ALLRESIST

Innovation
Creativity
customer-specific solutions

Positive / Negative Photoresists AR-P 1200 / AR-N 2200

AR-P 1200 / AR-N 2200 resist series for spray coating

Ready-to-use positive and negative spray resists for various applications

Characterisation

- broadband UV, i-line, g-line
- AR-P 1210 /AR-N 2210 positive/negative resists for a uniform coverage of vertical trenches
- AR-P 1220 /AR-N 2220 for etch profiles with 54° slopes
- AR-P 1230 /AR-N 2230 for planar wafers
- good adhesion, smooth surface
- combination of novolac and naphthoquinone diazide
- safer solvent PGMEA as well as methyl ethyl ketone

Properties I

Parameter / AR-P AR-N	1210 2210	1220 2220	1230 2230
Solids content (%)	4	4	4
Film thickness (µm)	4 - 10	3 - 8	0.5 - 1
Resolution (µm)	1.0	1.0	1.0
Contrast	3.0	3.0	3.0
Flash point (°C)	1	9	37
Storage 6 month (°C)	10 - 18		

Structure resolution

AR-P 1220
Film thickness 3.5 µm
Resolution up to 1.2 µm

Properties II

Glass transition temperature	108	
Dielectric constant	3.1	
Cauchy coefficients AR-P 1220 / AR-N 2220	N_0	1.625 / 1.595
	N_1	74.4 / 72.5
	N_2	170 / 85.0
Plasma etching rates (nm/min) (5 Pa. 240-250 V bias)	Ar-sputtering	8 / 8
	O_2	169 / 173
	CF_4	38 / 33
	80 CF_4 + 16 O_2	90 / 93

Process parameters

Substrate	Si 4“ wafer with topologies
Tempering	82 °C, chuck
Exposure	i-line stepper (NA: 0.65)
Development	AR 300-44, 4 min puddle

Parameters spray coater “Gamma AltaSpray”

Spray coater Gamma AltaSpray, Süss MicroTec	Positive resist AR-P 1220	Negative resist AR-N 2220
Resist flow (drops/min)	25	40
Arm speed (mm/s)	75	90
N_2 pressure (kPa)	91	91
Exposure	Nikon Stepper B14, i-line, NA = 0.65	Nikon Stepper B14, i-line, NA = 0.65
Sensitivity (film thickness)	200 mJ/cm², 5 µm	70 mJ/cm², 5 µm
Development with AR 300-44	4 x 60 s puddle	4 x 60 s puddle
Minimum resolution (µm)	1.2	1.4

Chuck temperature: 82 °C, nozzle height: 20 nm

Process chemicals

Developer	AR 300-44
Remover	AR 300-76, AR 300-73

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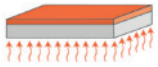
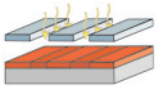
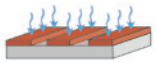
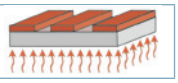
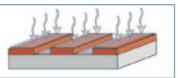
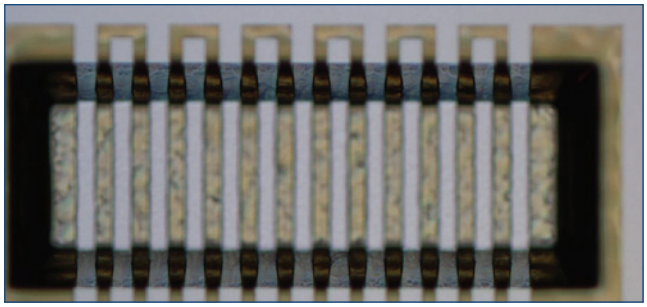
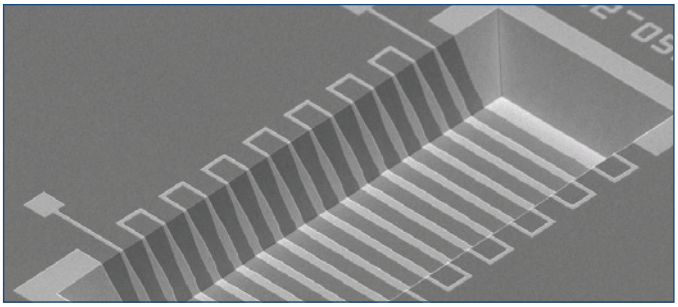
Process conditions

This diagram shows exemplary process steps for AR-P/N 1200/2200 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 photoresists". For recommendations on waste water treatment and general safety instructions, ☞ "General product information on Allresist photoresists".

Coating 	AR-P 1210 AR-N 2210	AR-P 1220 AR-N 2220	AR-P 1230 AR-N 2230
	5 µm	3 µm	1.0 µm
Tempering (±1 °C) 	For heated chucks: 70 - 80 °C without further drying For non-heated chucks: 90 °C, 2 min hot plate or 85 °C, 25 min convection oven		
UV exposure 	Broadband UV, 365 nm, 405 nm, 436 nm		
	Exposure dose (E_0, Nikon i-line stepper): AR-P 1220: 200 mJ/cm², 5 µm; AR-N 2220: 70 mJ/cm², 5 µm		
Cross-linking bake for AR-N 2210-2230 	90 °C, 5 min hot plate or 85 °C, 25 min convektion oven		
Development (21-23 °C ± 0.5 °C) puddle 	AR 300-44	AR 300-44	AR 300-44
	4 min	3 : 1, 5 min	2 : 1, 6 min
Rinse	DI-H_2O, 30 s		
Post-bake (optional) 	Not required		
Customer-specific technologies 	Generation of semi-conductor properties		
Removal 	AR 300-70 or O_2 plasma ashing		



Resist structures of AR-P 1220 in 200 µm deep etch grooves



Aluminium conductor paths after etching

Important processing instructions regarding single process steps are described on the following page ☞

Positive / Negative Photoresists AR-P 1200 / AR-N 2200

Processing Instructions for Spray Resists

Coating: For spray coating, resists are filled into the cartridges of the spray coater under yellow light. Gas formation in the resist supply line which is generally observed for AZ 4999 does not occur with AR resists.

The quality of the coating largely depends upon the respective spray coating device which is used. Adjustable device parameters such as dispensing rate, scanning speed, spray distance and chuck temperature exhibit a major influence on the film forming process. Commercially available spraying devices differ considerably with respect to their coating properties, and own experiments to determine the optimum parameters are therefore absolutely necessary.

Resists 1220/2220 and 1230/2230 form very homogeneous surfaces. Due to their specific solvent composition, solvent evaporation is reduced, but nevertheless a complete and at the same time sufficient coverage of the substrate is provided. Surfaces are thus considerably less rough as compared to AZ 4999.

If unheated chucks are used, coated substrates should be tempered on a hot plate at plate at 85 - 90 °C for 2-5 min or in a convection oven at 85 °C for 25 min to improve adhesion. A temperature of 90 °C should however not be exceeded to prevent edge retraction of the resist caused by possible softening processes.

With resists AR-P 1210 and 1220 as well as with AR-N 2210 and 2220 and under standard conditions, film thickness values of 4 - 8 µm can be obtained.

Higher film thicknesses are possible with higher dispensing rates or using multiple coating steps.

In comparison with AZ 4999, these resists have a lower tendency to form disturbing beads. Resists AR-P 1230 and AR-N 2230 are thus well suited for the generation of thin films with a thickness of 0.5 - 1 µm and can be used for spray coating as well as for spin coating applications. The thickness of films produced via spin coating ranges between 50 to 120 nm.

Exposure: For an exposure of positive resists, the entire UV-range of 300 to 450 nm can be utilised, while for the exposure of negative resists, a range between 300 to 436 nm is recommended. The exposure time generally depends on the film thickness. For a film thickness of about 5 µm, the sensitivity of positive resists is approx. 200 mJ/cm². Negative-tone resists with approx. 70 mJ/cm² are substantially more sensitive and require shorter exposure times, which is advantageous for the exposure of wafers with extreme topologies in order to prevent undesirable reflexions.

Thin films generated with AR-P 1230 and AR-N 2230 require lower exposure doses.

For negative resists, a cross-linking bake after exposure is mandatory!

Development: The development time strongly depends on the respective film thickness and amounts to approximately 5 minutes for 5 µm films. If edges are only marginally covered, a 3 : 1 dilution (3 parts developer : 1 part water) is recommended. For the development of thin films of about 0.5 µm, the developer should be diluted up to 2 : 1.

* In the following REM images, bright areas represent silicon. Images are displayed upside down.

AR-P 1220 (break line)*

Edge coverage of groove bottom

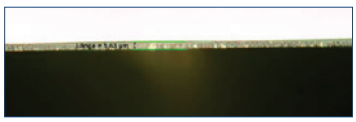
AR-P 1220 (break line)*

Edge coverage of upper edge

AR-P 1220

Smooth surface after coating step

AR-P 1220 (break line)*



Film thickness uniformity on wafer surface

AR-N 2220 (break line)*

Very good coverage of upper edge

AR-N 2220

Resolution at 5 µm film thickness: 1.6 µm