ARC® XL Series

Broadband
g-line & i-line
Anti-Reflective Coatings
Why Use a Brewer Science ARC?

Lithography Reflective Problems In Photoresist Without Brewer Science ARC

- Reflective Notching
- Standing Wave Effects

With Brewer ARC

- Back Scattered Light
- Loss of CD Control
How ARC Enhances Your Process

ARC Performance Results

- Eliminates Reflective Notching
- Eliminates Standing Waves & Scattered Light
- Maximizes Photoresist Exposure Latitude
- Increases Stepper Focus Latitude

Key Results

- Extends Overall Lithography Process Window
- Increased CD Control
- Maximizes Process Control
- Increases Usage Life of Stepper
XL Characteristics

- Absorbance at 436nm and 365nm
- Develops away with resist in one easy step
- Hard baking allows removal by dry etch process
- Typically requires separate coater and drain systems
- Bake temperature controls ARC solubility in developer
- Eliminates need for HMDS
XL Family Spin Speed Curves

Spin speed (RPM)

Bare Thickness (Å)

- XLT-750
- XLT
- XL-20
- XLX-20
- XLX-5

Brewer Science Inc., Rolla Mo, USA

Effective Date: 0X/0X/02 DCIF: MKT00XX Doc. Control#: F.6.6.010X.A
Thickness Measurement

Prometrix Setup

\begin{align*}
N1 &= 1.8376 \times 10^0 \\
N2 &= -1.0183 \times 10^7 \\
N3 &= 3.7146 \times 10^{14}
\end{align*}

wavelength min = 550 nm
wavelength max = 800 nm

Ellipsometer

\begin{align*}
\lambda &= 632 \text{ nm} \\
n &= 1.75 \\
k &= 0.00
\end{align*}
XL Series Reflectivity Curves at i-line

Refractive Index
Resist \( n = 1.68 \)

Barc Thickness (Å)

**Typical Reflectivity (I=100%)**

- **Aluminum**
- **Polysilicon**
- **Tungsten**
XL Series Reflectivity Curves at g-line

![Graph showing reflectivity curves for different BARC thicknesses and materials, including Aluminum, Polysilicon, and Tungsten. The graph includes a note that the refractive index for Resist is n = 1.65.](image)
Typical Optical Data

![Graph showing optical data with wavelength in nm on the x-axis and index of refraction (n) and absorption coefficient (k) on the y-axis.](image-url)
# XL Series Optical Properties

<table>
<thead>
<tr>
<th>Exposure Wavelength</th>
<th>XLT Family</th>
<th></th>
<th>XLX Family</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>k</td>
<td>n</td>
</tr>
<tr>
<td>g-line</td>
<td>1.74</td>
<td>0.34</td>
<td>1.79</td>
</tr>
<tr>
<td>i-line</td>
<td>1.61</td>
<td>0.18</td>
<td>1.61</td>
</tr>
</tbody>
</table>
XL Processing

Wet Developable
Lower bake of 168 to 17X
2 stage bake required for XLX-20
<.26 N developer for XLT-750 & XLT
>.26 N developer for XLX-5 & XLX-20
Extra develop and rinse time may be necessary for XLX-20

Dry Etch
Hard bake at > 190°C
2 stage bake required for XLX-20
Use dry etch process to remove ARC
# XL Processes

<table>
<thead>
<tr>
<th>XL Processes</th>
<th>(Å)</th>
<th>Spin Speed</th>
<th>Hotplate Bake</th>
</tr>
</thead>
<tbody>
<tr>
<td>XLT-750</td>
<td>750</td>
<td>5000 rpm / 60 sec</td>
<td>168°C / 60</td>
</tr>
<tr>
<td>XLX-5</td>
<td>1400</td>
<td>3000 rpm / 60 sec</td>
<td>168°C / 60</td>
</tr>
<tr>
<td>XLT</td>
<td>1300</td>
<td>5000 rpm / 60 sec</td>
<td>168°C / 60</td>
</tr>
<tr>
<td>XLX-20</td>
<td>2350</td>
<td>3500 rpm / 60 sec</td>
<td>168°C / 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100°C / 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>168°C / 60</td>
<td></td>
</tr>
</tbody>
</table>
Example Bake Window

ARC® XLX-20 (2200Å) + Shipley SPRT 518 (2.0µm) i-line
Dose=1.15 sec. Developer= 70 sec. CD26 (TMAH 0.26N).

Temperature (°C)

167 169 171 173 175 177 179 181

Stepper Resolution

Minimum Feature (µm)

0.3 0.5 0.7 0.9 1.1 1.3 1.5

Bake Latitude

Lifting

Scumming
Bake Window for Selected XL Series Products

Bake Temperature (degrees C)

Typical Minimum Visual resolution (mm)

Scumming Occurs

XLX-5
XLX-20
XLT
XLT-750

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Applications

• Poly level
  – ARC® XLT-750
  – ARC® XLT

• Metal applications
  – ARC® XLX-20

• Contacts / Via
  – ARC® XLX-20

• Lift Off
  – All

• SAW Devices
  – ARC® XLT-750
  – ARC® XLT
XLX-20 Swing Curve (g-line)

OCG 6500 w/wo ARC XLX-20 2350Å

- no ARC
- with ARC

Resist Thickness (µm)

% Reflectance
XLX-20 Swing Curve (i-line)

OCG 6500 w/wo ARC XLX-20 2350Å

- no ARC
- with ARC

Resist Thickness(µm)

Reflectance (%)
XLX-5 Profiles (i-line)

ARC XLX-5 (1300Å) w/ JSR IX500 (1.4µm)
350 mJ  .53 NA stepper

0.5 µm  0.7 µm
Edge Bead Removal

EBR Process using Brewer Science’s EBC:

1. Dispense Arm Position - approx. 3 mm in from edge. Dispense EBC for 6 secs.

2. Dispense Arm Position - retracted to home position, continue spinning for 5 secs.

3. Dispense Arm Position - approx. 2.5mm in from edge. Dispense EBC for 6 secs.


All steps were done with a spin speed of 2000 rpm except the final spin which was done at 3500 rpm. Final spin can be done at 2000 rpm but spin time will have to be increased till wafer is dry. Spin times and speeds may vary due to wafer size and environmental conditions.
Stripping the ARC

• **O2 plasma strip ability**

• **Piranha and RCA cleans**

• **Stripped in organic strippers**
  – (typically NMP based) with pH >10
XLX-20 Stability Data

![XLX-20 Stability Data Graph](image_url)
# ARC XLX Family Ion Analysis

<table>
<thead>
<tr>
<th>Element</th>
<th>Detection Limit</th>
<th>ppb</th>
<th>Detection Limit</th>
<th>ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum (Al)</td>
<td>0.1</td>
<td>21.0</td>
<td>Magnesium (Mg)</td>
<td>0.1</td>
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<tr>
<td>Barium (Ba)</td>
<td>0.1</td>
<td>0.2</td>
<td>Manganese (Mn)</td>
<td>0.1</td>
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<tr>
<td>Beryllium (Be)</td>
<td>1.0</td>
<td>&lt;1.0</td>
<td>Molybdenum (Mo)</td>
<td>0.5</td>
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<tr>
<td>Bismuth (Bi)</td>
<td>1.0</td>
<td>&lt;1.0</td>
<td>Nickel (Ni)</td>
<td>0.1</td>
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<tr>
<td>Cadmium (Cd)</td>
<td>0.1</td>
<td>0.1</td>
<td>Potassium (K)</td>
<td>5.0</td>
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<tr>
<td>Calcium (Ca)</td>
<td>3.0</td>
<td>27.0</td>
<td>Rubidium (Rb)</td>
<td>0.1</td>
</tr>
<tr>
<td>Cesium (Cs)</td>
<td>0.1</td>
<td>&lt;0.1</td>
<td>Silver (Ag)</td>
<td>1.0</td>
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<tr>
<td>Chromium (Cr)</td>
<td>0.5</td>
<td>3.3</td>
<td>Sodium (Na)</td>
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<tr>
<td>Cobalt (Co)</td>
<td>0.1</td>
<td>0.4</td>
<td>Strontium (Sr)</td>
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<tr>
<td>Copper (Cu)</td>
<td>0.5</td>
<td>4.9</td>
<td>Thorium (Th)</td>
<td>1.0</td>
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<tr>
<td>Gallium (Ga)</td>
<td>0.1</td>
<td>&lt;0.1</td>
<td>Tin (Sn)</td>
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<tr>
<td>Indium (In)</td>
<td>0.1</td>
<td>&lt;0.1</td>
<td>Titanium (Ti)</td>
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<tr>
<td>Iron (Fe)</td>
<td>3.0</td>
<td>18.0</td>
<td>Vanadium (V)</td>
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<tr>
<td>Lead (Pb)</td>
<td>0.1</td>
<td>&lt;0.1</td>
<td>Zinc (Zn)</td>
<td>1.0</td>
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<tr>
<td>Lithium (Li)</td>
<td>0.1</td>
<td>&lt;0.1</td>
<td>Zirconium (Zr)</td>
<td>1.0</td>
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</tbody>
</table>