Technical datasheet

AZ® nLOF™ 2000 Series

Negative Tone Photoresists for Single Layer Lift-Off

APPLICATION

AZ® nLOF™ 2000 Series i-line photoresists are engineered to simplify the historically complex image reversal and multi-layer lift-off lithography processes. Ideal lift-off pattern profiles are achieved using a standard expose/post expose bake/develop process flow. These photoresists are very fast and printed features are thermally stable to >200°C.

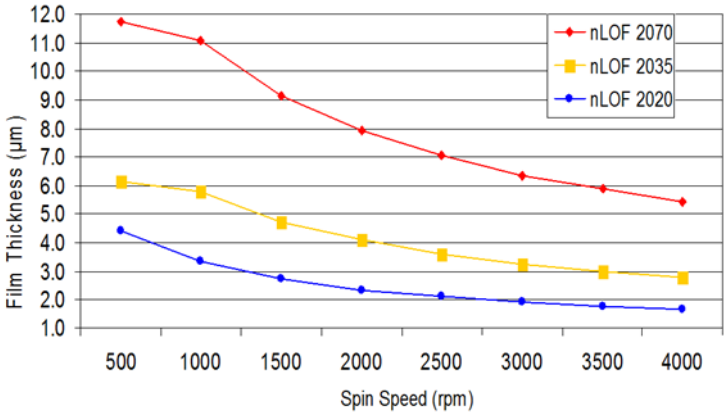
- TMAH developer compatible
- Single coat thicknesses from 2.0 to >10µm
- May be processed with vertical sidewalls for RIE etching

TYPICAL PROCESS

- Soft Bake: 110ºC/60-90s
- Rehydration Hold: None
- Expose: 365nm sensitive
- Post Expose Bake: 110ºC/60s
- Develop: Puddle, spray or immersion
- Developer Type: MIF

* PEB is required for proper imaging

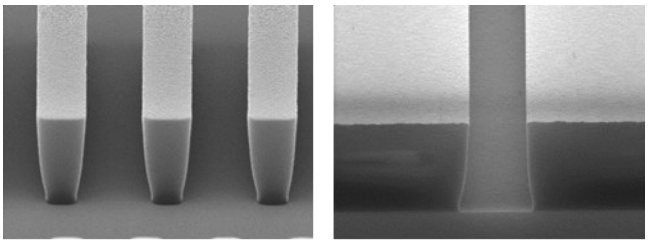
SPIN CURVES (150mm Silicon)



OPTICAL CONSTANTS*

Cauchy A	1.5946
Cauchy B (μm^2)	0.01188
Cauchy C (μm^4)	0.00028
n @ 633nm	1.626
k @ 633nm	0

* Unexposed photoresist film



2.0µm lines and 2.0µm iso trench
3.5µm thick AZ® nLOF™ 2035
72mJ/cm² i-line Exposure
AZ® 300 MIF Develop (120s)

COMPANION PRODUCTS

THINNING/EDGE BEAD REMOVAL

AZ EBR Solvent or AZ EBR 70/30

DEVELOPERS

AZ 300MIF, 726MIF, AZ 917MIF

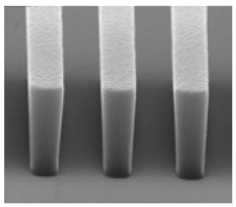
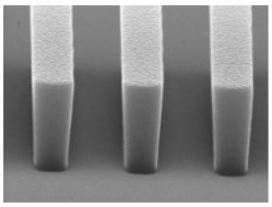
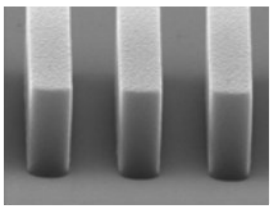
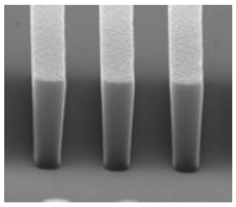
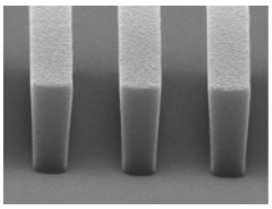
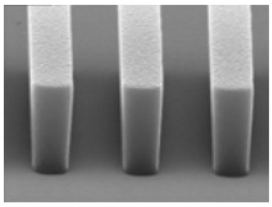
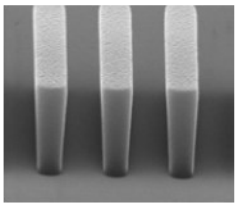
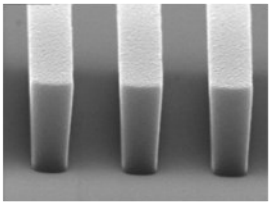
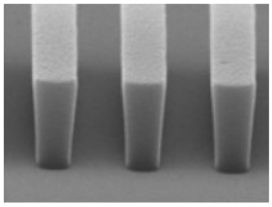
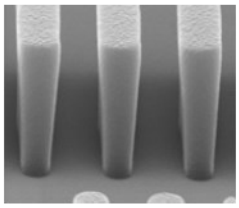
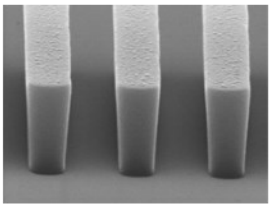
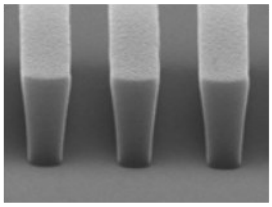
REMOVERS

AZ 300T, AZ 400T

EXAMPLE PROCESS (2.0µm Film Thickness on Si)

Process Step	Parameters
Prime	HMDS 140°C/60s (vapor)
Coat	2.0µm thick film AZ nLOF 2020 (33cPs) on bare Si
Soft Bake	110°C, 60 seconds, direct contact hotplate
Exposure	i-line @ 66mJ/cm^2 nominal (0.54NA) Nikon Stepper*
Post Expose Bake	110°C*, 60 seconds, direct contact hotplate
Develop	AZ 300MIF, 60s single puddle

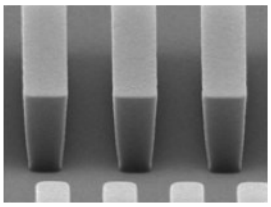
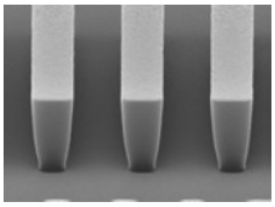
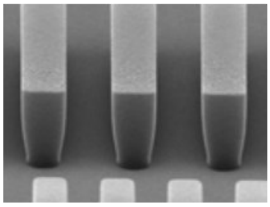
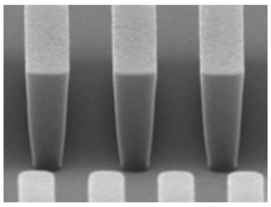
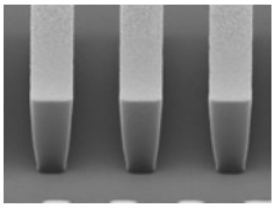
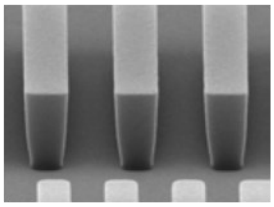
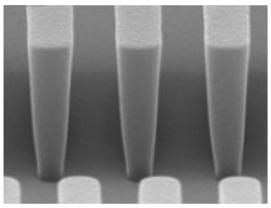
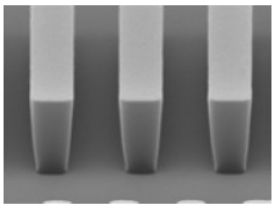
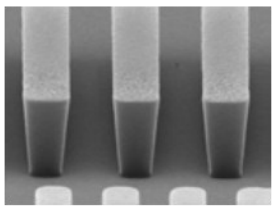
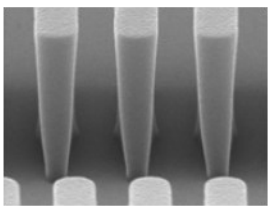
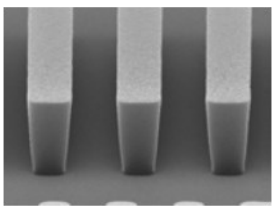
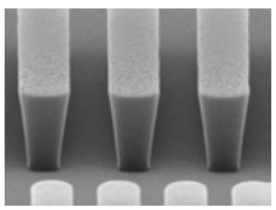
*** Pattern profiles can be modified by varying exposure dose and PEB temperature. See profile optimization matrix for additional information.**

Resolution @ 66mJ/cm^2	1.0µm Lines Through Dose	1.0µm Lines DoF @ 66mJ/cm^2
 0.95µm	 62mJ/cm^2	 -0.2µm
 0.85µm	 66mJ/cm^2	 0.2µm
 0.80µm	 70mJ/cm^2	 0.6µm
 0.70µm	 74mJ/cm^2	 1.0µm

EXAMPLE PROCESS (3.5µm Film Thickness on Si)

Process Step	Parameters
Prime	HMDS 140°C/60s (vapor)
Coat	3.5µm thick film AZ nLOF 2035 (79cPs) on bare Si
Soft Bake	110°C, 60s, direct contact hotplate
Post Bake Delay	None
Expose	i-line @ 80mJ/cm^2 nominal (0.548NA) Nikon Stepper*
Post Expose Bake	110°C*, 60 seconds, direct contact hotplate
Develop	AZ 300MIF, 120s single puddle

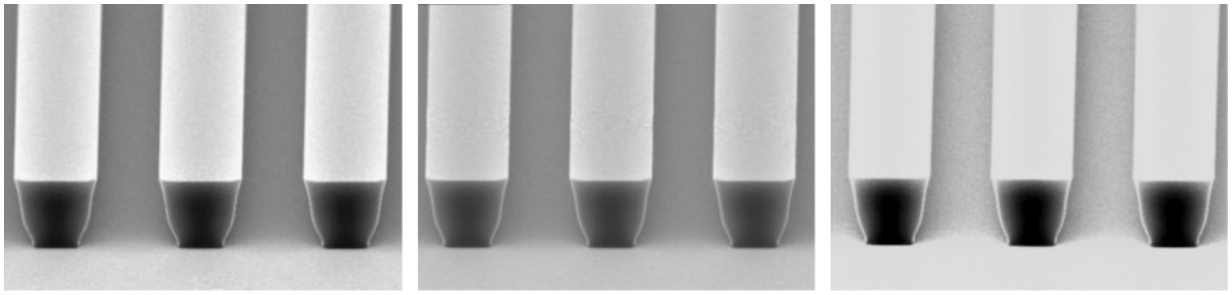
*** Pattern profiles can be modified by varying exposure dose and PEB temperature. See profile optimization matrix for additional information.**

Resolution @ 80mJ/cm^2	2.0µm Lines Through Dose	2.0µm Lines DoF @ 80mJ/cm^2
 2.00µm	 72mJ/cm^2	 -1.0µm
 1.50µm	 80mJ/cm^2	 0.0µm
 1.10µm	 88mJ/cm^2	 1.0µm
 0.90µm	 96mJ/cm^2	 1.8µm

EXAMPLE PROCESS (7.0µm Film Thickness on Si)

Process Step	Parameters
Prime	HMDS 140°C/60s (vapor)
Coat	7.0µm thick film AZ nLOF 2070 (330cPs) on bare Si
Soft Bake	110°C, 90s, direct contact hotplate
Post Bake Delay	None
Expose	i-line @ various doses (0.54NA) Nikon Stepper
Post Expose Bake	110°C, 90 seconds, direct contact hotplate
Develop	AZ 300MIF, 2 x 60 second puddles

BOTTOM CD vs. EXPOSURE DOSE (Mask CD = 7.0µm dense lines)



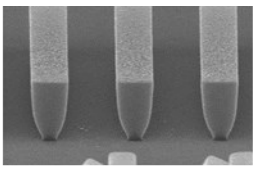
Dose: 174mJ/cm^2
Bottom CD: 4.45µm

Dose: 186mJ/cm^2
Bottom CD: 4.84µm

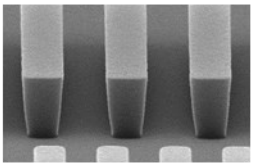
Dose: 198mJ/cm^2
Bottom CD: 5.31µm

EXAMPLE PEB SENSITIVITY (3.5µm Film Thickness on Si)

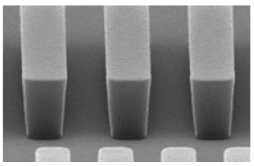
PEB **105°C**/60sec
Top size: 1.734
Bottom: 0.726µm

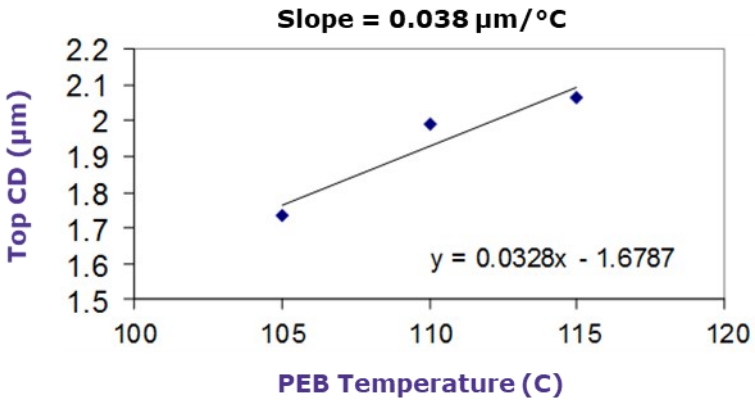


PEB **110°C** / 60sec
Top: 1.992 µm
Bottom: 1.439µm



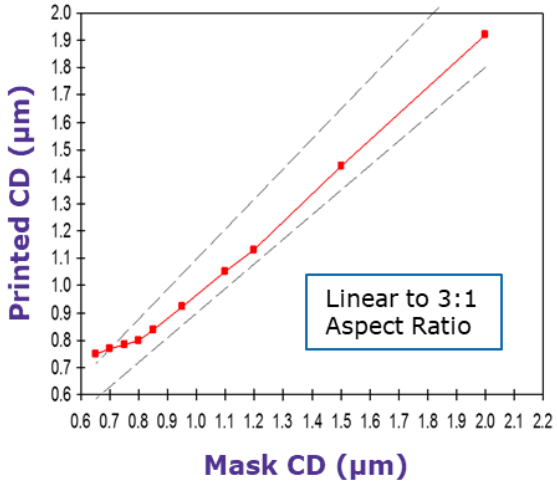
PEB **115°C** / 60sec
Top: 2.062 µm
Bottom: 1.687µm



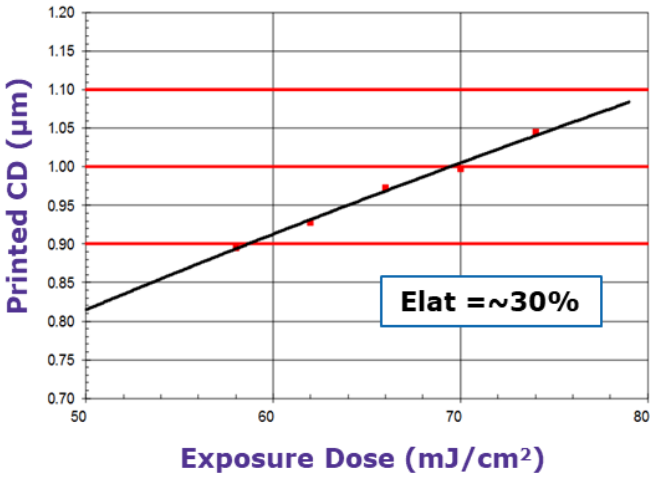


SAMPLE PROCESS WINDOWS on Si (FT 2.0µm and 3.5µm)

Linearity (dense lines)

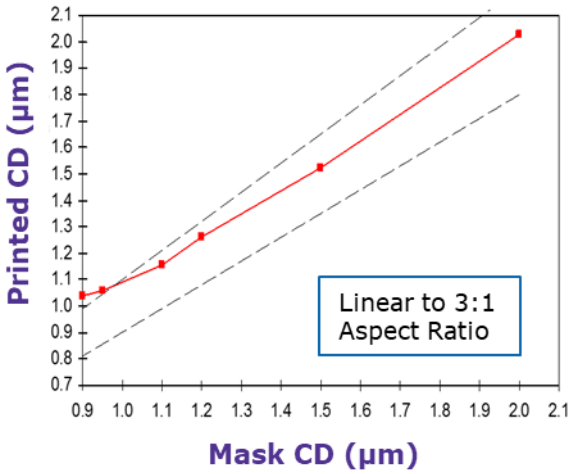


Exposure Latitude (1.0µm dense lines)

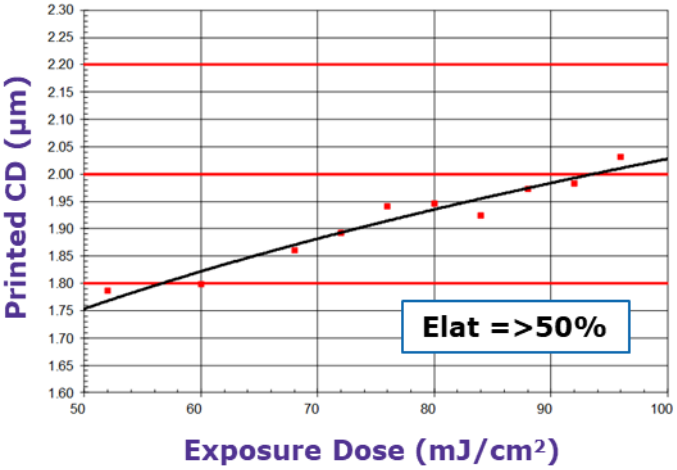


Coat: AZ® nLOF™ 2020 @ FT=2.0µm
Soft Bake: 110C/60s
Expose: Nikon Stepper @ 0.54NA
Post Expose Bake: 110C/60s
Develop: AZ® 300MIF 60s puddle

Linearity (dense lines)



Exposure Latitude (2.0µm dense lines)

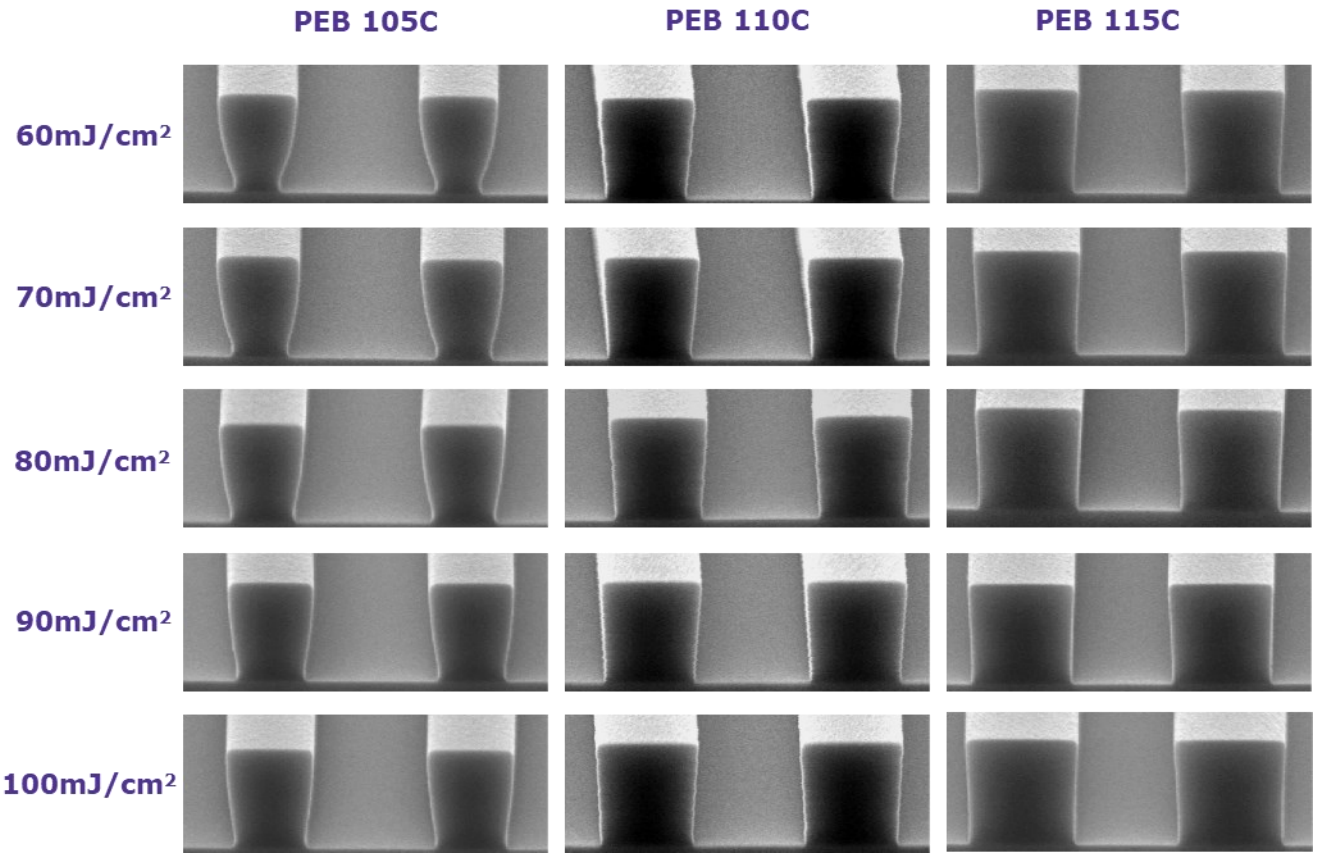


Coat: AZ® nLOF™ 2020 @ FT=3.5µm
Soft Bake: 110C/60s
Expose: Nikon Stepper @ 0.54NA
Post Expose Bake: 110C/60s
Develop: AZ® 300MIF 120s puddle

EXAMPLE PROFILE Tuning by Varying PEB and Exposure Dose

Process Step	Parameters
Prime	HMDS 140°C/60s (vapor)
Coat	2.0µm thick film AZ nLOF 2020 (33cPs) on bare Si
Soft Bake	110°C, 60 seconds, direct contact hotplate
Exposure	i-line @ varying dose (0.54NA) Nikon Stepper
Post Expose Bake	Various as indicated
Develop	AZ 300MIF, 60s single puddle

Profile Response to Varying Dose and PEB Temperature



PROCESS CONSIDERATIONS

SUBSTRATE PREPARATION

Substrates must be clean, dry, and free of organic residues. Oxide forming substrates (Si, etc.) should be HMDS primed prior to coating AZ nLOF™ 2000. Contact your product representative for detailed information on pre-treating with HMDS.

SOFT BAKE

Soft bake times and temperatures may be application specific. Process optimization is recommended to ensure optimum pattern profiles and stable lithographic and adhesion performance. Soft bake temperatures for AZ nLOF™ 2000 should be in the 100°-110°C range. Delays between soft bake and exposure should be minimized for optimum performance.

EXPOSURE

AZ nLOF 2000 requires exposure energy at the 365nm wavelength.

POST EXPOSE BAKE

A PEB is required for proper imaging of AZ nLOF™ 2000. PEB temperatures and times may be application specific. As a general rule, PEB temperatures should be in the 100° to 115°C range. As with any chemically amplified photoresist, CD's in nLOF™ 2000 will exhibit some dependency on PEB temperature (< 0.04µm/°C is typical).

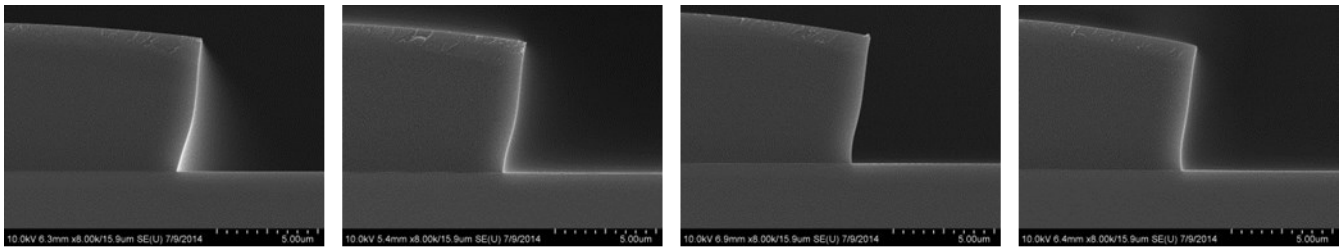
DEVELOPING

AZ nLOF™ 2000 series photoresists are compatible with industry standard 0.26N (2.38%) TMAH developers. AZ 300MIF is recommended.

HARD BAKE

Hard baking (post develop bake) improves adhesion in wet etch or plating applications and improves pattern stability in dry etch or deposition chambers. AZ nLOF™ materials are extremely thermally stable and may be hard baked at temperatures above 150°C.

HARD BAKE STABILITY for Large Pads in AZ nLOF™ 2070 (7.0µm Film Thickness)



115C Hard Bake | 120C Hard Bake | 125C Hard Bake | 130C Hard Bake

STRIPPING

AZ nLOF™ 2000 Series resists are compatible with industry standard solvent based removers. AZ 400T or AZ Remover 770 is recommended.

COMPATIBLE MATERIALS

AZ nLOF™ 2000 Series materials are compatible with all commercially available lithography processing equipment. Compatible materials of construction include glass, quartz, PTFE, PFA, stainless steel, HDPE, polypropylene, and ceramic. AZ nLOF™ 2000 series photoresists are not recommended for use on copper substrates.

HANDLING/DISPOSAL

AZ nLOF™ 2000 Series materials contain PGMEA (1-Methoxy-2-propanol acetate). Refer to the current version of the MSDS and to local regulations for up to date information on safe handling and proper disposal. Wear solvent resistant gloves, protective clothing, and eye/face protection.

AZ nLOF™ 2000 is compatible with drain lines handling similar organic solvent based materials.

www.merckgroup.com

Disclaimer

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