AZ® 12XT-20PL Series
Chemically Amplified Positive Tone Photoresists

APPLICATION
Thick chemically amplified photoresists featuring aspect ratios and photospeed not possible with conventional DNQ type materials. These photoresists expose and develop very quickly for improved equipment productivity and reduced chemical usage.

- Excellent environmental stability
- No post bake rehydration delays required
- Single coat thicknesses from 3.0 to >20µm
- Excellent for Through Silicon Via (TSV), plating, and RIE etch applications.

TYPICAL PROCESS
Soft Bake: 110ºC/120s
Rehydration Hold: None
Expose: 365nm sensitive
Post Expose Bake: 90ºC/60s
Develop: Puddle, spray or immersion
Developer Type: MIF

* PEB is required for proper imaging

SPIN CURVES (150MM Silicon)

OPTICAL CONSTANTS*

<table>
<thead>
<tr>
<th>Cauchy A</th>
<th>1.535</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cauchy B (µm²)</td>
<td>0.019251</td>
</tr>
<tr>
<td>Cauchy C (µm⁴)</td>
<td>-0.00112</td>
</tr>
<tr>
<td>n @ 633nm</td>
<td>1.5762</td>
</tr>
<tr>
<td>k @ 633nm</td>
<td>0.00</td>
</tr>
</tbody>
</table>

* Unexposed photoresist film

COMPANION PRODUCTS
Thinning/Edge Bead Removal
AZ® EBR Solvent or AZ® EBR 70/30
MIF Developers
AZ® 300MIF
Removers
AZ® 300T, AZ® 400T

2.4µm lines in 10µm thick AZ 12nXT
110mJ/cm² Exposure
AZ 300 MIF Develop (120s)
EXAMPLE PROCESS (5µm 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>5µm thick film on bare Si</td>
</tr>
<tr>
<td>Soft Bake</td>
<td>110C, 120 seconds, direct contact hotplate</td>
</tr>
<tr>
<td>Post Bake Delay</td>
<td>None*</td>
</tr>
<tr>
<td>Expose</td>
<td>i-line @ 100mJ/cm² nominal (0.48NA)</td>
</tr>
<tr>
<td>Post Expose Bake</td>
<td>90C, 60 seconds, direct contact hotplate</td>
</tr>
<tr>
<td>Develop</td>
<td>AZ 300MIF, 2 x 30 second puddles</td>
</tr>
</tbody>
</table>

* Thinner films of AZ 12XT may be affected by airborne amines if delays between soft bake and expose are excessive. Coats thinner than 6µm should be exposed and developed within 30-45 minutes after soft bake.
EXAMPLE PROCESS (10µm 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>10µm thick film on bare Si</td>
</tr>
<tr>
<td>Soft Bake</td>
<td>110C, 180s, direct contact hotplate*</td>
</tr>
<tr>
<td>Post Bake Delay</td>
<td>None</td>
</tr>
<tr>
<td>Expose</td>
<td>i-line @ 110mJ/cm² nominal (0.48NA)</td>
</tr>
<tr>
<td>Post Expose Bake</td>
<td>90C, 60 seconds, direct contact hotplate</td>
</tr>
<tr>
<td>Develop</td>
<td>AZ 300MIF, 2 x 60 second puddles</td>
</tr>
</tbody>
</table>

* Thicker films may require a ramped soft bake process to avoid bubble formation due to rapid outgassing of solvents. Contact your AZ product representative for ultra-thick coat and bake processing guidelines.
**EXAMPLE PROCESS (15µm 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>15µm thick film on bare Si</td>
</tr>
<tr>
<td>Soft Bake</td>
<td>110°C, 240s, direct contact hotplate*</td>
</tr>
<tr>
<td>Post Bake Delay</td>
<td>None</td>
</tr>
<tr>
<td>Expose</td>
<td>i-line @ 185mJ/cm² nominal (0.48NA)</td>
</tr>
<tr>
<td>Post Expose Bake</td>
<td>90°C, 60 seconds, direct contact hotplate</td>
</tr>
<tr>
<td>Develop</td>
<td>AZ 300MIF, 2 x 60 second puddles</td>
</tr>
</tbody>
</table>

* Thicker films may require a ramped soft bake process to avoid bubble formation due to rapid outgassing of solvents. Contact your AZ product representative for ultra-thick coat and bake processing guidelines.

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**Linearity @ 185mJ/cm²**

7.0µm

4.0µm

3.0µm

2.6µm

**7µm Lines Through Dose**

185mJ/cm²

200mJ/cm²

215mJ/cm²

230mJ/cm²

**7µm Lines DoF @ 185mJ/cm²**

2.0µm

4.0µm

6.0µm

8.0µm
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SAMPLE FOCUS/EXPOSURE CURVES on Si

Mask CD: 2.6µm lines @ 1:1 pitch
Coated thickness: 5.0µm
Soft Bake 110C/120s
Expose: ASML Stepper @ 0.48NA
Post Expose Bake: 90C/60s
Develop: AZ 300MIF 2x30s puddles

Mask CD: 5.0µm lines @ 1:1 pitch
Coated thickness: 10.0µm
Soft Bake 110C/180s
Expose: ASML Stepper @ 0.48NA
Post Expose Bake: 90C/60s
Develop: AZ 300MIF 2x60s puddles

Mask CD: 7.0µm lines @ 1:1 pitch
Coated thickness: 15.0µm
Soft Bake 110C/240s
Expose: ASML Stepper @ 0.48NA
Post Expose Bake: 90C/60s
Develop: AZ 300MIF 2x60s puddles
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**PATTERN PROFILES ON VARIOUS SUBSTRATES**

### Contact Holes on Si

- **Focus = 2.0**
- **Focus = 3.0**
- **Focus = 4.0**

*Mask CD: 3.0µm holes @ 1:1 pitch*
*Coated thickness: 6.3µm on Si*
*Soft Bake 110C/120s*
*Expose: ASML Stepper @ 0.50NA*
*Dose: 140mJ/cm²*
*Post Expose Bake: 90C/60s*
*Develop: AZ 300MIF 2x45s puddles*

### Lines and Holes on Cu

- **8.0µm Lines**
- **5.0µm Lines**
- **5.0µm Holes**
- **3.0µm Holes**

*Mask CD: As indicated @ 1:1 pitch*
*Coated thickness: 10.0µm on Cu*
*Soft Bake 110C/120s*
*Expose: ASML Stepper @ 0.50NA*
*Dose: 250mJ/cm²*
*Post Expose Bake: 90C/60s*
*Develop: AZ 300MIF 2x45s puddles*

### Lines on Au

- **10.0µm Lines**
- **8.0µm Lines**

*Mask CD: As indicated @ 1:1 pitch*
*Coated thickness: 10.0µm on Gold*
*Soft Bake 110C/120s*
*Expose: ASML Stepper @ 0.50NA*
*Dose: 200mJ/cm²*
*Post Expose Bake: 90C/60s*
*Develop: AZ 300MIF 2x45s puddles*
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EXAMPLE PROCESS FOR Suss MicroTec MA-200 MASK ALIGNER

<table>
<thead>
<tr>
<th>Process Step</th>
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</thead>
<tbody>
<tr>
<td>Coat</td>
<td>15µm thick film on bare Si</td>
</tr>
<tr>
<td>Soft Bake</td>
<td>110C, 180s, direct contact hotplate*</td>
</tr>
<tr>
<td>Post Bake Delay</td>
<td>None</td>
</tr>
<tr>
<td>Expose</td>
<td>Suss MicroTec MA-200 Mask Aligner (20µm proximity gap)</td>
</tr>
<tr>
<td>Post Expose Bake</td>
<td>90C, 60 seconds, direct contact hotplate</td>
</tr>
<tr>
<td>Develop</td>
<td>AZ 300MIF, 2 x 60 second puddles</td>
</tr>
</tbody>
</table>

10µm Lines Through Dose

- 360 mJ/cm²
- 400 mJ/cm²
- 440 mJ/cm²
- 480 mJ/cm²

10µm Holes Through Dose

- 360 mJ/cm²
- 400 mJ/cm²
- 440 mJ/cm²
- 480 mJ/cm²

Resolution @ 440 mJ/cm²

- 8.0 µm
- 7.0 µm
- 6.0 µm
- 5.0 µm

Merck KGaA, Darmstadt, Germany
Rev. 3/2016
AZ® 12XT-20PL 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 12XT. 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 12XT should be in the 95-110C range. Delays between soft bake and exposure should be minimized for optimum 12XT performance.

EXPOSURE
AZ 12XT requires exposure energy at the 365nm wavelength.

POST EXPOSE BAKE
A PEB is required for proper imaging of AZ 12XT. PEB temperatures and times may be application specific. As a general rule, PEB temperatures should be in the 90 to 100C range.

DEVELOPING
AZ 12XT 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 processes. Hard bake temperatures should be in the 100 to 115C range to ensure minimal thermal distortion of the pattern.

HARD BAKE STABILITY FOR 10µm LINES (6.5µm Film Thickness)

| No Hard Bake | 105C Hard Bake | 110C Hard Bake | 115C Hard Bake |

STRIPPING
AZ 12XT Series resists are compatible with industry standard solvent based removers. AZ Kwik Strip, AZ 300T, or AZ 400T is recommended.
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COMPATIBLE MATERIALS
AZ 12XT 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.

STORAGE
Store AZ 12XT 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 12XT 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 12XT is compatible with drain lines handling similar organic solvent based materials.