track Coat and Bake
SB: 110°C/2 minutes
ASML i-Line Stepper, F= +0.5mm
Opti Track PEB/Develop
PEB: 120°C/ 60 Seconds
Chill: 21°C/120 Seconds
AZ 300 MIF/ 2x55sec Spray/Puddle @23°C

300 mJ/cm²





50 mJ/cm² | 100 mJ/cm² | 150 mJ/cm² | 200 mJ/cm² | 250 mJ/cm²

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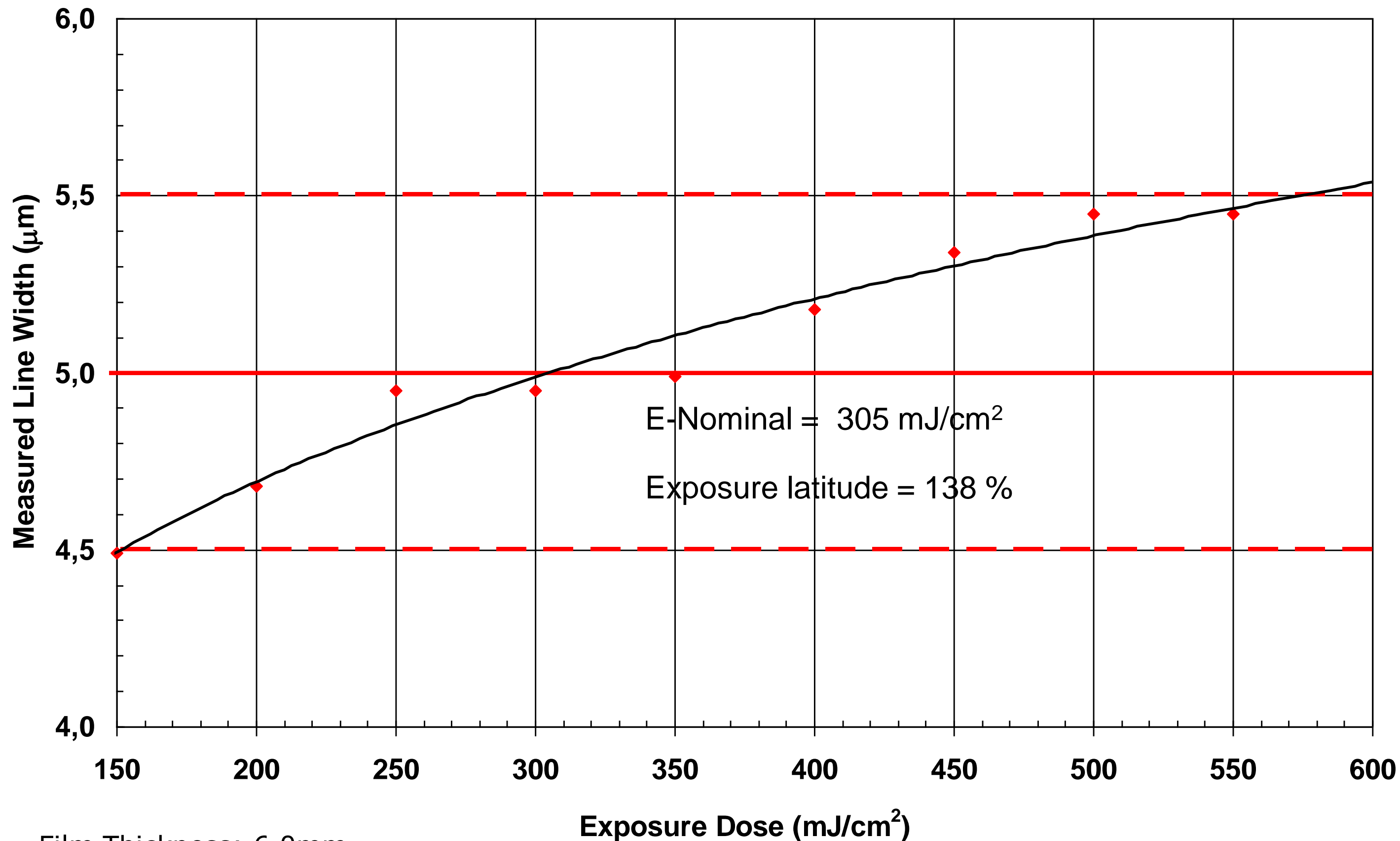
AZ® 15nXT (115 CPS)
FT = 6.0 mm, Focus =+0.5 mm
5.0 mm L/S Exposure Latitude on Cu Wafer



Film Thickness: 6.0mm
Opti Track Coat and Bake
SB: 110°C/2 minutes
ASML i-Line Stepper, F= +0.5mm
Opti Track PEB/Develop
PEB: 120°C/ 60 Seconds
AZ 300 MIF/ 2x55sec Spray/Puddle @23°C

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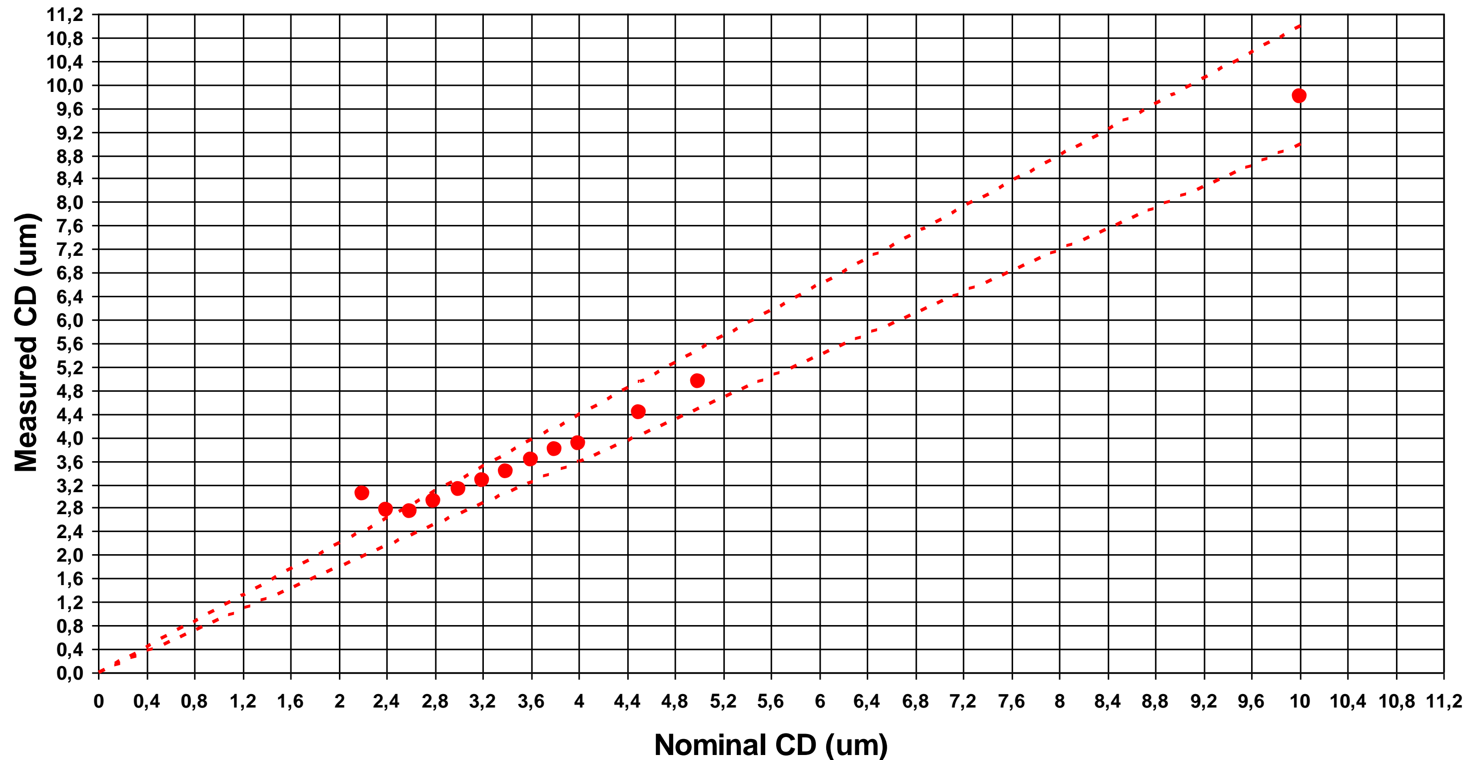
AZ® 15nXT (115 CPS)
L/S Linearity @ 300 mJ/cm², F = +0.5 mm



Film Thickness: 6.0mm
Opti Track Coat and Bake
SB: 110°C/2 minutes
ASML i-Line Stepper, F= +0.5mm
Opti Track PEB/Develop
PEB: 120°C/ 60 Seconds
AZ 300 MIF/ 2x55sec Spray/Puddle @23°C

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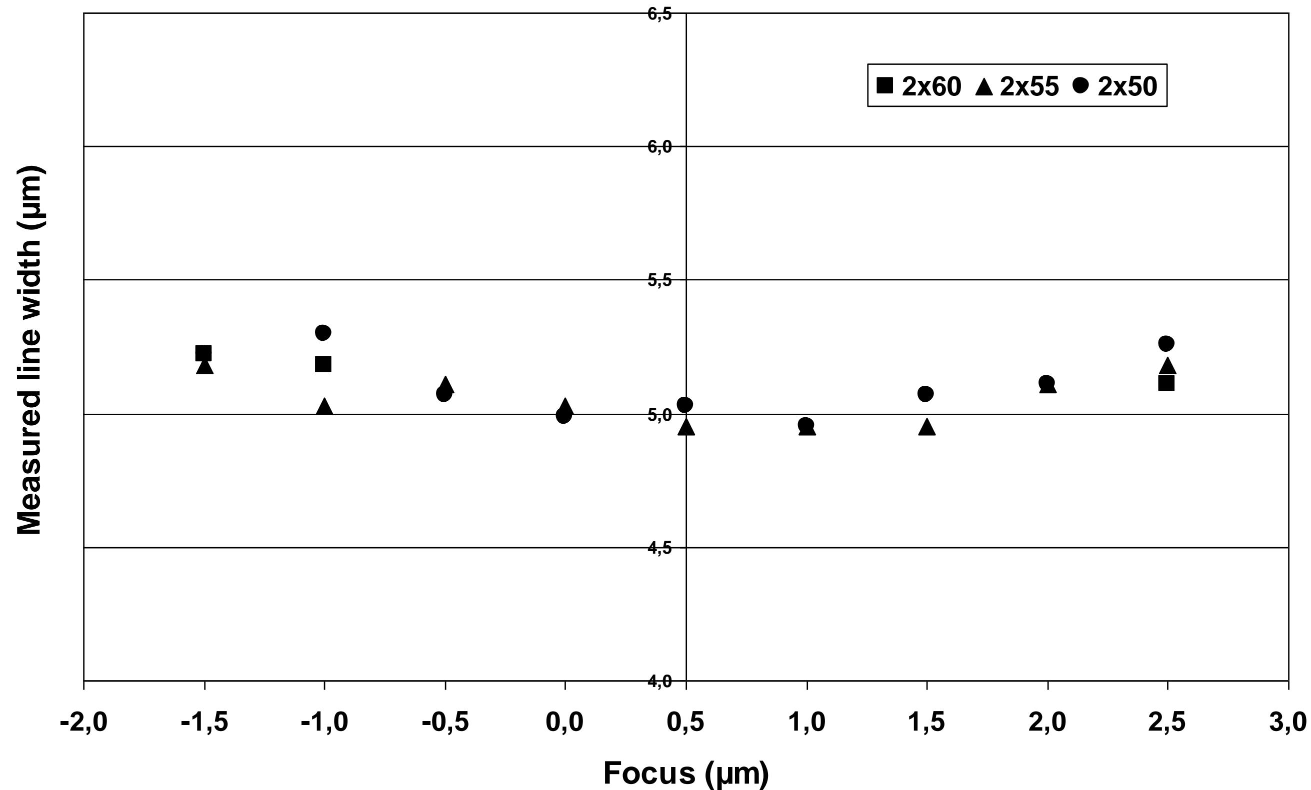
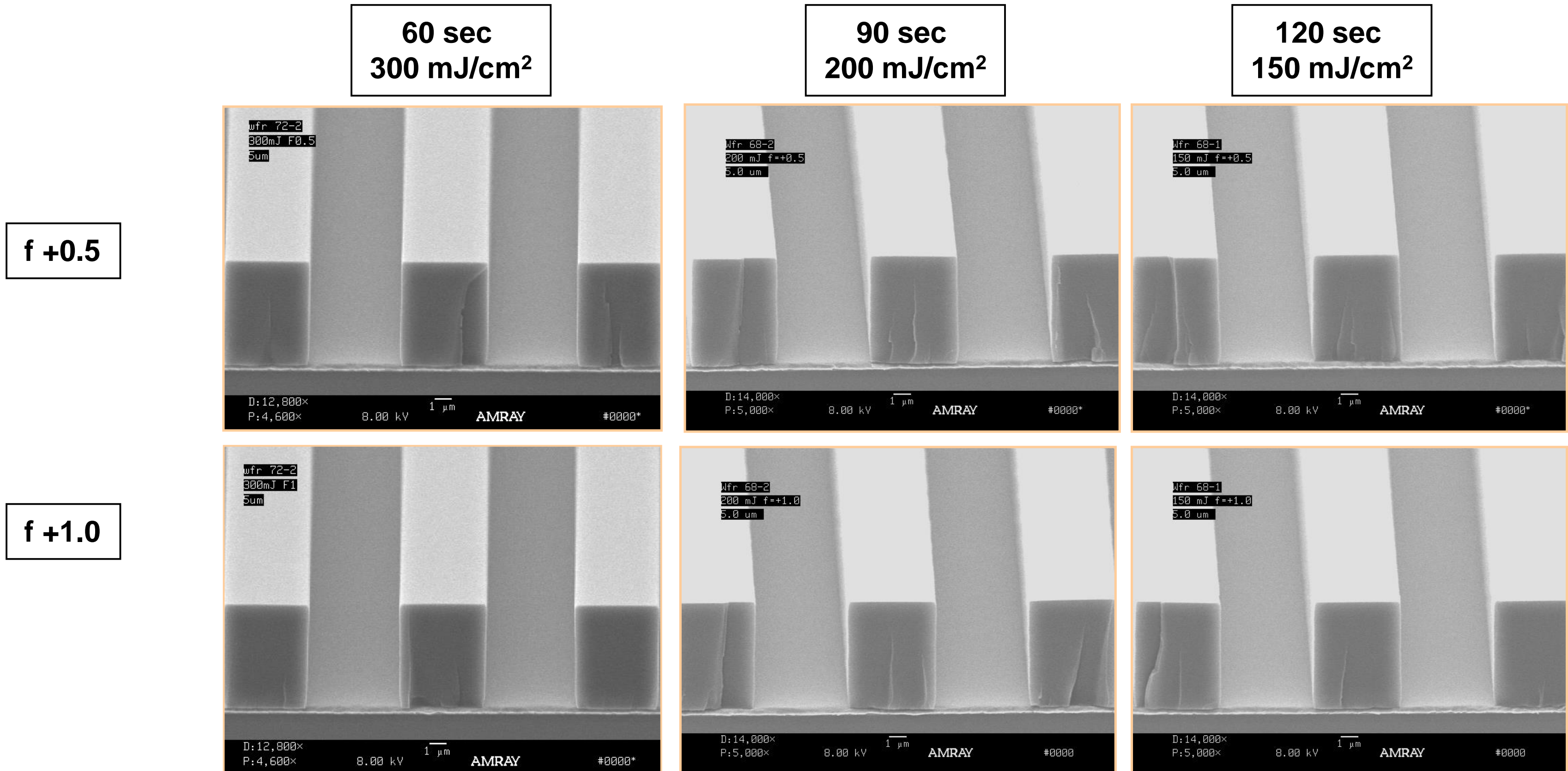
AZ® 15nXT (115 CPS)
FT = 6.0 mm, 5.0 mm L/S
Development Window on Cu Wafer



Film Thickness: 6.0mm
Opti Track Coat and Bake
SB: 110°C/2 minutes
ASML i-Line Stepper, 250 mJ/cm²
Opti Track PEB/Develop
PEB: 120°C/ 60 Seconds
AZ 300 MIF/ 2x55sec Spray/Puddle @23°C

AZ® 15nXT (115 CPS)
PEB Comparison on Cu Wafers @ 6 mm FT



Opti Track Coat and Bake
SB: 110°C/2 minutes
Film Thickness: 6.0mm/ 5.0mm L&S
ASML i-Line Stepper
Opti Track PEB/Develop
PEB: 120°C/ 60, 90, 120 Seconds
Chill: 21°C/120 Seconds
AZ 300 MIF/ 2x55sec Spray/Puddle @23°C

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AZ® 15nXT (115 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
- Thicker version available for higher FT range; 15nXT (450 CPS).

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