AZ® Electronic Materials

TX1311 Series

Thick 248nm Photoresist for High Energy Implant Applications
AZ® TX1311 Series
Spin Speed Curve

200mm Si Wafer, Softbake: 140°C/90 sec

Spin Speed (rpm)

Film Thickness (Å)

- 145cP
- 70cP
- 55cP
AZ® TX1311 55cP
Coating Uniformity

200mm Si Wafer
FT: 3.8um
SB: 140°C/150sec
St Dev: 0.21%
AZ® TX1311 55cP
Depth of Focus (25-36 mJ/cm²)

<Process Condition>
~RESIST PROCESS~
Substrate : 200mm Bare Si (with HMDS), Pre bake : 140°C/90sec (Hot Plate), Film Thickness 4.0um
Exposure : FPA-3000EX5(NA=0.55,sigma=0.55), PEB : 110°C/90sec (Hot Plate)
Development : AZ 300MIF(2.38% TMAH), 23°C / 90sec(Single Puddle)
Measurement Pattern size : 0.4um Trench (1:5)

<table>
<thead>
<tr>
<th>Focus Offset (µm)</th>
<th>CD (nm)</th>
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<tbody>
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<td>-1.6</td>
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AZ TX1311 Depth of Focus
SB : 140°C/90sec, PEB : 110°C/90sec

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AZ® TX1311 55cP
Depth of Focus (28-29 mJ/cm²)

Focus Offset
-1.6um  -1.4um  -1.2um  -1.0um  -0.8um  -0.6um

Depth measurements:
- 28.0 mJ/cm²: 368.8nm, 376.4nm, 392.2nm, 396.6nm, 399.1nm
- 29.0 mJ/cm²: 381.5nm, 384.7nm, 400.1nm, 404.6nm, 413.9nm, 423.4nm

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AZ® TX1311 55cP
Depth of Focus (Top View)

<Process Condition>
~RESIST PROCESS~
Substrate : 200mm Bare Si (with HMDS),  Pre bake : 140°C/ 90sec (Hot Plate), Film Thickness 4.0um
Exposure : FPA-3000EX5(NA=0.55,sigma=0.55),  PEB : 110°C/ 90sec (Hot Plate)
Development : AZ 300MIF(2.38% TMAH), 23°C / 90sec (Single Puddle)
Measurement Pattern size : 0.4um Trench (1:5)

Exposure Dose

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<th>Depth of Focus</th>
<th>25.0mJ/cm²</th>
<th>26.0mJ/cm²</th>
<th>27.0mJ/cm²</th>
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<th>31.0mJ/cm²</th>
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AZ® TX1311 55cP
Depth of Focus (Cross Section)

**Exposure Dose**

- 25.0mJ/cm²
- 26.0mJ/cm²
- 27.0mJ/cm²
- 28.0mJ/cm²
- 29.0mJ/cm²
- 30.0mJ/cm²
- 31.0mJ/cm²
- 32.0mJ/cm²
- 33.0mJ/cm²
- 34.0mJ/cm²
- 35.0mJ/cm²
- 36.0mJ/cm²

**Focus Offset**

- -0.6um
- -0.4um
- -0.2um
- -0.1um
- -0.0um
- 0.0um
- 0.1um
- 0.2um
- 0.4um

**Process Condition**

- Resin Process
- Substrate: 200mm Bare Si (with HMDS)
- Pre-bake: 140°C/90sec (Hot Plate)
- Film Thickness: 4.0um
- Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55), PEB: 110°C/90sec (Hot Plate)
- Development: AZ 300MIF (2.38% TMAH), 23°C/90sec (Single Puddle)
- Measurement Pattern size: 0.4um Trench (1:5)
AZ® TX1311 55cP
Depth of Focus (28-41 mJ/cm²)

<Process Condition>
~RESIST PROCESS~
Substrate : 200mm Bare Si (with HMDS), Pre bake : 140°C/60sec (Hot Plate), Film Thickness 4.0um
Exposure : FPA-3000EX5(NA=0.55,sigma=0.55), PEB : 110°C/60sec (Hot Plate)
Development : AZ 300MIF(2.38% TMAH), 23°C / 90sec (Single Puddle)
Measurement Pattern size : 0.4um Trench (1:5)

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<thead>
<tr>
<th>CD (nm)</th>
<th>28mJ</th>
<th>29mJ</th>
<th>30mJ</th>
<th>31mJ</th>
<th>32mJ</th>
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<th>37mJ</th>
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AZ® TX1311 55cP
Depth of Focus (31-32 mJ/cm²)

Focus Offset

31.0 mJ/cm²
-1.6um
384.9nm
-1.4um
387.7nm
-1.2um
388.6nm
-1.0um
398.0nm
-0.8um
400.2nm
-0.6um

32.0 mJ/cm²
397.7nm
392.5nm
404.4nm
408.7nm
415.3nm
AZ® TX1311 55cP
Depth of Focus (Top View)

<Process Condition>
~RESIST PROCESS~
Substrate: 200mm Bare Si (with HMDS), Pre bake: 140ºC/60sec (Hot Plate), Film Thickness 4.0um
Exposure: FPA-3000EX5(NA=0.55,sigma=0.55), PEB: 110ºC/60sec (Hot Plate)
Development: AZ 300MIF(2.38% TMAH), 23ºC / 90sec (Single Puddle)
Measurement Pattern size: 0.4um Trench (1:5)

<table>
<thead>
<tr>
<th>Exposure Dose</th>
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<tr>
<td>31.0mJ/cm²</td>
<td>-1.0um</td>
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<td>32.0mJ/cm²</td>
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<td>33.0mJ/cm²</td>
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AZ® TX1311 55cP
Depth of Focus (Cross Section)

Exposure Dose

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<th>29.0mJ/cm²</th>
<th>30.0mJ/cm²</th>
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<Process Condition>

~RESIST PROCESS~
Substrate : 200mm Bare Si (with HMDS), Pre bake : 140°C/60sec (Hot Plate), Film Thickness 4.0um
Exposure : FPA-3000ES5(NA=0.55,sigma=0.55), PEB : 110°C/60sec (Hot Plate)
Development : AZ 300MIF(2.38% TMAH), 23°C/90sec (Single Puddle)
Measurement Pattern size : 0.4um Trench (1:5)
AZ® TX1311 55cP
Lithography Performance, 0.50µm Trench (1:5)

Process Conditions
Coating: 200mm Silicon; FT = 3.8µm; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)
PEB: 110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle

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<th>17.0mJ</th>
<th>18.0mJ</th>
<th>19.0mJ</th>
<th>20.0mJ</th>
<th>21.0mJ</th>
<th>22.0mJ</th>
<th>23.0mJ</th>
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<td>Exposure</td>
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<td>PEB</td>
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AZ® TX1311 55cP
Lithography Performance, 0.45µm Trench (1:5)

Process Conditions

Coating: 200mm Silicon; FT = 3.8µm; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)
PEB: 110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle

17.0mJ 18.0mJ 19.0mJ 20.0mJ 21.0mJ 22.0mJ 23.0mJ 24.0mJ 25.0mJ

AZ® TX1311 55cP
Lithography Performance, 0.45µm Trench (1:5)

Process Conditions

Coating: 200mm Silicon; FT = 3.8µm; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)
PEB: 110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle

17.0mJ 18.0mJ 19.0mJ 20.0mJ 21.0mJ 22.0mJ 23.0mJ 24.0mJ 25.0mJ

AZ® TX1311 55cP
Lithography Performance, 0.45µm Trench (1:5)

Process Conditions

Coating: 200mm Silicon; FT = 3.8µm; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)
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17.0mJ 18.0mJ 19.0mJ 20.0mJ 21.0mJ 22.0mJ 23.0mJ 24.0mJ 25.0mJ

AZ® TX1311 55cP
Lithography Performance, 0.45µm Trench (1:5)

Process Conditions

Coating: 200mm Silicon; FT = 3.8µm; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)
PEB: 110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle

17.0mJ 18.0mJ 19.0mJ 20.0mJ 21.0mJ 22.0mJ 23.0mJ 24.0mJ 25.0mJ

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AZ® TX1311 55cP
Lithography Performance, 0.40µm Trench (1:5)

Process Conditions
Coating: 200mm Silicon; FT = 3.8um; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)
PEB: 110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle

17.0mJ  18.0mJ  19.0mJ  20.0mJ  21.0mJ  22.0mJ  23.0mJ  24.0mJ  25.0mJ

F-0.2µm

F-0.4µm

F-0.6µm
AZ® TX1311 55cP
Lithography Performance, 0.50µm Isolated Line

Process Conditions

Coating: 200mm Silicon; FT = 3.8um; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)
PEB: 110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle

17.0mJ  18.0mJ  19.0mJ  20.0mJ  21.0mJ  22.0mJ  23.0mJ  24.0mJ  25.0mJ

F-0.2um

F-0.4um

F-0.6um

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AZ® TX1311 55cP
Lithography Performance, 0.45µm Isolated Line

Process Conditions

Coating: 200mm Silicon; FT = 3.8um
Softbake: 140°C/90sec

Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)

PEB: 110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle

17.0mJ  18.0mJ  19.0mJ  20.0mJ  21.0mJ  22.0mJ  23.0mJ  24.0mJ  25.0mJ

F-0.2um

F-0.4um

F-0.6um
AZ® TX1311 55cP
Lithography Performance, 0.40µm Isolated Line

**Process Conditions**

<table>
<thead>
<tr>
<th>Coating</th>
<th>FT = 3.8µm</th>
<th>Softbake: 140°C/90sec</th>
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<tr>
<td>Exposure</td>
<td>FPA-3000EX5 (NA=0.55, sigma=0.55)</td>
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<td>PEB:</td>
<td>110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle</td>
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<th>Process Conditions</th>
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<tr>
<td><strong>Coating:</strong></td>
<td>200mm Silicon</td>
</tr>
<tr>
<td><strong>FT:</strong></td>
<td>3.8µm</td>
</tr>
<tr>
<td><strong>Softbake:</strong></td>
<td>140°C/90sec</td>
</tr>
<tr>
<td><strong>Exposure:</strong></td>
<td>FPA-3000EX5 (NA=0.55, sigma=0.55)</td>
</tr>
<tr>
<td><strong>PEB:</strong></td>
<td>110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy (mJ)</th>
<th>F-0.2µm</th>
<th>F-0.4µm</th>
<th>F-0.6µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.0mJ</td>
<td><img src="17.0mJ_F-0.2%C2%B5m.png" alt="Image" /></td>
<td><img src="17.0mJ_F-0.4%C2%B5m.png" alt="Image" /></td>
<td><img src="17.0mJ_F-0.6%C2%B5m.png" alt="Image" /></td>
</tr>
<tr>
<td>18.0mJ</td>
<td><img src="18.0mJ_F-0.2%C2%B5m.png" alt="Image" /></td>
<td><img src="18.0mJ_F-0.4%C2%B5m.png" alt="Image" /></td>
<td><img src="18.0mJ_F-0.6%C2%B5m.png" alt="Image" /></td>
</tr>
<tr>
<td>19.0mJ</td>
<td><img src="19.0mJ_F-0.2%C2%B5m.png" alt="Image" /></td>
<td><img src="19.0mJ_F-0.4%C2%B5m.png" alt="Image" /></td>
<td><img src="19.0mJ_F-0.6%C2%B5m.png" alt="Image" /></td>
</tr>
<tr>
<td>20.0mJ</td>
<td><img src="20.0mJ_F-0.2%C2%B5m.png" alt="Image" /></td>
<td><img src="20.0mJ_F-0.4%C2%B5m.png" alt="Image" /></td>
<td><img src="20.0mJ_F-0.6%C2%B5m.png" alt="Image" /></td>
</tr>
<tr>
<td>21.0mJ</td>
<td><img src="21.0mJ_F-0.2%C2%B5m.png" alt="Image" /></td>
<td><img src="21.0mJ_F-0.4%C2%B5m.png" alt="Image" /></td>
<td><img src="21.0mJ_F-0.6%C2%B5m.png" alt="Image" /></td>
</tr>
<tr>
<td>22.0mJ</td>
<td><img src="22.0mJ_F-0.2%C2%B5m.png" alt="Image" /></td>
<td><img src="22.0mJ_F-0.4%C2%B5m.png" alt="Image" /></td>
<td><img src="22.0mJ_F-0.6%C2%B5m.png" alt="Image" /></td>
</tr>
<tr>
<td>23.0mJ</td>
<td><img src="23.0mJ_F-0.2%C2%B5m.png" alt="Image" /></td>
<td><img src="23.0mJ_F-0.4%C2%B5m.png" alt="Image" /></td>
<td><img src="23.0mJ_F-0.6%C2%B5m.png" alt="Image" /></td>
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<tr>
<td>24.0mJ</td>
<td><img src="24.0mJ_F-0.2%C2%B5m.png" alt="Image" /></td>
<td><img src="24.0mJ_F-0.4%C2%B5m.png" alt="Image" /></td>
<td><img src="24.0mJ_F-0.6%C2%B5m.png" alt="Image" /></td>
</tr>
<tr>
<td>25.0mJ</td>
<td><img src="25.0mJ_F-0.2%C2%B5m.png" alt="Image" /></td>
<td><img src="25.0mJ_F-0.4%C2%B5m.png" alt="Image" /></td>
<td><img src="25.0mJ_F-0.6%C2%B5m.png" alt="Image" /></td>
</tr>
</tbody>
</table>

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AZ® TX1311 55cP

Lithography Performance, 1.0µm Dense Dots (1:0.5)

Process Conditions

Coating: 200mm Silicon; FT = 3.8µm; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)
PEB: 110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle

<table>
<thead>
<tr>
<th>Power (mJ)</th>
<th>20.0mJ</th>
<th>22.0mJ</th>
<th>24.0mJ</th>
<th>26.0mJ</th>
<th>28.0mJ</th>
<th>30.0mJ</th>
<th>32.0mJ</th>
<th>34.0mJ</th>
<th>36.0mJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-0.2µm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-0.4µm</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-0.6µm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-0.8µm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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AZ® TX1311 55cP
Lithography Performance, 1.0μm Dense Dots (1:0.5)

Process Conditions

Coating: 200mm Silicon; FT = 3.0μm; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)
PEB: 100°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle

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## Process Conditions

<table>
<thead>
<tr>
<th>Coating: 200mm Silicon; FT = 3.0um;</th>
<th>Softbake: 140°C/90sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)</td>
<td></td>
</tr>
<tr>
<td>PEB: 100°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle</td>
<td></td>
</tr>
</tbody>
</table>

### Lithography Performance, 0.80µm Dense Dots (1:0.5)

<table>
<thead>
<tr>
<th>Energy (mJ)</th>
<th>F-0.2um</th>
<th>F-0.4um</th>
<th>F-0.6um</th>
<th>F-0.8um</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.0mJ</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>24.0mJ</td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
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<tr>
<td>26.0mJ</td>
<td><img src="image9.png" alt="Image" /></td>
<td><img src="image10.png" alt="Image" /></td>
<td><img src="image11.png" alt="Image" /></td>
<td><img src="image12.png" alt="Image" /></td>
</tr>
<tr>
<td>28.0mJ</td>
<td><img src="image13.png" alt="Image" /></td>
<td><img src="image14.png" alt="Image" /></td>
<td><img src="image15.png" alt="Image" /></td>
<td><img src="image16.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>30.0mJ</strong></td>
<td><img src="image17.png" alt="Image" /></td>
<td><img src="image18.png" alt="Image" /></td>
<td><img src="image19.png" alt="Image" /></td>
<td><img src="image20.png" alt="Image" /></td>
</tr>
<tr>
<td>32.0mJ</td>
<td><img src="image21.png" alt="Image" /></td>
<td><img src="image22.png" alt="Image" /></td>
<td><img src="image23.png" alt="Image" /></td>
<td><img src="image24.png" alt="Image" /></td>
</tr>
<tr>
<td>34.0mJ</td>
<td><img src="image25.png" alt="Image" /></td>
<td><img src="image26.png" alt="Image" /></td>
<td><img src="image27.png" alt="Image" /></td>
<td><img src="image28.png" alt="Image" /></td>
</tr>
<tr>
<td>36.0mJ</td>
<td><img src="image29.png" alt="Image" /></td>
<td><img src="image30.png" alt="Image" /></td>
<td><img src="image31.png" alt="Image" /></td>
<td><img src="image32.png" alt="Image" /></td>
</tr>
<tr>
<td>38.0mJ</td>
<td><img src="image33.png" alt="Image" /></td>
<td><img src="image34.png" alt="Image" /></td>
<td><img src="image35.png" alt="Image" /></td>
<td><img src="image36.png" alt="Image" /></td>
</tr>
</tbody>
</table>
AZ® TX1311 55cP
Lithography Performance, 1.0µm Dense Contacts (1:1)

Process Conditions
Coating: 200mm Silicon; FT = 3.8µm; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)
PEB: 110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle

AZ Confidential

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AZ® TX1311 55cP
Lithography Performance, 0.70µm Dense Contacts (1:1)

**Process Conditions**

Coating: 200mm Silicon; FT = 3.8µm; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55,sigma=0.55)
PEB: 110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle
AZ® TX1311 55cps
Lithography Performance, 0.50μm Dense Contacts (1:1)

Process Conditions
Coating: 200mm Silicon; FT = 3.8um; Softbake: 140°C/90sec
Exposure: FPA-3000EX5 (NA=0.55, sigma=0.55)
PEB: 110°C/90sec; Develop: AZ 300MIF (2.38%), 23°C/60sec single puddle

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AZ® VS-01HJ
Shrink Technology for Thick 248nm Photoresist Applications
AZ® VS-01HJ Shrink
AZ TX1311, 0.40µm Isolated Trench (1:5)

Process Conditions

Coating: 200mm Silicon; **FT: 4.0um**; Softbake: 140°C/150sec
Exposure: FPA-3000EX5(NA=0.50,sigma=0.50)
PEB: 110°C/150sec; Develop: AZ 300MIF(2.38%), 23°C/60 sec single puddle
[VS Shrink:]
Set Bake: 85°C/70 sec; Mixing Bake: 110°C/70sec; Develop/Rinse: 120 sec spray

X-section
Top view

AZ TX1311(55cP)

Photoresist CD = 405.8nm

177.5nm shrink

AZ VS-01HJ

After VS-01HJ CD = 228.3nm
AZ® VS-01HJ Shrink
AZ TX1311, Dense Post Shrink Performance

Process Conditions
Coating: 200mm Silicon; **FT: 5.50um**, Softbake: 140°C/150sec
Exposure: FPA-3000EX5 (NA=0.50,sigma=0.50)
PEB: 110°C/150sec; Develop: AZ 300MIF(2.38%), 23°C/60 sec single puddle
[VS Shrink:]
Set Bake: 85°C/70 sec; Mixing Bake: 110°C/70sec; Develop/Rinse: 120 sec spray

AZ TX1311(55cP)

2.0um/0.50um

TX 1311 Litho to Coating VS-01HJ

AZ VS-01HJ

After VS-01HJ Bake and Develop/Rinse

3.0um/0.75um

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AZ VS-01HJ Summary

⚠️ VS-01HJ with TX1311 demonstrates shrink in the 100〜200nm range.
⚠️ VS-01HJ is compatible with most 248nm photoresists. The shrink amount achieved will vary based on formulation.
⚠️ VS-01HJ is commercialized and in volume manufacturing.