Negative Photoresist AR-N 4300

AR-N 4340 photoresist for the mid UV range

Highly sensitive negative resist for the production of integrated circuits

Characterisation

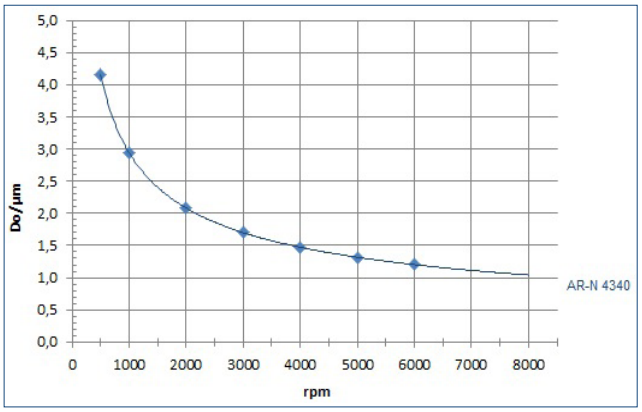
- i-line, g-line
- highest sensitivity, excellent resolution
- good adhesion, high contrast, chemically enhanced
- undercut profiles (lift-off) are possible
- plasma etching resistant, temperature-stable up to 220 °C after subsequent treatment
- novolac with photochemical acid generator and amine-based crosslinking agent
- safer solvent PGMEA

Properties I

Parameter / AR-N	4340
Solids content (%)	32
Viscosity 25 °C (mPas)	18
Film thickness/4000 rpm (µm)	1.4
Resolution (µm)	0.5
Contrast	5.0
Flash point (°C)	42
Storage temperature (°C)*	10 - 18

* Products have a guaranteed shelf life of temperatures from the date of sale if stored correctly and can also be used without guarantee until the date indicated on the label.

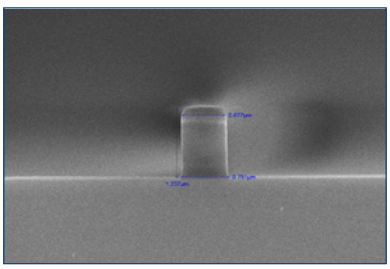
Spin curve



Properties II

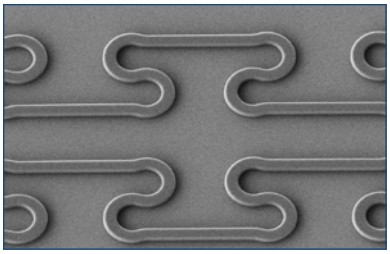
Glass transition temperature	102		
Dielectric constant	3.1		
Cauchy coefficients unexposed / exposed	N_0	1.593	1.599
	N_1	75.4	81.4
	N_2	80.0	81.4
Plasma etching rates (nm/min) (5 Pa, 240-250 V Bias)	Ar-sputtering	8	
	O_2	173	
	CF_4	33	
	80 CF_4 + 16 O_2	93	

Structure resolution



AR-N 4340
Film thickness 1.4 µm
Resist structure 0.7 µm L/S

Resist structures



AR-N 4340
Film thickness 2.0 µm
Resist structure 4.0 µm

Process parameters

Substrate	Si 4“ wafer
Tempering	85 °C, 60 s, hot plate
Exposure	i-line stepper (NA: 0.65)
Development	AR 300-475, 60 s, 22 °C

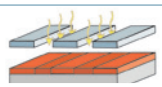
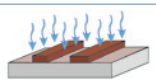
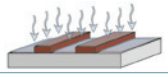
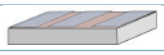
Process chemicals

Adhesion promoter	AR 300-80
Developer	AR 300-475
Thinner	AR 300-12
Remover	AR 300-76, AR 300-72

Negativ-Photoresist AR-N 4300

Process conditions

This diagram shows exemplary process steps for resist AR-N 4340. 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 	4000 rpm, 60 s 1.4 µm
Softbake (± 1 °C) 	90 °C, 1 min hot plate or 85 °C, 25 min convection oven
UV exposure 	Broadband UV, 365 nm, 405 nm, 436 nm Exposure dose (E_0, broadband UV stepper): 140 mJ/cm^2,1.4 µm
Crosslinking bake (± 1 °C) 	95 °C, 2 min hot plate or 90 °C, 25 min convection oven
Development (21-23 °C ± 0,5 °C) puddle 	Note: By extending the development time, an undercut (lift-off) of the resist structure can be obtained at minimum possible exposure dose AR 300-475, 60 s
Rinse	DI-H_2O, 30 s
Hardening of structures up to 300 °C (optional)	Flood exposure 150 mJ/cm^2, bake 115 °C, 1 min hot plate
Customer-specific technologies 	Generation of e.g. semiconductor properties or lift-off
Removal 	AR 300-76 or O_2 plasma ashing

TCD vs. bake temperature

Temperature °C	TCD [s]	Dose [mJ/cm^2]
70	20	480
80	22	250
90	24	140
100	41	65
110	80	55
120	210	220
130	∞	∞

Development recommendations

Developer	AR 300-26	AR 300-35	AR 300-40
AR-N 4340	1 : 1	undil.	300-475

Samples were dried at 85 °C and crosslinked at temperatures as indicated (developer: AR 300-475).

The development strongly depends on the bake temperature. Above a temperature of 130 °C, resist AR-N 4340 is not developable any more. Optimum temperatures range between 90 and 100 °C.

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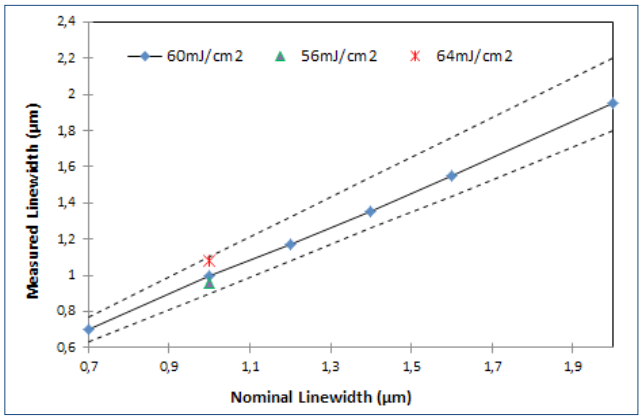
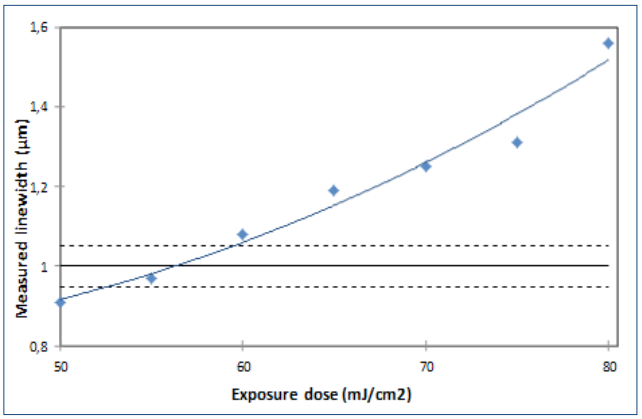
Linearity



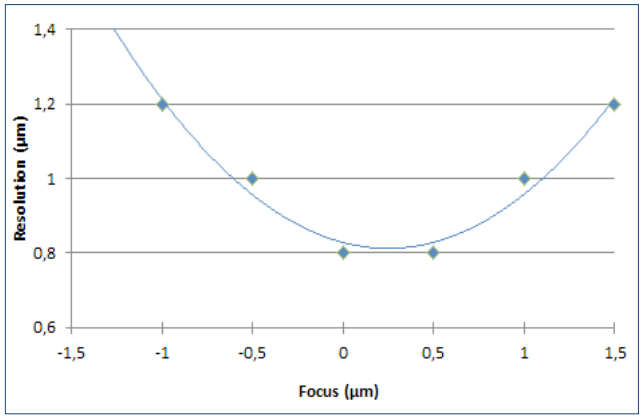
Up to a line width of 0.7 µm, the linearity is in the desired range (parameter see grafic Focus variation).

Optimum exposure dose



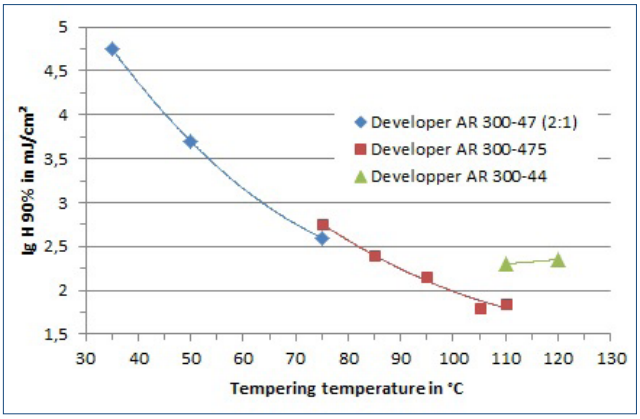
The optimum exposure dose for 1 µm-bars is 56 mJ/cm² (parameter see grafic Focus variation).

Focus variation



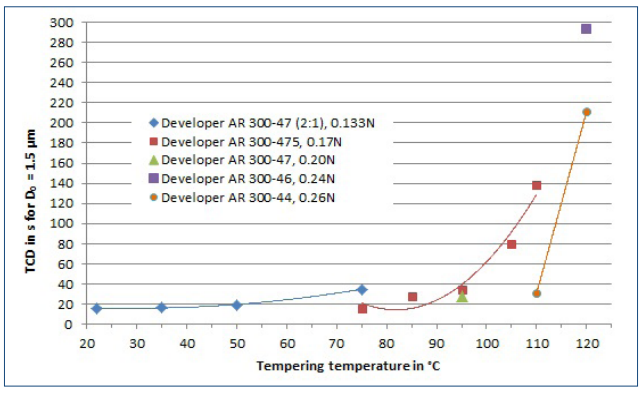
The resist achieves a resolution of 0.8 µm optimal focus adjustment REM measurement: Thickness 1,5 µm, PEB 105 °C, 180 s, I-line stepper (NA: 0,65), Developer AR 300-475.

Sensitivity in dependency on the bake



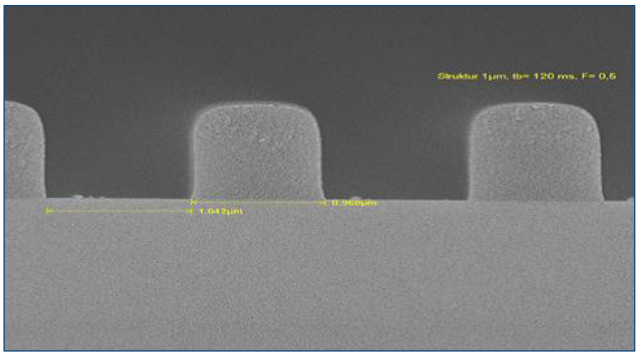
Samples were both dried and crosslinked at temperatures as indicated. The optimum working range is between 90 and 110 °C.

Time for complete development vs. bake



The time for complete development is very short at bake temperatures of < 50 °C, even if weak developers are used. With increasing temperature, the time for complete development (TCD) is considerably prolonged. Above a temperature of 120 °C, complete development of the resist is no longer possible.

Temperature stability after hardening



Hardened resist bar structures after tempering at 200 °C

The developed structures are stable between 140 -160 °C, depending on the drying procedure (hot plate or oven). Structures can be stabilized up to temperatures of 220 °C by flood exposure and a subsequent bake at 120 °C.