Positive Photoresists for UV, Laser & Electron Beam Lithography

- ma-P 1200 series, ma-P 1275HV for standard UV lithography
- ma-P 1200G series for greyscale lithography
- mr-PosEBR for e-beam lithography
- ma-P 1200LIL series for laser interference lithography

Unique features of the positive photoresists:
- Designed for - UV Lithography (mask aligner, laser greyscale lithography, laser interference) & E-beam Lithography
- No post exposure bake
- Easy removal
- Ready-to-use resist solutions in a variety of viscosities

- Made in Germany -
## Positive Photoresist Series and Thick Film Photoresists for UV lithography

<table>
<thead>
<tr>
<th>Resist</th>
<th>ma-P 1200 series</th>
<th>ma-P 1275</th>
<th>ma-P 1275HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral sensitivity</td>
<td>nm</td>
<td>330 - 450</td>
<td>350 - 450</td>
</tr>
<tr>
<td>Ready-to-use solutions for various film thicknesses</td>
<td>µm</td>
<td>ma-P 1205 → 0.5 ma-P 1210 → 1.0 ma-P 1215 → 1.5 ma-P 1225 → 2.5 ma-P 1240 → 4.0 ma-P 1275 → 7.5 @ 3000 rpm</td>
<td>6 - 40 in one spin-coating step</td>
</tr>
<tr>
<td>Exposure dose @ 365 nm*</td>
<td>mJ cm²</td>
<td>35 - 150</td>
<td>150 - 3000</td>
</tr>
<tr>
<td>Developer</td>
<td>ma-D 331 &amp; ma-D 331/S (NaOH based); mr-D 526/S (TMAH based)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Mask aligner broadband exposure

### Resist patterning with mask aligner broadband exposure and pattern transfer

**Resist mould for electroplating**

- 50 µm ma-P 1275HV mould
- 40 µm electroplated Ni

**Resist pattern reflow**

- 20 µm ma-P 1275, 60 µm diameter pillar
- 30 µm reflowed ma-P 1275, 60 µm diameter

### ma-P 1200 series and ma-P 1275 & ma-P 1275HV for microsystems technology and microelectronics

- Film thickness up to 60 µm in one spin-coating step
- Broadband-, g- and i-line exposure
- High stability in acid and alkaline plating baths
- High dry and wet etch resistance
- Good thermal stability of the resist patterns attainable
- Aqueous alkaline development
- Side wall angle up to 87° with mask aligner broadband exposure
- Suitable for pattern reflow

### Process flow

#### RIE

1. **Photoresist Coating**
2. **Expose**
3. **Develop**
4. **RIE**
5. **Resist Removal**

#### Electroplating

1. **Plating Base Coating**
2. **Expose**
3. **Develop**
4. **Electroplating**
5. **Resist Removal**

### Reflow of ma-P 1200/ ma-P 1200G and pattern transfer

**Pattern Transfer:**

- Substrate e.g. Si
- Dry Etch
- Resist Removal
- UV Lithography

**Lens array etched into substrate, e.g. silicon or glass**

**Glass UV molding with OrmoStamp**

**UV transparent mould**

**Lens array made with cured OrmoComp® (formed with the OrmoStamp® mould)**

### Main applications

- Etch mask - metals and semiconductors
- Mould for electroplating
- Fabrication of micro optical components, e.g. micro lenses by pattern transfer from reflowed resist patterns
- Mask for ion implantation

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OrmoComp®: DE 30 210 075 433; IR 1 091 982; TW 100030626 (application), OrmoStamp®: DE 30 210 075 435; IR 1 092 621; TW 100030629 (application)
Positive Photoresist Series for Greyscale Lithography

<table>
<thead>
<tr>
<th>Resist</th>
<th>ma-P 1215G</th>
<th>ma-P 1225G</th>
<th>ma-P 1275G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Film thickness *</td>
<td>µm</td>
<td>1.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Spin-coating rpm s</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
</tr>
<tr>
<td>Spectral sensitivity nm</td>
<td>350 - 450</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure dose @ 365 nm**</td>
<td>mJ cm²</td>
<td>35 - 150</td>
<td>150 - 300</td>
</tr>
<tr>
<td>Developer</td>
<td>ma-D 532/S, mr-D 526/S (TMAH based) for greyscale lithography</td>
<td>ma-D 331 (NaOH based) for standard lithography</td>
<td></td>
</tr>
</tbody>
</table>

* Resists with different viscosities available as custom-made products
** Mask aligner broadband exposure

Resist patterning with Laser Direct Writing

Convex and concave hexagonal lenses, 60 µm diameter*
Hexagonal concave lenses, ~17 µm width*
Pyramids, 10 µm base width, 5 µm height, 45 °angle**
53 µm pattern depth in 58 µm thick resist*

ma-P 1200G
for greyscale lithography

Specifically designed for the requirements of greyscale lithography, application in standard binary lithography also possible.

Process flow
Laser Direct Writing

UV-Laser direct writing (dose variation)

Substrate
Resist development

Process flow
Exposure through a greyscale mask

UV
Positive Photoresist
Greyscale mask

Substrate
Resist development

- Reduced contrast
- Film thickness 1 - 60 µm and higher
- High intensity laser exposure possible, no outgassing
- 50-60 µm greyscale pattern depth possible
- Aqueous alkaline development
- High dry etch resistance
- Suitable for pattern reflow after standard binary lithography

Main applications
Use of manufactured 3D patterns in microoptics, MEMS and MOEMS and displays
Pattern transfer by
- Electroplating
- Etching
- UV moulding
Positive Electron-Beam Resist Series

<table>
<thead>
<tr>
<th>Resist</th>
<th>mr-PosEBR 0.05</th>
<th>mr-PosEBR 0.1</th>
<th>mr-PosEBR 0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Film thickness (@ 3000 rpm)</td>
<td>nm</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Exposure dose</td>
<td>@ 30 keV</td>
<td>µC cm⁻²</td>
<td>75 - 200</td>
</tr>
<tr>
<td></td>
<td>@ 100 keV</td>
<td>µC cm⁻²</td>
<td>340 - 500</td>
</tr>
<tr>
<td>Developer</td>
<td></td>
<td>mr-Dev 800 (solvent based)</td>
<td></td>
</tr>
<tr>
<td>Dry etch selectivity vs. Si (SF₆/CF₄ process)</td>
<td></td>
<td>~2.5</td>
<td></td>
</tr>
</tbody>
</table>

Resist patterning with e-beam lithography and pattern transfer

- Highly sensitive
- High resolution capability
- Generation of sub 50 nm patterns
- Excellent dry etch stability
- Good pattern transfer fidelity
- Development in organic solvents
- Resist solvent anisole

Main applications
- Use in micro- and nanoelectronics
- Manufacture of semiconductor devices
- Etch mask for pattern transfer, e.g. into Si, SiO₂, Si₃N₄ or metals
- Mask for lift-off patterning
- Suitable for 3D surface patterning

mr-PosEBR for high resolution electron-beam lithography

- Steep sidewalls due to high contrast enable high quality etched pattern
- Good etch resistance
- Film thickness 100…500 nm

Main applications
- Masking of substrate surfaces during fabrication of steep-edged nano structures for diffractive optics:
  - Laminary gratings
  - VLS gratings

Thin Film Positive Photoresists in Laser Interference Lithography

mr-P 1200LIL for high resolution laser interference lithography

- Steep sidewalls due to high contrast enable high quality etched pattern
- Good etch resistance
- Film thickness 100…500 nm

Main applications
- Masking of substrate surfaces during fabrication of steep-edged nano structures for diffractive optics:
  - Laminary gratings
  - VLS gratings