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

OPTICAL CONSTANTS*

| Cauchy A   | 1.5946 |
| Cauchy B (µm²) | 0.01188 |
| Cauchy C (µm⁴) | 0.00028 |
| n @ 633nm   | 1.626  |
| k @ 633nm   | 0      |

* Unexposed photoresist film

COMPANION PRODUCTS

- Thinning/Edge Bead Removal
- AZ® EBR Solvent or AZ® EBR 70/30
- MIF Developers
  - AZ® 300MIF, AZ® 726MIF, AZ® 917MIF
- Removers
  - AZ® 400T, AZ Remover 770

2.0µm lines and 2.0µm iso trench
3.5µm thick AZ nLOF 2035
72mJ/cm² i-line Exposure
AZ 300 MIF Develop (120s)
AZ® nLOF™ 2000 Series

EXAMPLE PROCESS (2.0µm Film Thickness on Si)

<table>
<thead>
<tr>
<th>Process Step</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>HMDS 140°C/60s (vapor)</td>
</tr>
<tr>
<td>Coat</td>
<td>2.0µm thick film AZ nLOF 2020 (33cPs) on bare Si</td>
</tr>
<tr>
<td>Soft Bake</td>
<td>110C, 60 seconds, direct contact hotplate</td>
</tr>
<tr>
<td>Exposure</td>
<td>i-line @ 66mJ/cm² nominal (0.54NA) Nikon Stepper*</td>
</tr>
<tr>
<td>Post Expose Bake</td>
<td>110C*, 60 seconds, direct contact hotplate</td>
</tr>
<tr>
<td>Develop</td>
<td>AZ 300MIF, 60s single puddle</td>
</tr>
</tbody>
</table>

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

Resolution @ 66mJ/cm²

- 0.95µm
- 0.85µm
- 0.80µm
- 0.70µm

1.0µm Lines Through Dose

- 62mJ/cm²
- 66mJ/cm²
- 70mJ/cm²
- 74mJ/cm²

1.0µm Lines DoF @ 66mJ/cm²

- -0.2µm
- 0.2µm
- 0.6µm
- 1.0µm

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## AZ® nLOF™ 2000 Series

### EXAMPLE PROCESS (3.5µm Film Thickness on Si)

<table>
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<th>Process Step</th>
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<tr>
<td>Prime</td>
<td>HMDS 140°C/60s (vapor)</td>
</tr>
<tr>
<td>Coat</td>
<td>3.5µm thick film AZ nLOF 2035 (79cPs) on bare Si</td>
</tr>
<tr>
<td>Soft Bake</td>
<td>110°C, 60s, direct contact hotplate</td>
</tr>
<tr>
<td>Post Bake Delay</td>
<td>None</td>
</tr>
<tr>
<td>Expose</td>
<td>i-line @ 80mJ/cm² nominal (0.548NA) Nikon Stepper*</td>
</tr>
<tr>
<td>Post Expose Bake</td>
<td>110°C*, 60 seconds, direct contact hotplate</td>
</tr>
<tr>
<td>Develop</td>
<td>AZ 300MIF, 120s single puddle</td>
</tr>
</tbody>
</table>

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

### Resolution @ 80mJ/cm²

- 2.00µm
- 1.50µm
- 1.10µm
- 0.90µm

### 2.0µm Lines Through Dose

- 72mJ/cm²
- 80mJ/cm²
- 88mJ/cm²

### 2.0µm Lines DoF @ 80mJ/cm²

- -1.0µm
- 0.0µm
- 1.0µm

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EXAMPLE PROCESS (7.0µm Film Thickness on Si)

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

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

- Dose: 174mJ/cm²  
  Bottom CD: 4.45µm
- Dose: 186mJ/cm²  
  Bottom CD: 4.84µm
- Dose: 198mJ/cm²  
  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

Slope = 0.038 µm/°C

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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

Printed CD (µm)
Mask CD (µm)

Printed CD (µm)
Exposure Dose (mJ/cm²)

Elat =~30%

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

Printed CD (µm)
Mask CD (µm)

Printed CD (µm)
Exposure Dose (mJ/cm²)

Elat =>50%

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EXAMPLE PROFILE TUNING BY VARYING PEB AND EXPOSURE DOSE

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<tr>
<td>Coat</td>
<td>2.0µm thick film AZ nLOF 2020 (33cPs) on bare Si</td>
</tr>
<tr>
<td>Soft Bake</td>
<td>110C, 60 seconds, direct contact hotplate</td>
</tr>
<tr>
<td>Exposure</td>
<td>i-line @ varying dose (0.54NA) Nikon Stepper</td>
</tr>
<tr>
<td>Post Expose Bake</td>
<td>Various as indicated</td>
</tr>
<tr>
<td>Develop</td>
<td>AZ 300MIF, 60s single puddle</td>
</tr>
</tbody>
</table>

Profile Response to Varying Dose and PEB Temperature

- **PEB 105C**
- **PEB 110C**
- **PEB 115C**

![Profile images](image)
AZ® nLOF™ 2000 Series

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 AZ 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.

STORAGE
AZ nLOF 2000 Series materials are combustible liquids. Store in sealed original containers in a well ventilated, dry area away from heat, light, oxidizers, reducers, and sources of ignition. Recommended storage temperature is 30°-55°F.

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.