Any process conditions and data are examples. Those will not guarantee the same data in customers’ process.
1. Characteristics
ZEP520A is high performance positive EB resists which show high resolution, high sensitivity and dry etch resistance. They are suitable for various EB processes.
(1) Resolution
   Shows high resolution and rectangle pattern profile.
(2) Resistance to dry etching
   Shows high dry etch resistance and they are almost equivalent to that of positive photoresists generally used.
(3) Sensitivity
   Shows 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>ZEP520A</td>
<td>57,000</td>
<td>11</td>
<td>Anisol</td>
<td>1QT bottle or 100ml bottle</td>
</tr>
<tr>
<td>ZEP520A-7</td>
<td>7</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-A</td>
<td>Anisol</td>
<td>ZEP520A</td>
<td>1QT bottle</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>ZED-N50</td>
<td>n-Amyl acetate</td>
<td>high resolution</td>
<td>1GL bottle</td>
</tr>
</tbody>
</table>

 ZED-N50 is recommended

5. Rinse

<table>
<thead>
<tr>
<th>Item</th>
<th>Composition</th>
<th>Remarks</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZMD-D</td>
<td>Methyl isobutyl ketone 100%</td>
<td></td>
<td>1GL bottle</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

D.R.: Dilution Rate = \(\frac{\text{Original Resist(g)} + \text{Solvent(g)}}{\text{Original Resist(g)}}\) (Weight Ratio)

**Process Conditions**
- Substrate: 4inch Si wafer
- Resist: ZEP520A
- Spin: 300rpm, 3sec. → Xrpm, 120sec.
- PB Temp.: 180°C
- PB Time: 3 min.
8. Dependence on Prebake Temperature

**Effect on Dose to Clear**

- **Prebake Temperature (°C)**
  - 80 to 220
- **Dose to Clear (µC/cm²)**
  - 0 to 45

**Effect on Normalized Residual Thickness**

- **Prebake Temperature (°C)**
  - 80 to 220
- **Normalized Residual Thickness (%)**
  - 0.80 to 1.10

**Process conditions**
- Substrate: Si wafer
- Resist: ZEP520A
- Film Thickness: 5000Å
- PB Time: 3 min.
- Exposure: ELS3300, 20kV
- Developer: ZED-N50, 23°C
- Dev. Time: 1 min.
- Rinse: ZMD-D, 23°C, 10sec.
9. Dependence on Development Temperature

**Process Conditions**
- Substrate: Si wafer
- Resist: ZEP520A
- Film thickness: 5000Å
- PB temp.: 180°C
- PB time: 3 min.
- Exposure: ELS3300, 20kV
- Dev. time: 1 min.
- Rinse: ZMD-D, 23°C, 10sec.
9. Dependence on Development Time

**Process Conditions**
- Substrate: Si wafer
- Resist: ZEP520A
- Film thickness: 5000Å
- PB temp.: 180°C
- PB time: 3 min.
- Exposure: ELS3300, 20kV
- Dev. temp.: 23°C
- Rinse: ZMD-D, 23°C, 10 sec.

**Graphs**
- Top graph: Dose to clear vs. Development time.
- Bottom graph: Normalized residual thickness vs. Development time.
10. Examples of application

**0.15μm Isolated space**

**Process Conditions**
- Resist : ZEP520
- Film thickness : 5000Å
- PB temp. : 180°C
- PB time : 2 min.
- Exposure : $30kV, 5 \times 10^{-11} A$, 1 line exp.
- $50 \times 10^{-5} \mu C/cm$
- Dev. temp. : ZED-WN, 23°C, 30 sec.

**0.1μm Isolated line**

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

**0.05μm Isolated space**

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

*These SEM photographs & Data are offers of ELIONIX INC. Although ZEP520 is not sold from consideration of environment now. We think that the same pattern formations are possible also in ZEP520A.*
11. Dry Etching Resistance

(1) CF<sub>4</sub> Dry Etching Rate

CF<sub>4</sub> Dry Etching Condition
0.15torr, 70sqcm, 200W

(2) Cl<sub>2</sub>+O<sub>2</sub> Dry Etching Rate

Cl<sub>2</sub>+O<sub>2</sub> Dry Etching Condition
Cl<sub>2</sub>/O<sub>2</sub>=4/1, 5min.
12. Example of Process Conditions

(1) Coating

- ZEP520A: 2000rpm×60sec → 5000Å
- ZEP520A-7: 2000rpm×60sec → 3000Å

(2) Prebake

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

(3) Exposure

- 20-50 μC/cm² at 20kV

(4) Development

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

(5) Rinse

- 20-25°C×10-60sec. (Dipping)
- ZMD-D

(6) Post bake

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

(7) De-scum

- O₂-plasma (if need be)

(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 N-methyl-2-pyroridone (NMP),
  - 23°C×1min.

  *As the polymer of ZEP520A is decomposed by deep-UV irradiation, it can be easily removed.

- <organic solvent>
  - Dimethylacetamide (DMAC) (30-35°C)
  - N-methyl-2-pyroridone(NMP) (30-35°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 CO$_2$ 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)] and dark place. Use in clean room.
14. Appendix

(1) Refractive index of ZEP520A film

Cauchy coefficient
\[ n = n_0 + n_1/\lambda^2 + n_2/\lambda^4 \]
\[ n_0 = 1.541093 \]
\[ n_1 = 4.113002 \times 10^5 \]
\[ n_2 = 4.070357 \times 10^{12} \]
absorption coefficient = 0

unit of \( \lambda \) : Å
measured by UV-1250/SE (KLA Tencor)

(2) Glass transition temperature of ZEP520A polymer

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