

## Positive E-Beam Resist AR-P 7400

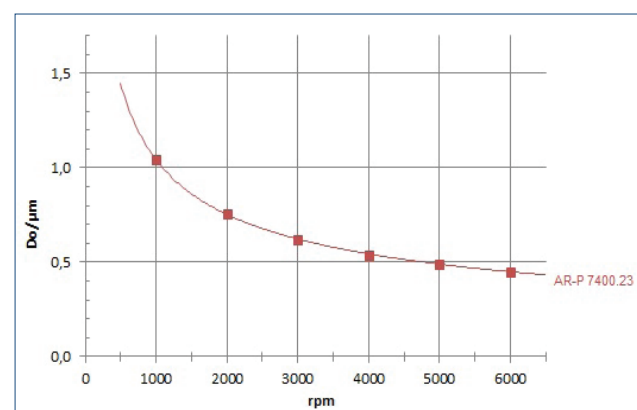
### AR-P 7400 e-beam resists for mix & match

Plasma etching resistant e-beam resists for the production of integrated circuits and masks

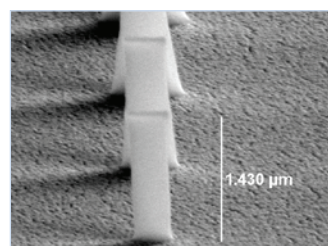
#### Characterisation

- e-beam, deep UV, g-line, i-line: positive and negative
- intermediate sensitivity
- process-stable, plasma etching resistant
- designed for e-beam exposure
- suitable for UV exposure ( $\lambda = 310 - 450 \text{ nm}$ )
- mix & match is possible
- combination of novolac and naphthoquinone diazide
- safer solvent PGMEA

#### Spin curve



#### Structure resolution



AR-P 7400.23  
150 nm columns at a  
film thickness of 1.43 μm  
(negative process)

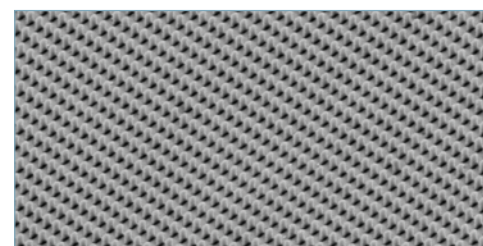
#### Properties I

| Parameter / AR-P           | 7400.23 |
|----------------------------|---------|
| Solids content (%)         | 23      |
| Viscosity 25 °C (mPas)     | 6       |
| Schichtdicke/4000 rpm (μm) | 0.60    |
| Resolution best value (nm) | 40      |
| Contrast (negative)        | 10      |
| Flash point (°C)           | 42      |
| Storage 6 month (°C)       | 8 - 12  |

#### Properties II

|   |   |       |
|---|---|-------|
| Glass trans. temperature (°C)                           | 108                                       |       |
| Dielectric constant                                     | 3.1                                       |       |
| Cauchy coefficients                                     | N <sub>0</sub>                            | 1.620 |
|   | N <sub>1</sub>                            | 57.0  |
|   | N <sub>2</sub>                            | 220.4 |
| Plasma etching rates (nm/min)<br>(5 Pa, 240-250 V bias) | Ar-sputtering                             | 8     |
|   | O <sub>2</sub>                            | 169   |
|   | CF <sub>4</sub>                           | 40    |
|   | 80 CF <sub>4</sub><br>+ 16 O <sub>2</sub> | 89    |

#### Resist structures



AR-P 7400.23  
Arrays with a pixel  
size of 220 x 85 nm  
(negative)

#### Process parameters

|             |                          |
|-------------|--------------------------|
| Substrate   | Si 4" wafer              |
| Tempering   | 90 °C, 10 min, hot plate |
| Exposure    | Raith Pioneer, 30 kV     |
| Development | AR 300-26, 1:2, 60 s     |

#### Process chemicals

|                   |                      |
|-------------------|----------------------|
| Adhesion promoter | AR 300-80            |
| Developer         | AR 300-47            |
| Thinner           | AR 300-12            |
| Remover           | AR 300-76, AR 600-71 |

## Positive E-Beam Resist AR-P 7400

### Process conditions - positive

This diagram shows exemplary process steps for AR-P 7400 resists. All specifications are guideline values which have to be adapted to own specific conditions. For further information on processing, ☞ "Detailed instructions for optimum processing of e-beam resists". For recommendations on waste water treatment and general safety instructions, ☞ "General product information on Allresist e-beam resists".

|   |  |   |
|---|--|---|
| Coating                                   |  | AR-P 7400.23<br>4000 rpm, 60 s<br>0.6 μm  |
| Tempering (± 1 °C)                        |  | 85 °C, 1 min hot plate or<br>85 °C, 30 min convection oven  |
| E-beam exposure                           |  | Raith Pioneer (single dot emitter), acceleration voltage 30 kV<br>Area dose (E <sub>0</sub> ): 660 μC/cm <sup>2</sup><br>UV exposure dose (E <sub>0</sub> , BB UV): 80 mJ/cm <sup>2</sup> , for mix & match |
| UV exposure (optional)                    |  |   |
| Development<br>(21-23 °C ± 0,5 °C) puddle |  | AR 300-26, 2 : 3<br>60 s  |
| Rinse                                     |  | DI-H <sub>2</sub> O, 30 s   |
| Post-bake<br>(optional)                   |  | 120 °C, 1 min hot plate or 120 °C, 25 min convection oven<br>for slightly enhanced plasma etching resistance  |
| Customer-specific<br>technologies         |  | Generation of semiconductor properties  |
| Removal                                   |  | AR 300-76 or O <sub>2</sub> plasma ashing   |

#### Processing instructions

For mix & match applications can be more easily performed in the positive mode. For this purpose, small structures are written with e-beam before the larger areas are irradiated with UV light. The subsequent development is performed in one step. Mix & match processes have to be coordinated carefully between both exposure methods, e-beam and UV lithography.



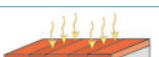

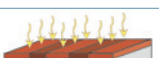
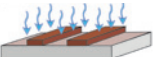
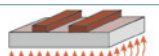

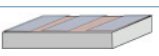
The most flexible developer for resist AR-P 7400.23 is AR 300-26. Contrast and development rate can be adjusted to a large degree by a dilution of the developer. Developer dilutions of 1 : 1 to 1 : 3 with DI water are possible. In the positive mode, higher dilutions result in an increased contrast and a reduction of the development rate. The development time should ideally range between 30 and 60 seconds.

| Development recommendations |           |           |               |
|-----------------------------|-----------|-----------|---------------|
| Developer                   | AR 300-26 | AR 300-35 | AR 300-40     |
| AR-P 7400.23                | 2 : 3     | 1 : 2     | 300-47, 1 : 2 |

## Positive E-Beam Resist AR-P 7400

### Process conditions – negative



This diagram shows exemplary process steps for AR-P 7400 resists. All specifications are guideline values which have to be adapted to own specific conditions. For further information on processing, ☞ "Detailed instructions for optimum processing of e-beam resists". For recommendations on waste water treatment and general safety instructions, ☞ "General product information on Allresist e-beam resists".

|   |   |  |
|---|---|--|
| Coating                                   |    | AR-P 7400.23<br>4000 rpm, 60 s, 0.6 µm   |
| Tempering (± 1 °C)                        |    | 85 °C, 1 min hot plate or<br>85 °C, 30 min convection oven   |
| E-beam exposure                           |    | Raith Pioneer (single dot emitter), acceleration voltage 30 kV<br>Exposure dose ( $E_0$ ): 125 µC/cm², no mix & match possible |
| Image reversal bake                       |   | 105 °C, 5 min hot plate or 100 °C, 25 min convection oven  |
| Flood exposure                            |  | Mask aligner i-line<br>Exposure dose ( $E_0$ ): 300 mJ/cm²   |
| Development<br>(21-23 °C ± 0,5 °C) puddle |  | AR 300-26, 1 : 2 diluted<br>60 s   |
| Rinse                                     |   | DI-H <sub>2</sub> O, 30 s  |
| Post-bake<br>(optional)                   |  | 120 °C, 1 min hot plate or 120 °C, 25 min convection oven<br>for slightly enhanced plasma etching resistance                   |
| Customer-specific<br>technologies         |  | Generation of e.g. semiconductor properties  |
| Removal                                   |  | AR 300-76 or O <sub>2</sub> plasma ashing  |

### Processing instructions

For mix & match applications in the negative mode, a tempering and flood exposure after the image-wise primary exposure are added as further steps to the procedure which makes the entire process quite complex. The most flexible developer for resist AR-P 7400.23 is AR 300-26. Contrast and development rate can be adjusted to a large degree by dilution of the developer. Developer dilutions of 1 : 1 to 1 : 3 with DI water are possible. In the negative mode, a comparably strong developer (AR 300-26) yields better results. The development time should ideally range between 30 and 60 seconds.

### Development recommendations

 optimal  suitable

| Developer    | AR 300-26 | AR 300-35 | AR 300-40     |
|--------------|-----------|-----------|---------------|
| AR-P 7400.23 | 2 : 3     | 1 : 2     | 300-47, 1 : 2 |