Positive Photoresist AR-P 3700

AR-P 3700 photoresists for sub-µm structures

Sensitive positive-tone standard resist for the production of highly integrated circuits

Characterisation

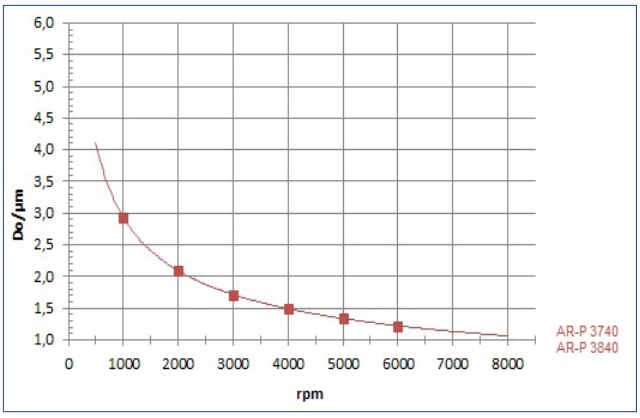
- broadband UV, i-line, g-line
- high sensitivity, highest resolution up to 0.4 µm
- high contrast, excellent dimensional accuracy
- optimised coating properties on topologically complex substrate surfaces
- plasma etching resistant, stable up to 120 °C
- combination of novolac and naphthoquinone diazide
- safer solvent PGMEA

Properties I

Parameter / AR-P	3740
Solids content (%)	29
Viscosity 25 °C (mPas)	22
Film thickness / 4000 rpm (µm)	1.4
Resolution (µm)	0.4
Contrast	6.0
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.

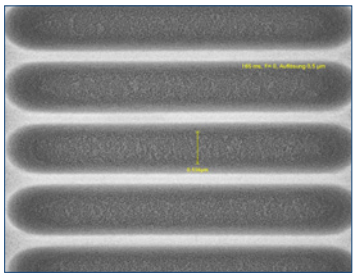
Spin curve



Properties II

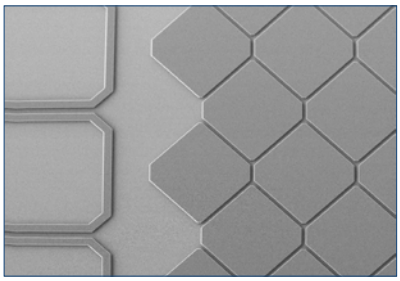
Glass transition temperature	108	
Dielectric constant	3.1	
Cauchy coefficients AR-P 3740	N_0	1.623
	N_1	81.8
	N_2	160.4
Plasma etching rates (nm/min) (5 Pa, 240-250 V bias)	Ar-sputtering	8
	O_2	164
	CF_4	38
	80 CF_4 + 16 O_2	88

Structure resolution



AR-P 3740
Film thickness 1.1 µm
Resist structures 0.5 µm L/S

Resist structures



AR-P 3740
Film thickness 1.8 µm
Resist structures up to 1.0 µm

Process parameters

Substrate	Si 4“ wafer
Tempering	100 °C, 90 s, hot plate
Exposure	i-line stepper (NA: 0.65)
Development	AR 300-47, 60 s, 22 °C

Process chemicals

Adhesion promoter	AR 300-80
Developer	AR 300-47, AR 300-26
Thinner	AR 300-12
Remover	AR 300-76, AR 600-71

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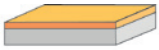
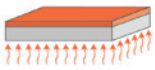
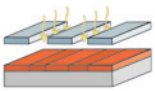
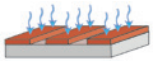
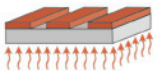
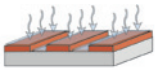
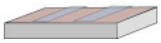
Process conditions

This diagram shows exemplary process steps for AR-P 3700 resist. 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 3740	AR-P 3840	
	4000 rpm, 60 s 1.4 µm	4000 rpm, 60 s 1.4 µm	
Tempering (± 1 °C) 	100 °C, 1 min hot plate or 95 °C, 25 min convection oven		
UV exposure 	Broadband UV, 365 nm, 405 nm, 436 nm		
	Exposure dose (E_0, broadband UV stepper):		
	55 mJ/cm²	72 mJ/cm²	
Development (21-23 °C ± 0.5 °C) puddle 	AR 300-47 60 s	AR 300-47 60 s	
Rinse	DI-H_2O, 30 s		
Post-bake (optional) 	115 °C, 1 min hot plate or		
	115 °C, 25 min convection oven		
Customer-specific technologies 	Generation of semiconductor properties		
Removal 	AR 300-70 or O_2 plasma ashing		

Development recommendations

Resist / Developer	AR 300-26	AR 300-35	AR 300-40
AR-P 3740	1 : 3	4 : 1	300-46 high speed 300-47 high contrast

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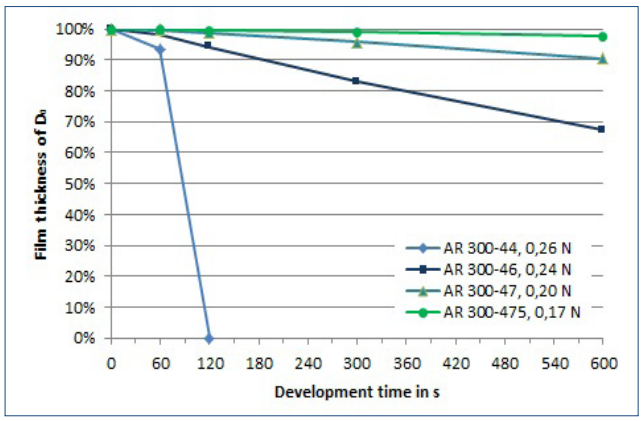
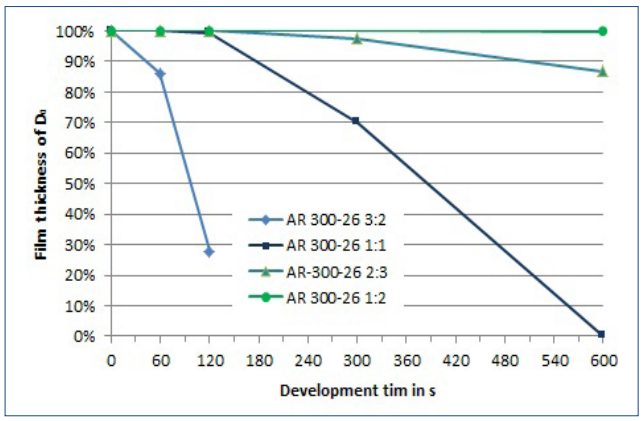
Dark erosion

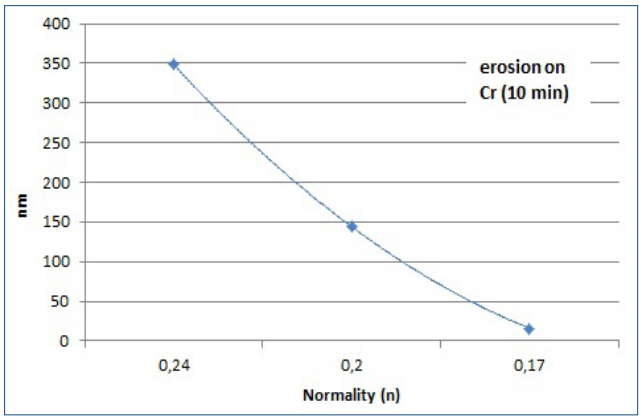


AR-P 3740 may be developed with any of the four TMAH developers. A high sensitivity is associated with high erosion rates. No dark erosion is obtained if weaker developers are chosen (see diagram Influence of developer strength)



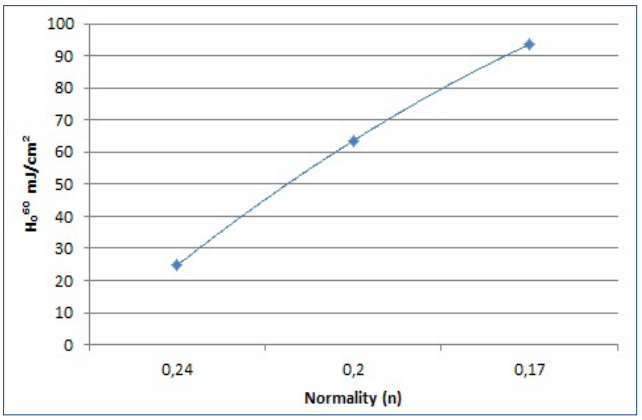
Using a dilution series of AR 300-26, the desired development properties can be adjusted accordingly. A dilution of 3:2 (3 parts AR 300-26, 2 parts DI water) is not recommended, due to the high erosion rate. More suitable in this case is a dilution of 1:1 to 2:1.

Influence of developer strength of the dark erosion



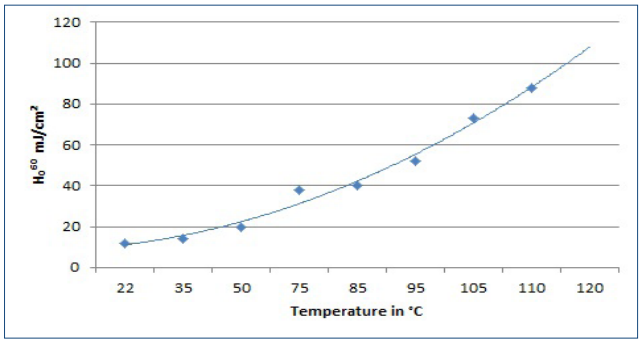
Using coated Cr-substrates (thickness 1.5 µm), 15 – 350 nm are removed within 10 min depending on the respective developer strength. The highest erosion is obtained with the strong developer AR 300-46 (0.24 n).

Influence of developer strength of exposure dose



Using the strong developer AR 300-46, short exposure times can be realised. The highest contrast and thus a slightly higher resolution is obtained with the weak developer AR 300-475 (0.17 n).

Dependency of sensitivity (exposure dose) on resist drying



	Temperature in °C	Time	H_0^{60} mJ/cm2
Room	22	24 h	12
Convection oven	35	4 h	14
	50	1 h	20
	75	30 min	38
	85		40
	95		52
	105		73
	110		83
	120		-

Performed by bb UV with developer 300-35 1 : 1

It is also possible to develop resists which were only dried at room temperature (24 h). In this case, resists are technically very sensitive, but are however also characterised by high dark erosion. A good development is provided for resists baked at up to 110 °C (AR 300-35, 1 : 1), while developers with higher strength are required for bake temperatures above 120 °C (AR 300-35, 2 : 1). Resist layers tempered at 130 °C are basically non-developable any more.

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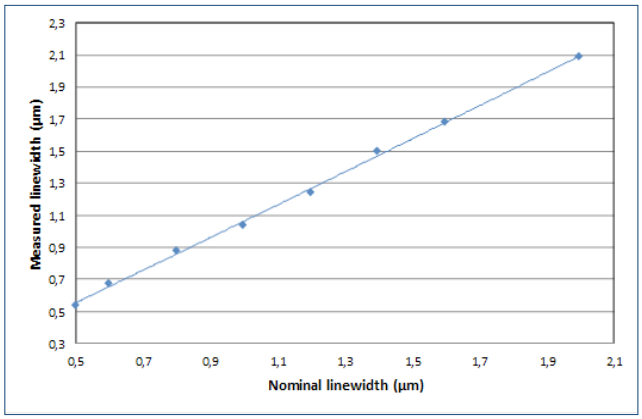
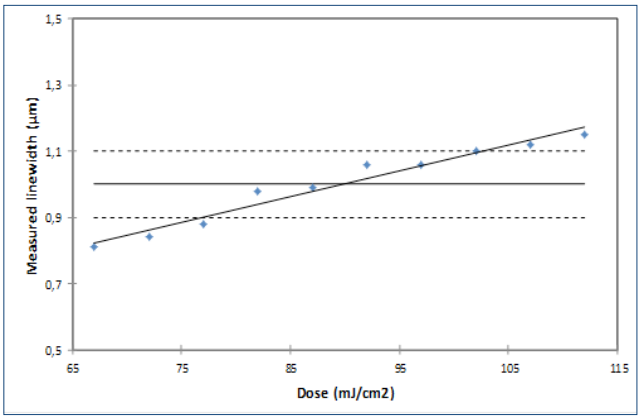
Linearity



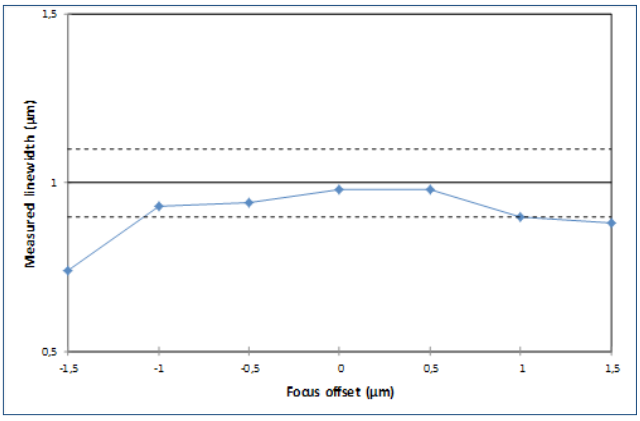
Up to a structure width of 0.5, a very good agreement is obtained.

Optimum exposure dose



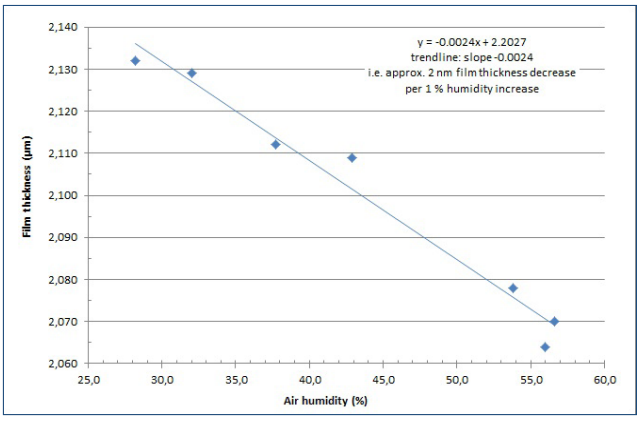
The optimum exposure dose for 1 µm lines is 88 mJ/cm^2.

Focus variation



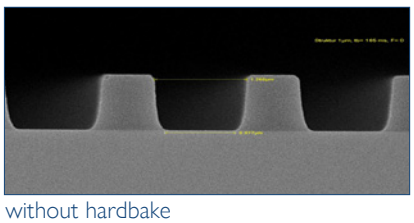
The intended structure sizes can be realised by varying the focus between -1.0 to 1.0.

Dependency of film thickness on air humidity

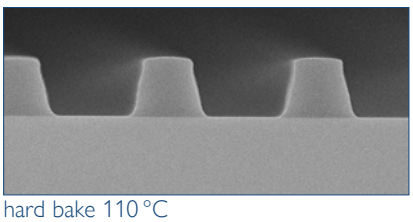


With increasing humidity, the resulting film thickness during coating of the resist decreases.

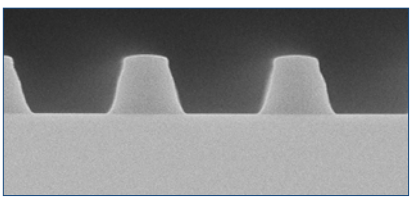
Thermal behaviour of resist structures



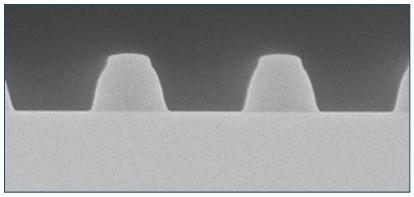
without hardbake



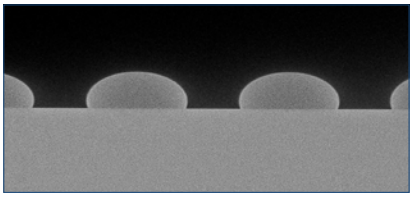
hard bake 110 °C



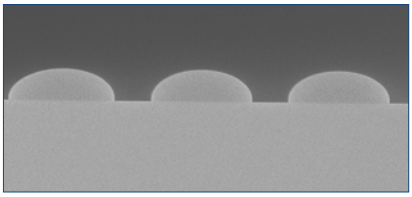
hard bake 120 °C



hard bake 130°C



hard bake 140 °C



hard bake 150 °C