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Any process conditions and data are examples. Those will not guarantee the same data in customers’ process.
1. Characteristics

ZEP520 series are high performance positive EB resists which show high resolution, high sensitivity and high dry etch resistance. They are suitable for various EB processes.

(1) Resolution
   Show high resolution and rectangle pattern profile

(2) Resistance to dry etching
   Show high dry etch resistance and are almost equivalent to that of positive photoresists generally used

(3) Sensitivity
   Show high sensitivity

2. Properties

<table>
<thead>
<tr>
<th>Item</th>
<th>Mw</th>
<th>Viscosity (mPa•s)</th>
<th>Solvent</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZEP520-12</td>
<td>57,000</td>
<td>12</td>
<td>o-Dichlorobenzene</td>
<td>1QT bottle</td>
</tr>
<tr>
<td>ZEP520</td>
<td></td>
<td>22</td>
<td></td>
<td>or 100ml bottle</td>
</tr>
<tr>
<td>ZEP520A</td>
<td></td>
<td>7</td>
<td>Anisole</td>
<td></td>
</tr>
<tr>
<td>ZEP520A(\frac{1}{2})</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Thinner

<table>
<thead>
<tr>
<th>Item</th>
<th>Composition</th>
<th>Remarks</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZEP-S</td>
<td>o-Dichlorobenzene</td>
<td>ZEP520-12</td>
<td>1QT bottle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZEP520</td>
<td></td>
</tr>
<tr>
<td>ZEP-A</td>
<td>Anisole</td>
<td>ZEP520A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZEP520A(\frac{1}{2})</td>
<td></td>
</tr>
</tbody>
</table>

4. Developer

<table>
<thead>
<tr>
<th>Item</th>
<th>Composition</th>
<th>Remarks</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZEP-RD</td>
<td>Xylene (o-,m-,p- mixed)</td>
<td>standard</td>
<td>1GL bottle</td>
</tr>
<tr>
<td>ZEP-N50</td>
<td>n-Amyl acetate</td>
<td>high resolution</td>
<td></td>
</tr>
<tr>
<td>ZED-WN</td>
<td>o-Xylene</td>
<td>high resolution</td>
<td></td>
</tr>
<tr>
<td>ZEP-SD</td>
<td>2-Butanone 40% Methyl isobutyl ketone 60%</td>
<td>high sensitivity</td>
<td></td>
</tr>
</tbody>
</table>
5. Rinse

<table>
<thead>
<tr>
<th>Item</th>
<th>Composition</th>
<th>Remarks</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZMD-B</td>
<td>Methyl isobutyl ketone 89%</td>
<td></td>
<td>1GL bottle</td>
</tr>
<tr>
<td></td>
<td>Isopropyl alcohol 11%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Remover

<table>
<thead>
<tr>
<th>Item</th>
<th>Composition</th>
<th>Remarks</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZDMAC</td>
<td>Dimethylacetamide</td>
<td></td>
<td>1GL bottle</td>
</tr>
</tbody>
</table>

7. Spin Curve

**ZEP520 Spin Curve**

- ZEP520
- ZEP520/Dilution Rate=2.5
- ZEP520-12
- ZEP520-12/Dilution Rate=2.0
- ZEP520-12/Dilution Rate=2.5

**Process Conditions**
- Substrate: 4 inch Si wafer
- Spin Time: 60sec.
- PB temp.: 180°C
- PB time: 20min. (Oven)

**ZEP520A Spin Curve**

- ZEP520A
- ZEP520A-7

**Process Conditions**
- Substrate: 4 inch Si wafer
- Spin Time: 60sec.
- PB temp.: 180°C
- PB time: 20min. (Oven)
8. Dependence on Pre-bake Temperature

**Process Conditions**
- Substrate: Si wafer
- Resist: ZEP520
- Film thickness: 5000 Å
- PB time: 3min.
- Exposure: ELS3300, 20kV
- Developer: ZED-N50
- Dev. temp.: 23°C
- Dev. time: 1, 3min.
- Rinse: ZMD-B, 23°C, 10sec.
9. Dependence on Development Temperature

**Process Conditions**
- Substrate: Si wafer
- Resist: ZEP520
- Film thickness: 5000Å
- PB temp.: 180°C
- PB time: 3min.
- Exposure: ELS3300, 20kV
- Dev. time: 1min.
- Rinse: ZMD-B, 23°C, 10sec.
9. Dependence on Development Time

**Process Conditions**
- **Substrate**: Si wafer
- **Resist**: ZEP520
- **Film thickness**: 5000Å
- **PB temp.**: 180°C
- **PB time**: 3min.
- **Exposure**: ELS3300, 20kV
- **Dev. temp.**: 23°C
- **Rinse**: ZMD-B, 23°C, 10sec.

- **Dose to Clear (uC/cm²)**
- **Normalized residual thickness (%)**

![Graph showing Dependence on Development Time](image-url)
10. Application Examples

0.15μm Isolated Space

Process Conditions
Resist: ZEP520
Film thickness: 5000Å
PB temp.: 180°C
PB time: 2min.
Exposure: 30kV, 5×10⁻¹¹A, 1 line exp.
50×10⁻⁵μC/cm
Dev. temp.: ZED-WN, 23°C, 30sec.

0.1μm Isolated Line

Process Conditions
Resist: ZEP520
Film thickness: 5000Å
PB temp.: 180°C
PB time: 2min.
Exposure area: 100μm (20000×20000dot)
Exposure: 30kV, 5×10⁻¹¹A, 1 line exp.
0.7μsec./dot
Dev. temp.: ZED-WN, 23°C, 60sec.

0.05μm Isolated Space

Process Conditions
Resist: ZEP520
Film thickness: 15000Å
Exposure: 75kV

These data were presented by ELIONIX INC.
11. Dry Etching Resistance

(1) CF$_4$ Dry Etching Rate

CF$_4$ Dry Etching Conditions
0.15torr, 70sqcm, 200W

(2) Cl$_2$+O$_2$ Dry Etching Rate

Cl$_2$+O$_2$ Dry Etching Conditions
Cl$_2$/O$_2$=4/1, 5min.
12. Example of Process Conditions

(1) Coating

- ZEP520/520A: 2000rpm×60sec → 5000Å
- ZEP520-12/520A-7: 2000rpm×60sec → 3000Å

(2) Pre-bake

- 170-200°C×20-30min. (Oven)
- 170-200°C×2-5min. (Hot Plate)

(3) Exposure

- 20-50μC/cm² at 20kV

(4) Development

- 20-25°C×60-360sec. (Dipping)
- ZEP-RD, ZED-N50, ZED-WN

(5) Rinse

- 20-25°C×10-60sec. (Dipping)
- ZMD-B

(6) Post bake

- In case of wet etching
  - 100-140°C×20-30min. (Oven)
  - 100-140×2-3min. (Hot Plate)

(7) De-scum

- O₂-plasma

(8) Etching

- Dry process and wet process can be used.

Wet Etching solution for Cr

- Ammonium cerium (IV) nitrate: (NH₄)₂Ce(NO₃)₆ 13-18wt%
- Perchloric acid: HClO₄ 3-8wt%
- Pure water: H₂O 77-84wt%

(9) Resist Removing

- <deep-UV + organic solvent>
  - 1st step: 185nm+254nm, 10mW/cm², 3min.-irradiation
  - 2nd step:
    - Dimethylacetamide (DMAC) or 1-Methyl-2-pyrrolidinone (NMP), 23°C×1min.
- *As the polymer of ZEP520 is decomposed by deep-UV irradiation, it can be easily removed.

- <organic solvent>
  - N-methyl-2-pyrrolidone (30-35°C)

- <hot H₂SO₄-H₂O₂>
  - hot H₂SO₄-H₂O₂ (90-100°C)
13. Handling Precautions

(1) Flammable Liquid
(2) Harmful by inhalation
(3) Avoid contact with skin and eyes

CAUTION: Open carefully. Use in well ventilated area. In case of contact with skin and eyes, rinse immediately with plenty of water for 15 minutes and get medical attention. In case of fire use Alcohol form CO₂ or dry chemical, never use water.

STORAGE: Keep capped and away from oxidants, sparks and open flame. Store at cool [32°F (0°C) - 77°F (25°C)], dark place. Use in clean room.
14. Appendix

(1) Refractive Index of ZEP520 Film

**Cauchy Coefficient**

\[ n = n_0 + \frac{n_1}{\lambda^2} + \frac{n_2}{\lambda^4} \]

\[ n_0 = 1.541093 \]
\[ n_1 = 4.113002 \times 10^5 \]
\[ n_2 = 4.070357 \times 10^{12} \]

Absorption coefficient = 0

Unit of \( \lambda \) : Å
Measured by UV-1250/SE (KLA Tencor)

(2) Glass Transition Temperature of ZEP520 Polymer

\[ T_g : 105^\circ C \]  
Measured by DSC

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**< U.S.A >**

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