ALLRESIST

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Product information

PHOTORESISTS AND SPECIAL RESISTS

THE ALLRESIST GMBH

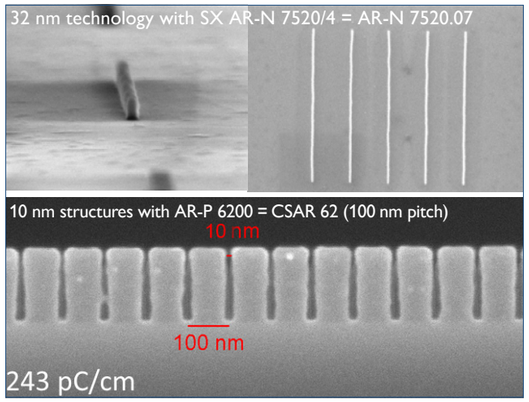
Company for chemical Products

The executive board Brigitte und Matthias Schirmer with daugther and successor Ulrike Schirmer

The company is represented worldwide with an extensive product range. In addition to our standard products, we also manufacture customer-specific products on request.

Allresist furthermore develops innovative products for future-oriented technologies like e.g. microsystems technologies and electron beam lithography. In these constantly growing markets, top-performance resists with high sensitivity and a high resolution are in strong demand.

Our newly developed e-beam resists CSAR 62 and Medusa 82 meet these demands, pushing forward innovative technologies with their excellent properties. With Electra 92 as top layer, e-beam resists can be processed also on insulating substrates like glass, quartz, or GaAs.



The Allresist GmbH offers a wide range of resists and process chemicals for all standard applications of photo and e-beam lithography which are required for the fabrication of electronic components.

As independent resist manufacturer, we develop, produce and distribute our products worldwide. On the market since 1992, Allresist benefits from a comprehensive know-how gained in 30 years of resist research, and fabricates products with highest quality (ISO 9001).

As chemical company, we are particularly aware of our obligation to a healthy environment. A responsible and protective resource management and voluntary replacement of environmentally hazardous products is living politics for us. Allresist is environmentally certified (ISO 14001) and environmental partner of the Federal State of Brandenburg.

Our flexible approach to customer's demands, together with effective production technologies, allows us to provide fast availability which results in very short delivery times, small packaging sizes from ¼ l onwards, 30 ml test samples as well as an individually tailored advisory service.

Allresist received a number of awards for scientific and economic top performance (technology transfer prize, innovation award, customer's champion, quality award and Ludwig-Erhard-prize).

Interesting news and further information for you are compiled on our web page where you will find answers to many questions in our resist-WIKI and the FAQ.

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OUR NEWS

for Microstructuring

Photoresists

2017 - 2020

Three further important new developments in principle allow new resist applications: very stable negative resist **Atlas 46** (AR-N 4600, comparable to SU-8), thermally structurable **Phoenix 81** (AR-P 8100, nanofrazor), and high-resolution **Medusa 82** (SX AR-N 8200, comparable to HSQ). Medusa 82 has higher storage stability than HSQ. The sensitivity can be increased by up to 20 times by a post exposure bake or an addition of acid generators. Currently under development is a variant that can also be processed with broadband UV.

The ready-to-use spray resists AR-P 1200, AR-N 2200 are used to evenly cover vertical trenches, for etched 54 ° slopes, and for spin coating.

2016

AR-PC 5090 and 5091 were specifically developed for the efficient dissipation of electrical charges during e-beam lithography on insulating substrates. The new, highly conductive protective coatings can be applied on PMMA, CSAR 62, and HSQ as well as on novolac-based e-beam resists and are removed easily and completely after the process. **Electra 92** can furthermore be used as a replacement for metal vapour deposition in SEM images.

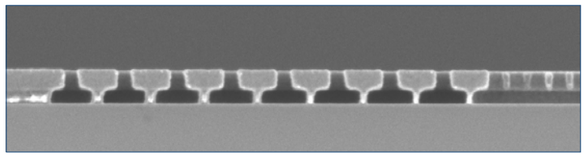
2014, 2015

Due to the classification of the raw material NEP which is contained in removers AR 300-70 and 300-72 as toxic for reproduction, Allresist now introduced the less harmful new remover **AR 300-76** with respect to dissolving power.

Additional eight PMMA solids complement the PMMA product portfolio which now comprises 43 solids contents.

2013

The new 5 µm-resist **AR 4400-05** completes the CAR series 44 and represents an efficient alternative to SU-8. The possible film thickness values now range from 2.5 µm to 100 µm.



Structures with extreme undercuts is possible: 22 nm structures with two-layer system AR-P 6200 / AR-P 679.03

The new remover **AR 600-71** is already at room temperature particularly efficient for the removal of e-beam- and photoresist films baked at higher temperatures.

The new electron beam resist **CSAR 62** is a further development of the well-known ZEP resists. This copolymer on the basis of methyl styrene-co-α-chloromethacrylate with addition of halogenated acid generators ensures a high sensitivity and excellent resolution, a steep contrast as well as excellent plasma etching stability.

With different developers, a resolution of up to 10 nm and sensitivities of about 10 µC/cm² can be realised. If used in a two-layer system with PMMA, the fabrication of smallest.

2012

With the new e-beam resist **AR-N 7520/4** (replacing resist AR-N 7520 new), Allresist introduces a high-resolution and at the same time sensitive new resist onto the market. In contrast to currently available e-beam resists, this resist is characterised by a 7-fold higher sensitivity. The dose to clear a 100-nm layer reduces the writing times at 30 KV to 35 µC/cm².

18 new anisole-PMMA resists AR-P 632…672 of types 50K, 200K, 600K and 950K complement the current anisole PMMA resist palette which also, just like the chlorobenzene PMMAs, meet the high demands of e-beam lithography.

2011

Other new products are polyimide resists which are temperature-stable up to 400 °C: protective coating **SX AR-PC 5000/80** and the positive resist **AR-P 5000/82**.

Currently still in development

We work with high pressure to develop a positive, highly sensitive CAR E-beam resist **EOS 72 (alternative to FEP 171).**

With **our new fluorescent and coloured resists,** new applications in microbiology and optics arise. Dyes or quantum dots illuminate the structures.

The bottom resists of the AR-BR 5400 series have been optimised for the technological requirements of some large customers. They are used as a lower layer in a two-layer system (photoresist on top), especially for lift-off applications.

Content and Product Overview Photoresists

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Product Portfolio Photoresist & Special Resist

Resist system	Product	Do/ µm 4000 rpm	Type	Characteristic Properties	Application	Resolution [µm]	Contrast	Exposure	Thinner	Developer	Remover
AR-P 1200	**1210,1220, 1230**	[0.5 - 10]	positive resist	spray resist, various applications	MEMS	1	3	i-line, g-line, BB-UV	-	300-44	600-71 300-76
AR-P 3100	**3110, 3120, 3170**	1,0 ; 0,6 ; 0,1		high resolution, adhesion-enhanced	masks, lattices	0.5 ; 0.4; 0.4	3.0		300-12	300-35 300-26	300-76 300-73
AR-P 3200	**3210, 3220, 3250**	10 ; 10; 5		thick resist with high dimen. accuracy up to 100 µm	electroplating, MST	4 ; 3 ; 1.2	2.0; 2.0; 2.5		300-12	300-26	300-76 600-71
AR-P 3500	**3510, 3540**	2.0 ; 1.4		wide process range, high resolution	ICs	0.8 ; 0.7	4.0; 4.5		300-12	300-35 300-26	300-76 600-71
AR-P 3500 T	**3510 T, 3540 T**	2.0 ; 1.4		wide process range, high res., developable in 0.26 n TMAH	ICs	0.6 ; 0.5	4.5 ; 5.0		300-12	300-44 300-26	300-76 600-71
AR-P 3700	**3740**	1.4		highest resolution, sub-µm, high contrast	VLSIC	0.4	6.0		300-12	300-47 300-26	300-76 600-71
AR-P 5300	**5320, 5350**	5.0 ; 1.0		undercut structures (single layer lift-off)	evaporation structures	2 ; 0.5	4 ; 5		300-12	300-26 300-35	300-76 600-71
SX AR-P 3500/6	**3500/6**	2.0		for holographic gratings (488 nm)		1	3		300-12	300-47	600-70 300-76
AR-N 2200	**2210, 2220, 2230**	[0.5 - 10]	negative resist	spray resist, various applications	MEMS	1	3		-	300-44	600-71 600-70
AR-N 4300	**4340**	1.4		highest sensitivity, high resolution, CAR	ICs	0.5	5	i-line, g-line	300-12	300-26 300-475	600-76 300-72
AR-N 4400	**4400-50, -25, -10, -05**	1.000 rpm: 50 ; 25 ; 10 ; 5		thick films up to 10-100 µm, easy removal	electroplating, MST, LIGA	5.0 ; 3.5; 2.0; 1.0	6; 5; 4; 4	e-beam, i-line	300-12	300-44 to -475	600-71 600-70
AR-N 4600 Atlas 46	**4600-10**	1.000 rpm: 10		extreme stable resist structures, thick thickness, adequate SU-8	electroplating, MST	2	4	-	300-12	300-12	300-12
AR-BR 5400	**5460, 5480**	1.0 ; 0.5	BR	bottom resist for 2L lift-off	lift-off (pos./neg.)	3 ; 1.5	lift-off	-	600-07	300-47	300-76 300-73
AR-PC 500(0)	**504, 5040**	2.2 ; 2.8	Protective Coating	protective coating, 40% KOH etch-stable	protective film	-	-	-	600-01	-	300-76 600-71
Blackprotect	**SX AR-PC 5000/41 new**	5.0		40% KOH- and 50% HF-resistant	electroplating, MST	1 L: - 2 L: 10	1 L: - 2 L: 1	1 L: - 2 L: i-line	300-74/1	300-26	300-74/1
AR-P 3500 Thermo	**SX AR-P 3500/8**	1,4	special resists: temperatur stable	temperature stable positive photoresist up to 300 °C	ICs, MST	1	3	i-line. g-line, BB-UV	300-12	300-47	300-76
AR-N 4300 Thermo	**SX AR-N 4340/7**	1.4		temperature stable negative resist up to 270 °C (1-/2L-system)	ICs MST	0.5	5	i-line, g-line	300-12	300-47	300-76 600-71
AR-N 4800 PMMA	**SX AR-N 4810/1**	0,3		temperature stable negative resist up to 280 °C	non water ICs	2	2	i-line	300-74/1	600-60	300-70 300-76
AR-PC 5000 **PI**	**SX AR-PC 5000/80.2**	0.4		protective coating for 2 L-patterning, temperature-stable up to 450 °C	sensors	1 L: - 2 L: 2	1 L: - 2 L: 1	1 L:- 2 L: i-line	300-12/3	-	600-70 300-76
	SX AR-PC 5000/82.7	0.8		polyimide structurable and temperature-stable up to 450 °C	sensors	1.5	2	i-line	300-12/3	300-26 300-47	300-76 300-72

All resist systems show optimal adhesion features with adhesion promoter AR 300-80 new which is applied prior to resist deposition.

General Product Information on Allresist Photoresists

This general part explains and completes our individual photoresist product information and provides a first overview as well as profound background knowledge. At www.allresist.de, you will find further information in our FAQ as well as our resist-WIKI and a detailed collection of product parameters.

Overview of composition, mode of action and specific properties of photoresists

Photoresists (photo coatings) are in particular used in microelectronics and microsystems technology for the fabrication of µm- and sub-µm-structures.

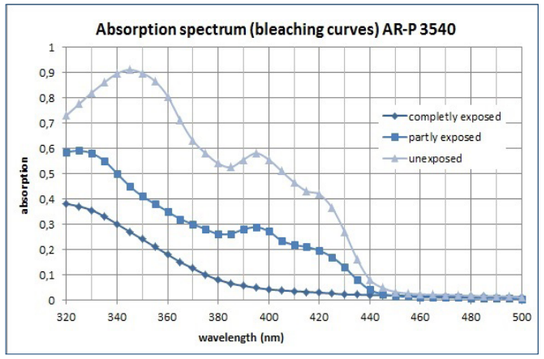
Resists are in most cases applied by spin coating. For thin resists, the optimum rotational speed ranges from 2000 to 4000 rpm, for thick resists between 250 and 2000 rpm. Generally utilizable is a spin speed of up to 9000 rpm to generate films of 30 nm to 200 µm depending on the respective type of resist used. Thicker films of up to 1 mm can be fabricated with casting procedures.

Alternative coating techniques are e.g. dip coating (for large and/or substrates with irregular surface geometry) and spray coating (for highly structured topologies, for complicated substrate shapes) or roller coating procedures.

Allresist offers a large variety of different types of resists which cover a wide range of possible applications:

Positive photoresists like e.g. AR-P 3100, 3200, 3500, 3700 are composed of a combination of film forming agents like e.g. cresol novolac resins and light-sensitive components such as e.g. naphthoquinone diazide, which are for example dissolved in solvents like methoxypropyl acetate (equivalent to PGMEA). The addition of the light-sensitive component to the alkali-soluble novolac results in a reduced alkaline solubility. After exposure to UV light (308 - 450 nm) using an exposure mask, the light-sensitive component is converted in exposed areas into the corresponding indene carboxylic acid derivative which then increases the alkaline solubility of positive resists by a factor of about 100. The refractive index of novolac-based resists is in a range of 1.60. After development, only areas protected by the mask remain while the exposed areas are dissolved. Photoresists provide an excellent protection against etch media with pH-values between 0 and 13.

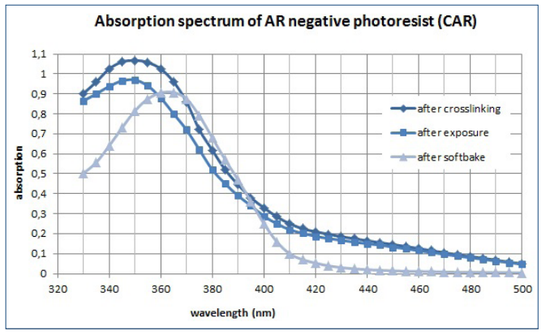
Image reversal resists are the resists of the AR-U 4000 series which are positive resists containing an additional amine. Depending on the respective manufacturing process, positive or negative images can be generated. Negative images are produced if an additional tempering step and a flood exposure of the entire surface is performed after image-wise exposure.



Negative photoresists like AR-N 4300, 4400 are composed of novolacs, acid generators and amine components (CAR) dissolved in solvents like e.g. methoxypropyl acetate (PGMEA).

After exposure and subsequent tempering step, the composition of CAR leads to a crosslinking of the exposed negative-tone resist film. Irradiated areas are consequently rendered insoluble and remain after development, while unexposed areas are still soluble and are dissolved by the developer.

Thick negative films up to 200 µm can be produced with CAR 44 (AR-N 4400). This resist which is highly sensitive in a range between 300 - 440 nm and provides excellent structural quality.



Resists for lift-off applications are the positive resist AR-P 5300 and the two-component resist system AR-BR 5400/AR-P 3510. Lift-off is also possible with negative resists AR-N 4300 and 4450 as well as with the image reversal resists AR-U 4000.

Protective coatings like AR-PC 500 and 5000 are offered by Allresist for a large variety of applications, e.g. for the backside protection of processed wafers during KOH and HF etchings, for a mechanical protection during transport, or as insulating layer. Protective coatings are not light-sensitive and cannot be patterned if used alone. They can however be patterned with photoresists within the context of a two-layer system.

Allresist also produces a wide range of special resists, e.g. electroplating-stable resists like SX AR-P 5900/4 for applications performed at a pH-value of 13.

For hydrofluoric acid etchings and BOE-processes (up to 5 % HF), the 5 µm-resist AR-P 5910 (formerly X AR-P 3100/10) offers considerably better adhesion properties than all other photoresists.

For a **patterning of glass/SiO2 substrates in concentrated HF**, the positive-tone two-component system SX AR-PC 5000/40 – AR-P 3540 T or the negative-tone two-component system SX AR-PC 5000/40 –AR-N 4400-10 is recommended. The upper photoresist layer is initially developed under aqueous-alkaline conditions before the lower SX AR-PC 5000/40 film is developed with solvents.

AR products are available both for the **deep UV range of 240 – 300 nm** (AR-N 4300) as well as for the **long-wavelength range up to 500 nm** (SX AR-P 3500/6).
Temperature-stable resists up to 400 °C are the polyimide resists SX AR-PC 5000/80 and SX AR-P 5000/82.

User-oriented photoresists

Allresist is able to consider specific customer's requests already in early stages of design and development of new photoresists, due to its high competence and flexibility. For industry customers, Allresist develops tailor-made resists or modifies standard resists according to the respective technology requirements.

Just ask us! Based on our innovative experience potential are we able to realise cost-efficient resist formulations also in small amounts within short time. More detailed investigations may then be conducted within the scope of R&D projects.

Stability and optimum storage conditions

Photoresists are light-sensitive, they react to light exposure or high temperatures and also during storage, age-related changes occur. Resists are therefore filled in light-protected amber bottles, stored in a cool place and can only be processed under yellow light (λ > 500 nm).

The shelf life of temperatures from the date of sale is guaranteed if the product is handled and stored as specified in the product information. Beyond that, products can be used without guarantee up to the date indicated on the label if stored according to the instructions.
Our recommended storage temperatures are listed in the product information under the respective product in the table "Properties".
Any use after the minimum shelf life is possible without guarantee until the date indicated on the label, but please check beforehand if this is sufficient for your specific technological needs. This additional information is our contribution to customer service and environmental protection.

Photoresists stored for several years are outdated and may only be used with considerable restrictions. This also applies to resists stored at too high temperatures and to highly diluted resists which age faster than normal. Possible consequences are the formation of particles which is caused by a precipitation of the light-sensitive component. Repeated fine filtrations is however only helpful at an early stage. The steadily declining concentration of the light-sensitive component will successively lead to lower development rates, increased dark erosion and reduced resist adhesion properties.

Wastewater treatment

Up to 90 % of the organic material can be removed from developer wastes if the pH of used aqueous alkaline developer and remover solutions is adjusted to pH 9 to 10 by addition of acids, followed by subsequent separation of the precipitate.

Prior to waste disposal, filtered solutions have to be adjusted to pH 6.5 – 8.0. Solid wastes may be disposed of at sanitary landfills or by incineration in officially authorized plants. Collected resist and solvent wastes have to be disposed of in approved incinerators.

Safety instructions

Resists, thinner and remover contain organic solvents. Adequate ventilation in the working area is thus mandatory.
Developer solutions are caustic alkaline liquids which may irritate the skin. Avoid direct contact with products and their vapours (wear safety goggles and gloves).

EG-safety data sheets of our products may be downloaded from www.allresist.de/products or be requested at info@allresist.de.

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Detailed Instructions for Optimum Processing of Photoresists

0. Adhesion – substrate pre-treatment

The adhesion between substrate and resist is of major importance for the safe processing of resists. Smallest changes of the cleaning procedure or the technology can exhibit a significant influence on the adhesive strength. Silicon, silicon nitride and base metals (aluminium, copper) are generally characterised by good resist adhesion properties, while adhesion is reduced on SiO_2, glass, noble metals such as gold and silver or on gallium arsenide. For these substrates, adhesion promoters are absolutely required to improve the adhesion strength. High air humidity (> 60 %) also reduces adhesion substantially.

If new clean substrates (wafers) are used, a bake at approximately 200 °C minutes (3 min, hot plate) is sufficient for drying, but substrates should be processed quickly thereafter. A temporary storage in a desiccator is highly recommended in order to prevent rehydration.

Pre-used wafers or wafers which are contaminated with organic agents require a previous cleaning in acetone, followed by isopropanol or ethanol treatment and subsequent drying if necessary. This procedure will improve adhesion of the resist. If only acetone is used for cleaning, the substrate must be dried in a drying oven to remove the condensed moisture.

If a technology involves repeated processing of wafers or subjecting these to various conditions, a thorough cleaning is recommended. The cleaning procedure is however highly process- and substrate-dependent (and depends also on the structures already deposited). The use of removers or acids (e.g. piranha) for removal, followed by rinsing and tempering, may be required. In very difficult cases, an ultra- or megasonic cleaning may be helpful.

To improve the adhesion features, adhesion-enhancing agents such as e.g. adhesion promoter AR 300-80 may be used which is applied immediately before resist coating in a very simple procedure by spin coating as thin layer of approx. 15 nm thickness and tempered. It is also possible to evaporate HMDS onto the substrates. The monomolecular layer on the wafer surface has an adhesion-promoting effect due to its hydrophobic properties which facilitate adsorption of the resist.

1. Coating

Substrates should be cooled down prior to coating, and resists have to be adjusted to the temperature of the (preferably air-conditioned) working area. If the resist is too cold, air moisture precipitates on the resist. Bottles removed from the refrigerator should therefore be warmed to room temperature for a few hours prior to opening.

Air bubbles can be avoided if resist bottles are slightly opened a few hours before coating to allow for pressure compensation and then left undisturbed. Thick resists require several hours for this process, thin resists need less time. Applying the resist with caution and not too fast with a pipette or dispenser will also prevent bubbles and inhomogeneities in the resist films.

A repeated opening of resist bottles causes evaporation of the solvent and an increased viscosity of the resist. For resist films with a thickness of 1.4 µm, a loss of only 1 % of the solvent already increases the film thickness by 4 %, thus requiring considerably higher exposure doses.

Generally used coating conditions are temperatures of 20 to 25 °C with a temperature constancy of ± 1 °C (optimum 21 °C) and a relative humidity of 30 to 50 % (optimum 43 %). Above a humidity of 70 %, coating is basically impossible. The air moisture also affects the film thickness which is reduced with increasing humidity. For AR-P 3510, the film thickness decreases by about 2 nm per each percent of humidity.

At spin speeds of > 1500 rpm, 30 s are sufficient to obtain the desired film thickness. At lower spin speeds, the time should be extended to 60 s. For an exposure of rectangular masks, usually a Gyrset (closed chuck) system is used, which provides a beter film quality and reduces edge bead formation. It has however to be taken into account that the film thickness decreases to approximately 70 % of the film thickness which is obtained with open chucks.

2. Tempering / Softbake

Resists films which have been previously coated still contain, depending on the film thickness, a substantial amount of residual solvent. A subsequent tempering at 90 – 100 °C is performed to dry and to harden the resist films. In addition to improved resist adhesion properties, also the dark erosion during development is reduced by these means.

The decision if a hot plate or a convection oven should be preferred depends for thin films (< 5 µm) on the availability, since technically none of the procedures offers a particular advantage. The fast through-put of a hot plate is compensated by the option for batch tempering (approx. 25 wafers in one step) in convection ovens. Drying thicker films in a convection oven is however unfavourable since the dried resist surface inhibits a fast solvent evaporation. In these cases, a hot plate is recommended because more solvent is expelled from the bottom of the resist film.

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Photoresists

Insufficiently tempered resist films (either too short or at too low temperatures) entail a variety of further problems. Air bubbles may develop successively which are due to an evaporation of residual solvent. Possible consequences are inaccurate structural images, a roundening of resist profiles as well as unacceptable high dark erosion during development.

If temperature-sensitive substrates are processed it is also possible to work at considerably lower softbake temperatures (< 60 °C). The development regime has to be adjusted accordingly.

If the hard bake of resist films was too rigid (temperature too high or tempered too long), a partial destruction of the light-sensitive component results which significantly increases exposure times and reduces the sensitivity.

After the softbake, substrates are cooled to room temperature prior to further use. Especially thick resists require an appropriate waiting time for rehydration before exposure.

3. Exposure

The exposure is performed through masks in suitable exposure systems such as e.g. steppers (i-, g-line), mask aligners or contact exposure systems in the respective spectral working range. Direct laser exposure without masks is also possible.

AR photo coatings are light-sensitive in the broad band UV range (300 - 450 nm) and thus also at the typical emission lines of mercury at 365 nm (i-line), 405 nm (h-line), and 436 nm (g-line) (→ Absorption spectra), with maximum sensitivity in the g- and h-line range. Values for recommended exposure dose as specified in our product information are only guideline values determined for our standard processes and have to be confirmed accordingly in own experiments.

Air bubbles may develop either during or after exposure and are e.g. caused by too high light doses or exposure intensities. This can be avoided if the optimum light dose is determined by exposure bracketing or in several consecutive exposure steps with intermediate pauses. A too short or too low tempering after coating results in insufficient drying of the resist film, since still too much solvent is present in the films which causes bubble formation due to outgassing.

The exposure dose which is required to develop a large area of positive resists without structures in a suitable development time is called “dose to clear”. This exposure dose should be increased slightly for patterning, depending on the desired resolution. The maximum resolution requires the highest exposure dose.

The dose to clear unexposed areas of negative resists is in a range of 30 - 40 s for films with a thickness of 1 - 2 µm. This exposure dose which produces a layer buildup of > 90 % should accordingly be increased by 10 - 20 % for patterning undil. poses. For thick films of more than 100 µm, development times of more than 1 hour may be required.

Coated and tempered resist films can be stored for several weeks prior to exposure without quality loss. Photoresists are however more sensitive directly after coating as compared to layers which were stored for several hours or days. The decrease in sensitivity is approximately 3 % after 3 h, 6 % after 72 h, and 8 % after 72 hours (in relation to the initial value) and remains then more or less constant for several weeks.

4. Development

During development, positive resist films are structured by dissolving exposed areas, while unexposed areas are removed if negative resists are developed. For reproducible results, temperatures between 21 and 23 °C with a temperature constancy of ± 0.5 °C should be maintained.

All offered developers (AR 300-35, AR 300-26, AR 300-40) are suitable both for immersion and puddle development, while developers AR 300-26 and 300-40 can additionally be used for spray development.

Optimally adapted developers and dilutions for each resist are specified in the product information. Entries like for example AR 300-26 1 : 2 indicate a dilution of 1 part of developer AR 300-26 with 2 parts of DI water.

The optimal development time is dependent on the respective resist type and film thickness as well as on the exposure wavelength, tempering and development procedure. Favourable development times for films of up to 2 µm are e.g. for immersion or puddle development in a range between 20 and 60 s and should not exceed 120 s.

Layers of up to 10 µm thickness require 2 to 10 min, while films with thickness values of up to 100 µm may need development times of more than 60 min. The more intensive spray developments require shorter times.

Developer concentrations as listed in our product information were determined for specific film thickness values or process parameters and can only serve as guideline values under other conditions. The exact developer concentration has always to be adjusted to specific demands (film thickness, development time, tempering).

Detailed Instructions for Optimum Processing of Photoresists

The parameters contrast and sensitivity are adjusted via the developer concentration by defined dilution of the developer with DI water.
Note: Metal ion-free developers are more sensitive to dilution differences than buffered systems. These developers should be diluted immediately prior to use and extremely thoroughly, if possible with scales, in order to assure reproducible results.

Higher developer concentrations formally result in an increased light sensitivity of positive resist developer systems. The required exposure energy is minimised and the development time is reduced, which allows for a high process throughput. Possible disadvantages are an increased dark erosion and (in some cases) a too low process stability (too fast). Negative resists require a higher exposure dose for crosslinking at higher developer concentrations.

Lower developer concentrations provide a higher contrast for positive resist films and reduce resist erosion in unexposed regions or only partly exposed interface areas even at longer development times. This particularly selective working method ensures a high detail rendition.

The effectiveness of the developing bath for immersion development is limited by factors such as process throughput and CO_2 absorption from air. The throughput depends on the fraction of exposed areas. CO_2 absorption is also caused by frequent opening of the developer bottle and leads to a reduced development rate. This effect is avoided by if the surface of the developer bath is kept under nitrogen.

5. Rinse

After development, substrates have to be rinsed immediately with deionised water until all residual developer is completely removed, and subsequently dried.

6. Postbake / hardbake

For specific process steps, a postbake at approximately 110 °C leads to a higher etch stability during wet-chemical and plasma-chemical etching procedures. Higher temperatures are possible for stronger etch conditions, may however result in a rounding of resist profiles.

Structures in very thick films (> 5 µm) may even converge. UV curing (short wave deep UV exposure with simultaneous heating of the wafer to up to 180 °C, if required) leads to strong hardening of resist structures. While the melting of structures is now prevented in most cases, a subsequent removal is extremely difficult.

7. Customer-specific technologies

Generation of semiconductor properties

The produced resist mask is utilised for technological processes according to the user's requirements. Semiconductor properties are generated in a user-specific manner, e.g. by boron or phosphorous doping, by etch processes or by formation of conductor paths. Thereafter, the resist is in most cases no longer needed and removed.

8. Removal

For the removal of softbaked resist films, polar solvents like e.g. the thinner AR 300-12 and Acetone are suitable.

For the wet chemical stripping of tempered resist films, the organic, highly versatile removers AR 300-70, AR 300-72 and AR 300-76 are available which may be heated to 80 °C to reduce the dissolution time. Due to a classification of the raw material NEP (Ar 300-70 and -72) as toxic for reproduction, Allresist strongly recommends to use the newly introduced, less harmful remover AR 300-76 which is equivalent with respect to its dissolving power.

Remover AR 300-73 which was designed for special resists may be heated to 50 °C, does however attack aluminium surfaces.

Remover AR 600-71 which is already highly efficient at room temperature is particularly suitable for customers who are able to use removers with low flash point.

In semiconductor industries, the removal (stripping) is mostly performed by ashing in a plasma asher. The O_2-plasma generated by microwave excitation is used for an isotropic etching of the photoresist. But also oxidising acid mixtures (piranha, nitrohydrochloric acid, nitric acid and others) may be applied in wet chemical removal procedures.

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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

Structure resolution

AR-N 2210
Film thickness 5 µm
Resolution up to 1.4 µm

Process parameters

Substrate	Si 6“ wafer
Tempering	82 °C, chuck
Exposure	broadband (h-, g-, i-line)
Development	AR 300-44, 4 min puddle

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 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.

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

Parameters spray coater “EVG® 150”

Spray coater EVG® 150, EV Group	Positive resist AR-P 1210	Negative resist AR-N 2210
Resist flow (drops/min)	25	25
Arm speed (mm/s)	200	200
N_2 pressure (kPa)	50	50
Exposure	EVG® 6200NT Automated Mask Alignment System	
Sensitivity (film thickness)	170 mJ/cm², 4,5 µm	50 mJ/cm², 4,5 µm
Development with AR 300-44	1:30 min	2 min
Minimum resolution (µm)	1.4	1.4

Process chemicals

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

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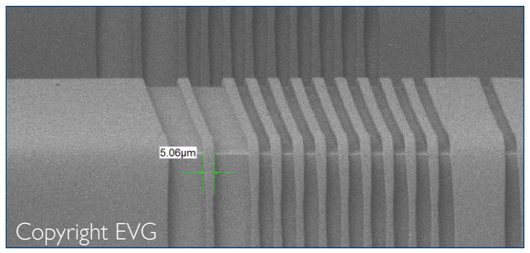
Positive / Negative Photoresists AR-P 1200 / AR-N 2200

Photoresists

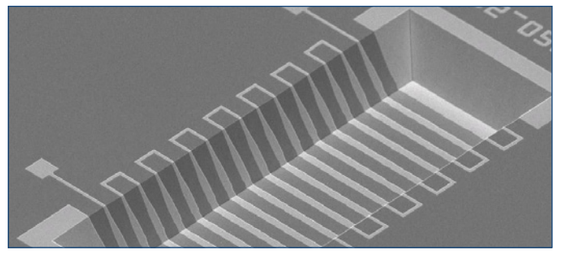
Process conditions

This diagram shows exemplary process steps for AR-P/N 1200/2200 resists with the EVG® 150. 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, EVG® 6200NT Automated Mask Aligner): AR-P 1210: 170 mJ/cm², 4,5 µm; AR-N 2210: 50 mJ/cm², 4,5 µm		
Cross-linking bake for AR-N 2210-2230	90 °C, 5 min hot plate or 85 °C, 25 min convection 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		



5 µm resist structures of AR-N 2220 in 150 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. The best experiences we have had with the devices of EV Group. 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.

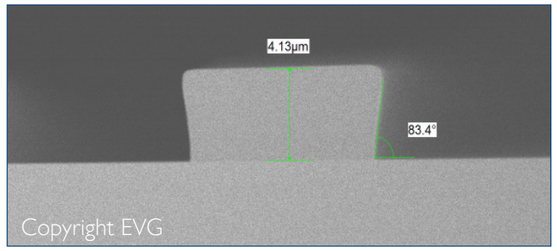
In comparison with AZ 4999, these resists have a lower tendency to form disturbing beads. Resists AR-P 1230 and AR-N 2230 are thus well suited for the generation of thin films with a thickness of 0.5 - 1 µm and can be used for spray coating as well as for spin coating applications. The thickness of films 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/cm^2. Negative-tone resists with approx. 70 mJ/cm^2 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.

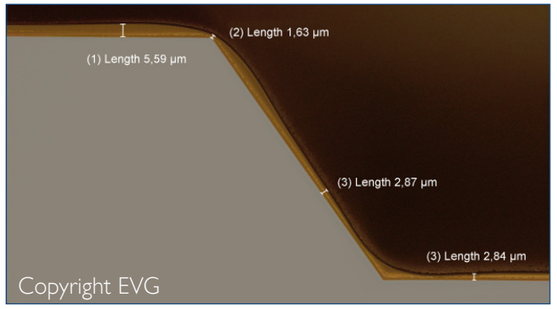
Thin films generated with AR-P 1230 and AR-N 2230 require lower exposure doses.

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.



Lift-off structures with AR-N 2220 after spray coating



Very good coverage of groove bottom and of upper edge

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Positive Photoresist AR-P 3100

AR-P 3100 photoresist product series for mask production

Adhesion-enhanced positive resists for the production of masks and fine scale divisions

Characterisation

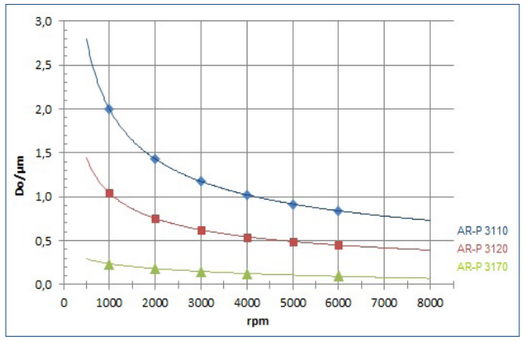
- broadband UV, i-line, g-line
- high photosensitivity, high resolution
- strong adhesion to critical glass/chromium surfaces for extreme stresses during wet-chemical etching processes
- for the production of CD masters and lattice structures
- 3170 also suitable for laser interference lithography
- plasma etching resistant
- combination of novolac and naphthoquinone diazide
- safer solvent PGMEA

Properties I

Parameter / AR-P	3110	3120	3170
Solids content (%)	28	21	8
Viscosity 25 °C (mPas)	12	5	2
Film thickness/ 4000 rpm (nm)	1000	550	120
Resolution (µm)	0.5	0.4	0.4
Contrast	3.0	3.0	3.0
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.

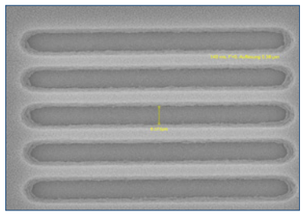
Spin curve



Properties II

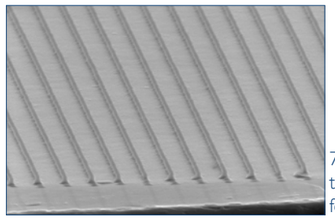
Glass transition temperature	108	
Dielectric constant	3.1	
Cauchy coefficients	N_0	1.621
	N_1	65.6
	N_2	195.6
Plasma etching rates (nm/min) (5 Pa, 240-250 V bias)	Ar-sputtering	7
	O_2	165
	CF_4	38
	80 CF_4 + 16 O_2	89

Structure resolution



AR-P 3120
Film thickness 0.6 µm
Resist structures 0.38 µm L/S

Resist structures



70-nm-lines generated with the AR-P 3170 by laser interference lithography

Process parameters

Substrate	Si 4“ wafer
Tempering	95 °C, 90 s, hot plate
Exposure	i-line stepper (NA: 0.65)
Development	AR 300-47, 1:1, 60 s, 22 °C

Process chemicals

Adhesion promoter	AR 300-80
Developer	AR 300-26, AR 300-47
Thinner	AR 300-12
Remover	AR 300-76, AR 300-73

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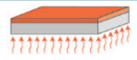
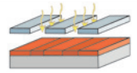
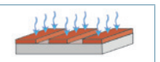
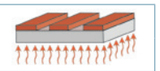
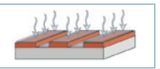
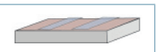
Positive Photoresist AR-P 3100

Photoresists

Process conditions

This diagram shows exemplary process steps for AR-P 3100 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”.

	AR-P 3110	AR-P 3120	AR-P 3170
Coating 	4000 rpm, 60 s 1000 nm	4000 rpm, 60 s 550 nm	4000 rpm, 60 s 120 nm
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):		
	70 mJ/cm²	65 mJ/cm²	60 mJ/cm²
Development (21-23 °C ± 0,5 °C) puddle 	AR 300-26 2 : 5 60 s	AR 300-47, 5 : 1 60 s	AR 300-47, 3 : 1 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 e.g. semi-conductor properties		
Removal 	AR 300-70 or O_2 plasma ashing		

Development recommendations

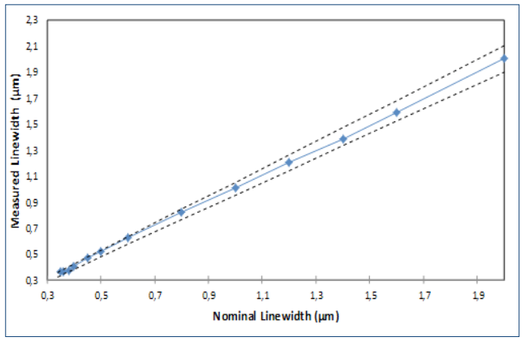
Resist / Developer	AR 300-26	AR 300-35	AR 300-47
AR-P 3110	1 : 2 to 1 : 3	pure	6 : 1
AR-P 3120	1 : 3	5 : 1	5 : 1
AR-P 3170	1 : 4	2 : 1	3 : 1

Photoresists

As of October 2019

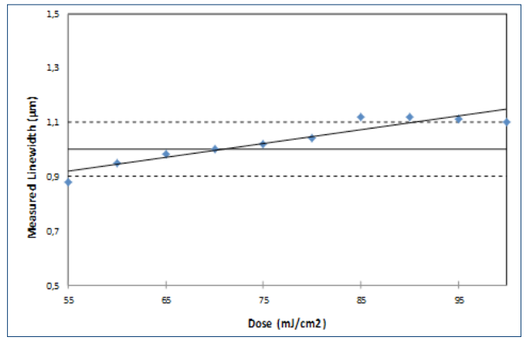
Positive Photoresist AR-P 3100

Linearity



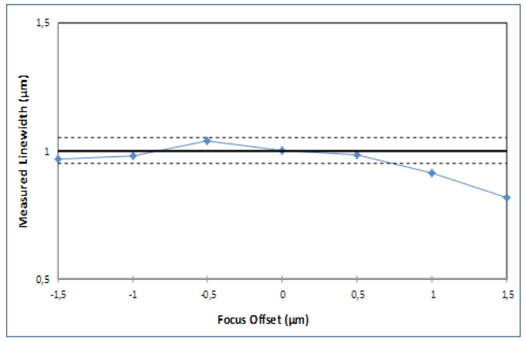
Up to a structure width of 0.38, a very good agreement is obtained. REM measurement: Thickness 560 nm, i-line stepper (NA: 0.65 NA), Developer AR 300-47 1 : 1.

Optimum exposure dose



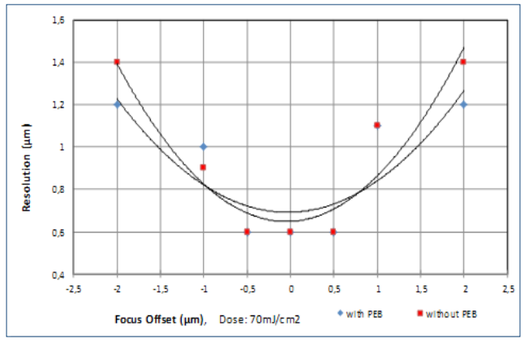
Underexposure leads in the case of complete development (more than 55 ml/cm²) to narrower trenches, while overexposure results in a widening of trenches.

Focus variation



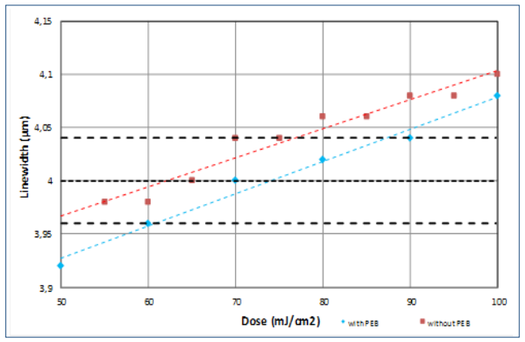
The intended structure sizes can here be realised by varying the focus between -1.5 to 0.8 (parameter see grafic linearity).

Focus variation (with and without PEB)



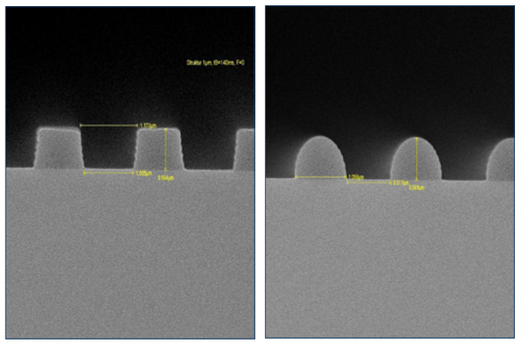
Without PEB, a higher resolution is obtained since the focus curve is steeper (PEB, 90 °C, 60 s).

Optimum exposure dose



Optimum dose, with hard bake (110 °C) and without hard bake. The additional hard bake requires 15 % more light (PEB, 90 °C, 60 s).

Thermal properties of resist structures



Untempered

Hard bake 115 °C

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Positive Photoresist AR-P 3200

AR-P 3200 photoresist series for high film thicknesses

Thick positive resists for electroplating and microsystems technology

Characterisation

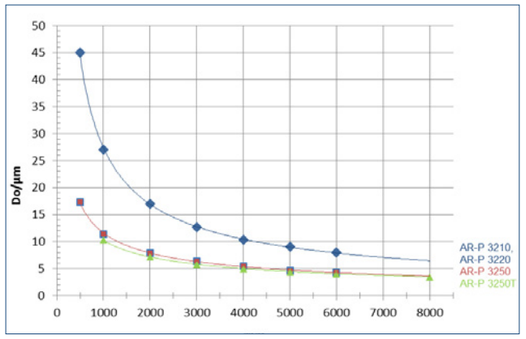
- broadband UV, i-line, g-line
- high photosensitivity, high resolution
- profiles with high edge steepness dimens. accuracy
- plasma etch resistant, electroplating-stable
- 3210/3250 for film thicknesses up to 40 µm/20 µm
- 3220 transparent for thick films up to 100 µm in multiple coating steps, 100 µm development in one step
- combination of novolac and naphthoquinone diazide
- safer solvent PGMEA

Properties I

Parameter / AR-P	3210	3220	3250(T)
Solids content (%)	47	47	39
Viscosity 25 °C (mPas)	1990	1820	250
Film thickness/ 4000 rpm (µm)	10	10	5
Resolution (µm)	4.0	3.0	1.2
Contrast	2.0	2.0	2.5
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.

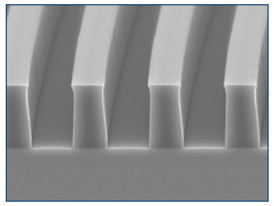
Spin curve



Properties II

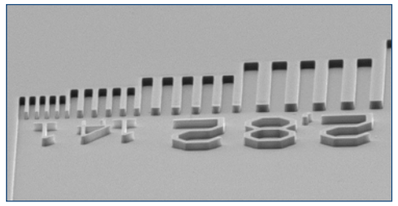
Glass transition temperature	108	
Dielectric constant	3.1	
Cauchy coefficients AR-P 3210	N_0	1.597
	N_1	79.5
	N_2	105.1
Plasma etching rates (nm/min) (5 Pa, 240-250 V bias)	Ar-sputtering	7
	O_2	170
	CF_4	39
	80 CF_4 + 16 O_2	90

Structure resolution



AR-P 3210
Film thickness 12 µm
Resist structures 4 µm

Resist structures



AR-P 3220
Film thickness 25 µm

Process parameters

Substrate	Si 4“ wafer
Tempering	95 °C, 10-15 min, hot plate
Exposure	Maskaligner MJB 3, contact exposure
Development	AR 300-26, 1 : 3, 3 min, 22 °C

Process chemicals

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

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Positive Photoresist AR-P 3200

Photoresists

Process conditions

This diagram shows exemplary process steps for AR-P 3200 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”.

	AR-P 3210	AR-P 3220	AR-P 3250	AR-P 3250T
Coating	4000 rpm, 90 s 10 µm	600 rpm, 120 s; 30 µm	4000 rpm, 60 s; 5.0 µm	4000 rpm, 60 s; 5.0 µm
Tempering (± 1 °C) H*	95 °C, 4 min	95 °C, 15 min	95 °C, 2 min	95 °C, 2 min
Tempering (± 1 °C) C*	90 °C, 40 min	90 °C, 90 min	90 °C, 30 min	90 °C, 30 min
UV exposure	Broadband UV, 365 nm, 405 nm, 436 nm			
	Exposure dose (E_0, broadband UV stepper):			
	450 mJ/cm²	900 mJ/cm²	220 mJ/cm²	300 mJ/cm²
Development (21-23 °C ± 0,5 °C) puddle	AR 300-26, 1 : 2 2 min	AR 300-26, 1 : 1; 3 min	AR 300-26, 3 : 2; 2 min	AR 300-44, pur; 2 min
Rinse	DI-H_2O, 30 s			
Post-bake (optional)	Not required			
Customer-specific technologies	Generation of e.g. semi-conductor properties, galvanic, MEMS			
Removal	AR 300-76 or O_2 plasma ashing			

H* = hot plate or C* = convection oven

Processing instructions (for the processing of thick films > 40 µm)

Coating: Coating should be performed in two or several steps using the same procedure. After a low initial spin speed (30 s), a main spin speed of 250 – 500 rpm for at least 2-5 min should be chosen. A brief subsequent spinning off at 600 – 800 rpm for 5 s reduces edge bead formation.

Tempering: Tempering should be performed in 2 steps: 1. 75 °C, 5 min hot plate or 70 °C, 30 min convection oven; 2. 90 °C, 20 min hot plate or 90 °C, 80 min convection oven. After tempering, a slow cooling is recommended to avoid stress cracks.

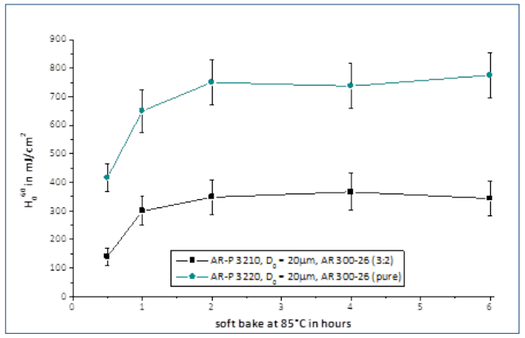
Development recommendations

Resist / Developer	AR 300-26	AR 300-35	AR 300-44
AR-P 3210 (up to 20 µm)	1 : 2 to 1 : 3 (2-10 min)	undil. up to 10 µm (2-10 min)	-
AR-P 3220 (up to 20 µm)	1 : 1 (2-5 min)	-	-
AR-P 3250 (up to 10 µm)	2 : 1 to 3 : 2 (1-5 min)	-	-
AR-P 3250T (up to 5 µm)	-	-	undil. up to 5 µm (1-5 min)

Photoresists

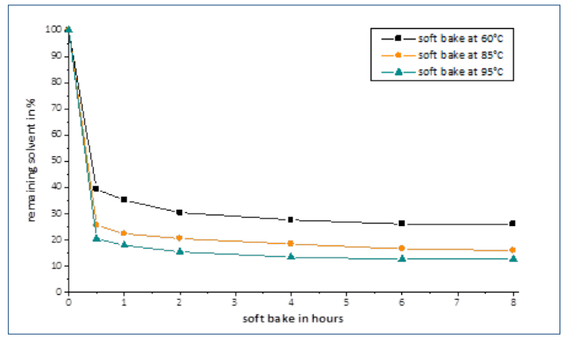
Positive Photoresist AR-P 3200

Sensitivity vs. duration of the soft bake



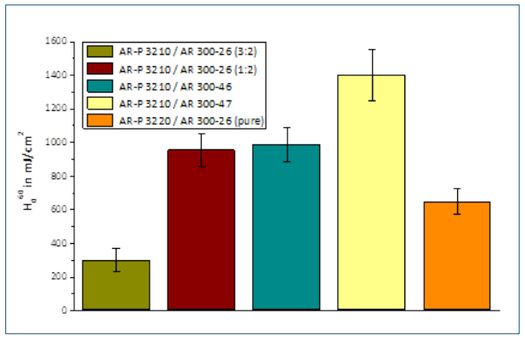
After 2 hours, the sensitivity remains more or less constant (broadband UV, resist thickness 20 µm).

Residual solvent after tempering



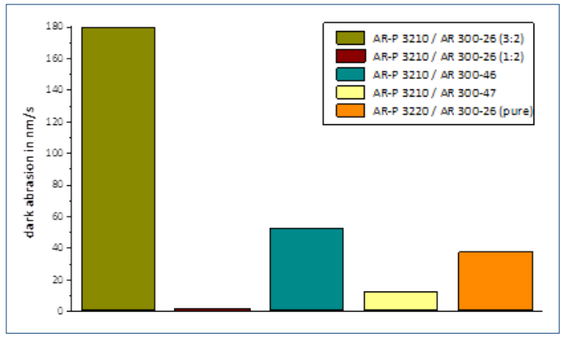
After a bake at 95 °C, approx. 7 % of the solvent remain in the layer (initial solids content: 47 %)

Sensitivity in different developers



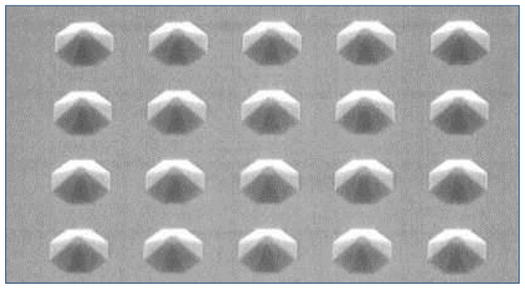
Film thickness 20 µm, soft bake 85 °C, 1 h convection oven, bb UV

Dark erosion in different developers



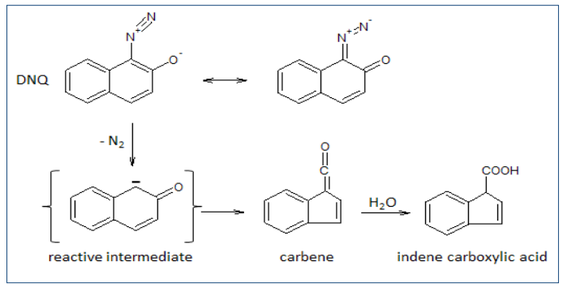
Erosion corresponding to determined sensitivities

Grey tone mask lithography



28 µm-high 3D pyramids with AR-P 3220

Photolysis of photo-active compound (PAC)



Chemical reaction for bleaching and full exposure of the layer (Süss-reaction)

The transparency of AR-P 3220 is higher as compared to AR-P 3210, due to the lower concentration of the PAC. The gradation is accordingly relatively low. This fact can be used for the fabrication of three-dimensional structures using grey tone masks with AR-3220. Different exposure doses will result in different resist film thicknesses.

ALLRESIST
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Positive Photoresists AR-P 3500 / 3500 T

AR-P 3500 (T) photoresist series with wide process range

Sensitive positive-tone standard resists for the production of integrated circuits

Characterisation

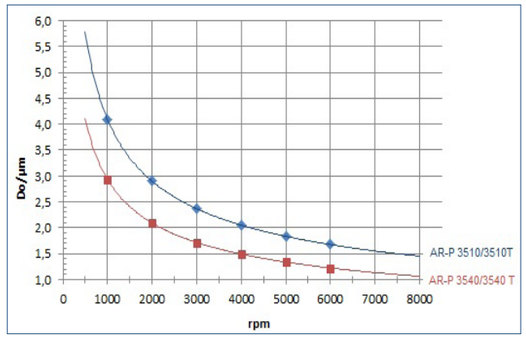
- broadband UV, i-line, g-line
- high photosensitivity, high resolution
- very good adhesion properties
- 3500 T: robust processing, suitable for TMAH developer 0.26 n
- plasma etching resistant, temperature-stable up to 120 °C
- combination of novolac and naphthoquinone diazide
- safer solvent PGMEA

Properties I

Parameter / AR-P	3510 / 3510 T	3540 / 3540 T
Solids content (%)	35 / 32	31 / 28
Viscosity 25 °C (mPas)	33 / 38	18 / 21
Film thickness / 4000 rpm (µm)	2.0	1.4
Resolution (µm)	0.8 / 0.6	0.7 / 0.5
Contrast	4.0 / 4.5	4.5 / 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.

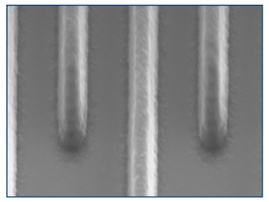
Spin curve



Properties II

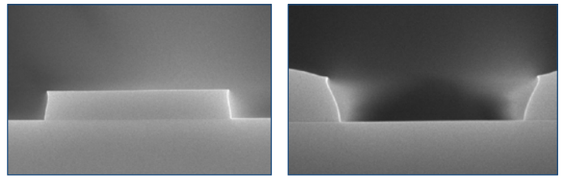
Glass transition temperature	108	
Dielectric constant	3.1	
Cauchy coefficients AR-P 3540 T	N_0	1.627
	N_1	71.4
	N_2	164.8
Plasma etching rates (nm/min) (5 Pa, 240-250 V bias)	Ar-sputtering	7
	O_2	165
	CF_4	37
	80 CF_4 + 16 O_2	88

Structure resolution



AR-P 3540 T
Film thickness 1.5 µm
Resist structures 0.5 µm

Temperature stability



Structures without hard bake and with tempering at 140 °C (hot plate, 1 mm) with AR-P 3540

Process parameters

Substrate	Si 4“ wafer
Tempering	95 °C, 90 s, hot plate
Exposure	g-line stepper (NA: 0.56)
Development	AR 300-44, 60 s, 22 °C

Process chemicals

Adhesion promoter	AR 300-80
Developer	AR 300-26, T: AR 300-44
Thinner	AR 300-12
Remover	AR 300-76, T: AR 300-76

ALLRESIST
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Positive Photoresists AR-P 3500 / 3500 T

Photoresists

Process conditions

This diagram shows exemplary process steps for AR-P 3500 (T) 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”.

	AR-P 3510	AR-P 3540 T
Coating	4000 rpm, 60 s, 2.0 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	120 mJ/cm²
Development (21-23 °C ± 0,5 °C) puddle	AR 300-26, 1 : 5 60 s	AR 300-44 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 or lift-off	
Removal	AR 300-70 or O_2 plasma ashing	

Development recommendations

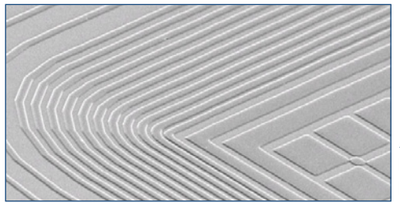
Resist / Developer	AR 300-26	AR 300-35	AR 300-40
AR-P 3510, 3540	1 : 5	1 : 1	300-47, 1 : 1
AR-P 3510 T, 3540 T	1 : 2	undil.	300-44

Focus width AR-P 3540 T g-line stepper

Ridge	DOF @ 230 mJ	Dose range
1.5 µm	> 2.0 µm	110-260 mJ/cm²
1.0 µm	> 1.5 µm	130-260 mJ/cm²
0.7 µm	> 1.25 µm	160-250 mJ/cm²
0.5 µm	> 1.0 µm	190-240 mJ/cm²

Best edge steepness: 180-200 mJ/cm²

Resist structures

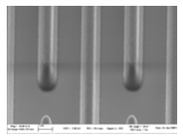
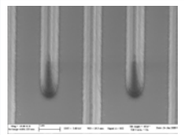
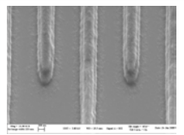
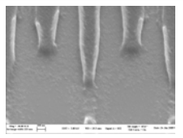
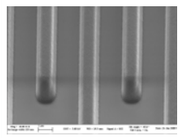
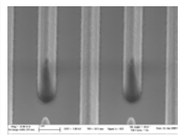
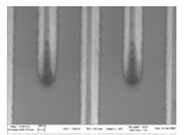
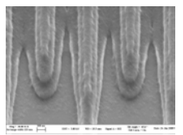
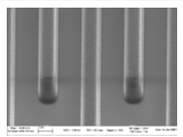
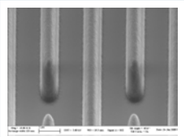
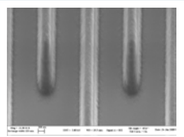
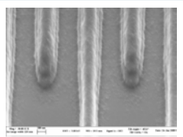
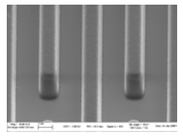
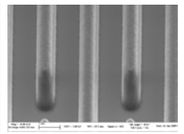
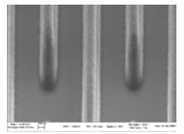
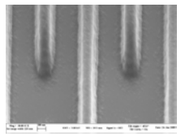
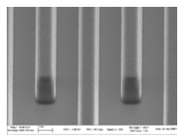
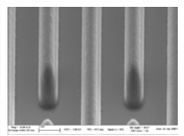
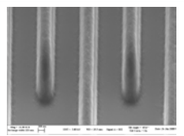
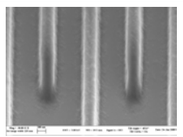
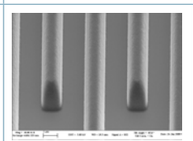
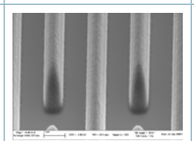
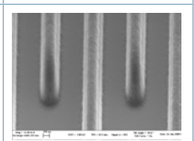
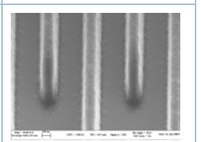
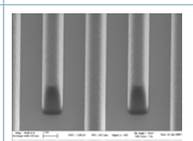
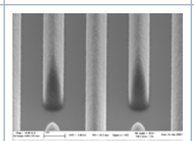
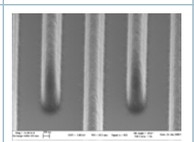
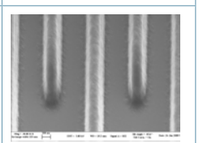
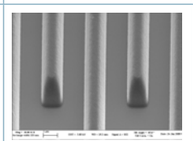
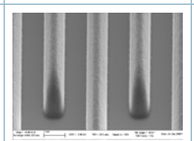
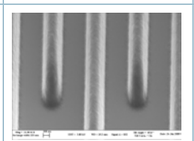
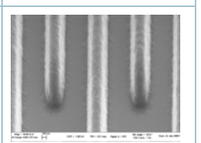


AR-P 3500
Film thickness 2 µm
Resist structures 5 µm

Positive Photoresists AR-P 3540 T

Focus width

Film thickness 1.5 µm on Si-wafer, dose: 230 mJ/cm2

Focus	1.5 µm L/S	1.0 µm L/S	0.7 µm L/S	0.5 µm L/S
- 1.0				
- 0.75				
- 0.5				
- 0.25				
0.0				
+ 0.25				
+ 0.5				
+ 0.75				

Tempering: 95 °C, 90 s, hot plate (contact), exposure: g-line stepper (NA: 0.56; 0.75 s).
Development: AR 300-44, 60 s, 22 °C, puddle

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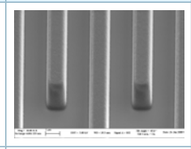
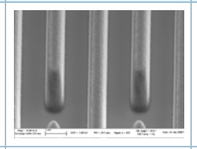
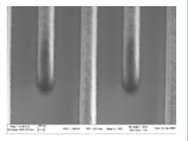
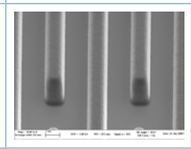
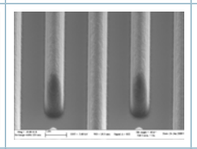
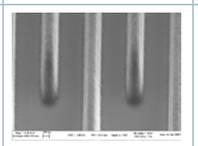
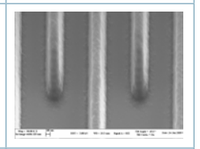
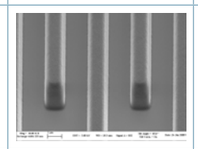
Positive Photoresists AR-P 3540 T

Photoresists

Linearity

Film thickness 1.5 µm on Si-wafer, focus: 0.0

Dose	1.5 µm L/S	1.0 µm L/S	0.7 µm L/S	0.5 µm L/S
160 mJ				
190 mJ				
210 mJ				
230 mJ				

Dark field erosion

Film thickness 1.5 µm on Si-wafer, focus: 0.0

Dose	1.5 µm L/S	1.0 µm L/S	0.7 µm L/S	0.5 µm L/S
190 mJ				
210 mJ				
230 mJ				

Tempering: 95 °C, 90 s, hot plate (contact), exposure: g-line stepper (NA: 0.56; 0.75 s).
Development: AR 300-44, 60 s, 22 °C, puddle

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

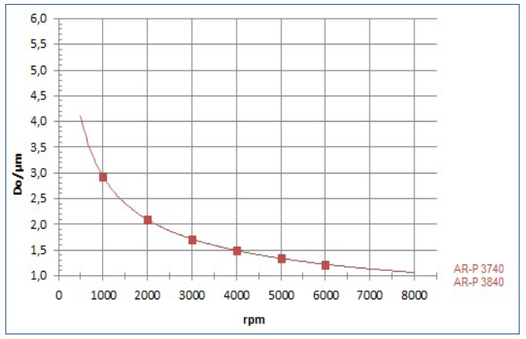
- broadband UV, i-line, g-line
- high sensitivity, highest resolution up to 0.4 µm
- high contrast, excellent dimensional accuracy
- optimised coating properties on topologically complex substrate surfaces
- plasma etching resistant, stable up to 120 °C
- combination of novolac and naphthoquinone diazide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

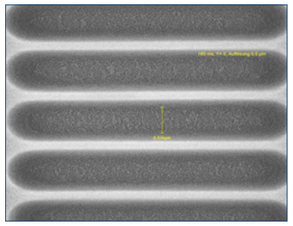
Spin curve



Properties II

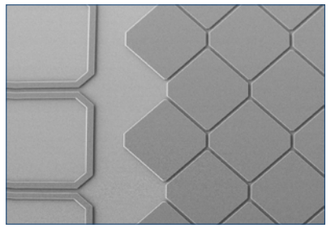
Glass transition temperature	108	
Dielectric constant	3.1	
Cauchy coefficients AR-P 3740	N_0	1.623
	N_1	81.8
	N_2	160.4
Plasma etching rates (nm/min) (5 Pa, 240-250 V bias)	Ar-sputtering	8
	O_2	164
	CF_4	38
	80 CF_4 + 16 O_2	88

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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Positive Photoresist AR-P 3700

Photoresists

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	

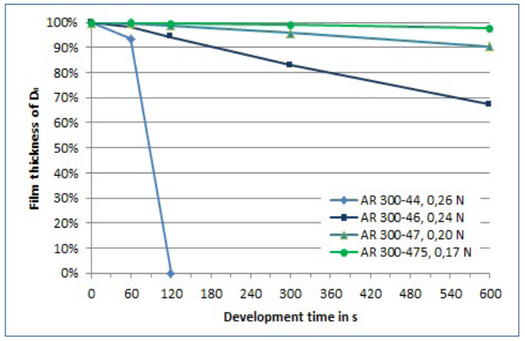
Development recommendations

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

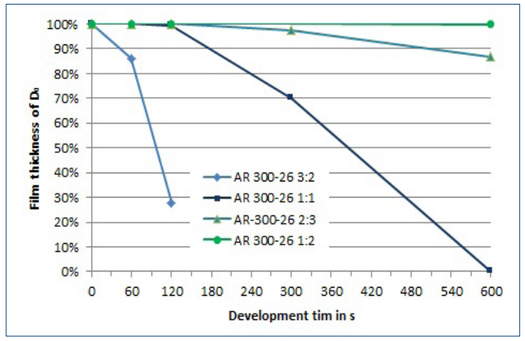
As of January 2021

Positive Photoresist AR-P 3700

Dark erosion

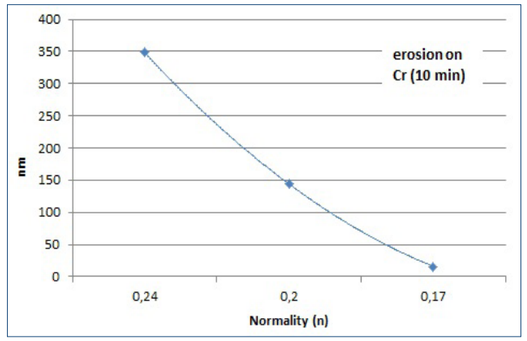


AR-P 3740 may be developed with any of the four TMAH developers. A high sensitivity is associated with high erosion rates. No dark erosion is obtained if weaker developers are chosen (see diagram Influence of developer strength)



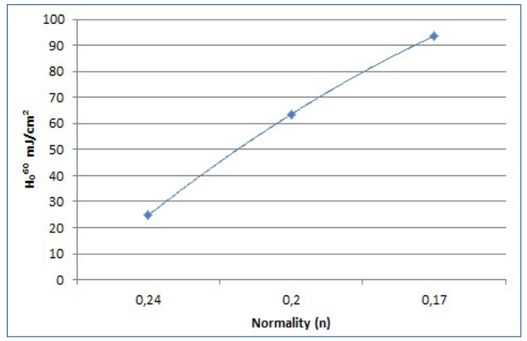
Using a dilution series of AR 300-26, the desired development properties can be adjusted accordingly. A dilution of 3:2 (3 parts AR 300-26, 2 parts DI water) is not recommended, due to the high erosion rate. More suitable in this case is a dilution of 1:1 to 2:1.

Influence of developer strength of the dark erosion



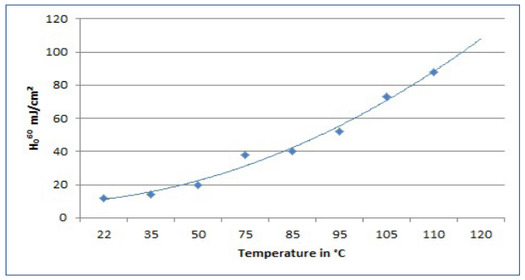
Using coated Cr-substrates (thickness 1.5 µm), 15 – 350 nm are removed within 10 min depending on the respective developer strength. The highest erosion is obtained with the strong developer AR 300-46 (0.24 n).

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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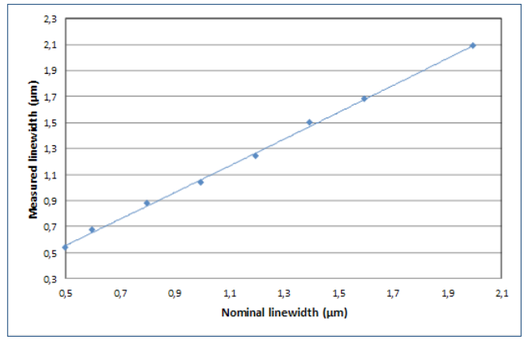
Positive Photoresist AR-P 3700

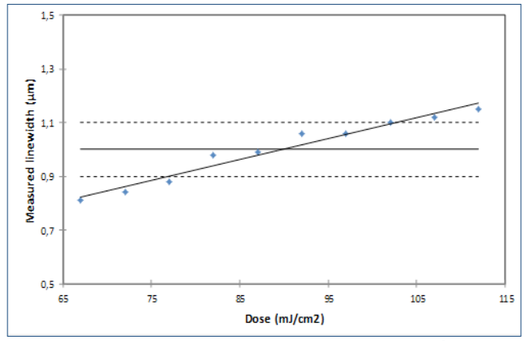
Photoresists

Linearity



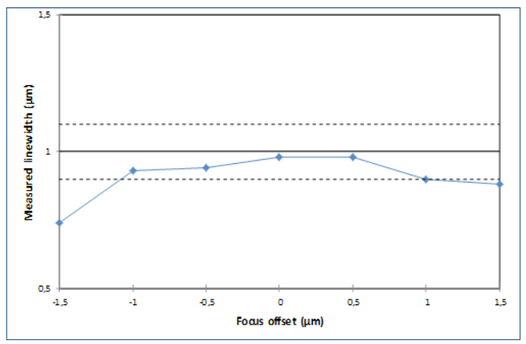
Up to a structure width of 0.5, a very good agreement is obtained.

Optimum exposure dose



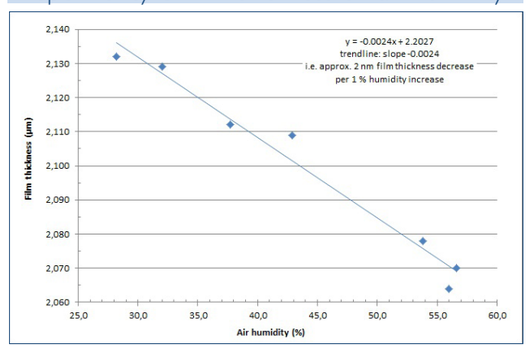
The optimum exposure dose for 1 µm lines is 88 mJ/cm².

Focus variation



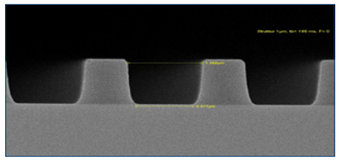
The intended structure sizes can be realised by varying the focus between -1.0 to 1.0.

Dependency of film thickness on air humidity

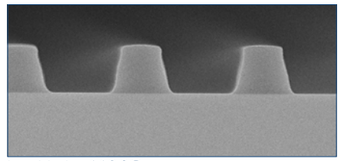


With increasing humidity, the resulting film thickness during coating of the resist decreases.

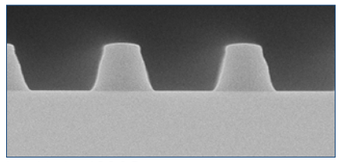
Thermal behaviour of resist structures



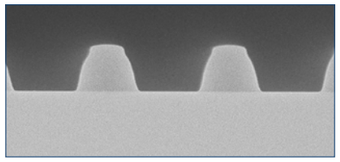
without hardbake



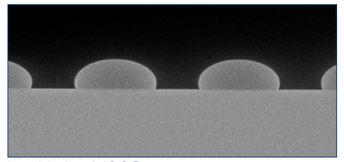
hard bake 110 °C



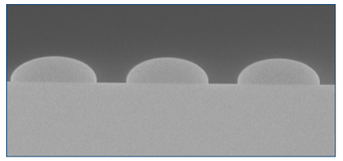
hard bake 120 °C



hard bake 130°C



hard bake 140 °C



hard bake 150 °C

Photoresists

As of January 2021

Positive Photoresist for Lift-off AR-P 5300

AR-P 5300 photoresist series for lift-off applications

Sensitive positive-tone resists for the production of evaporation samples

Characterisation

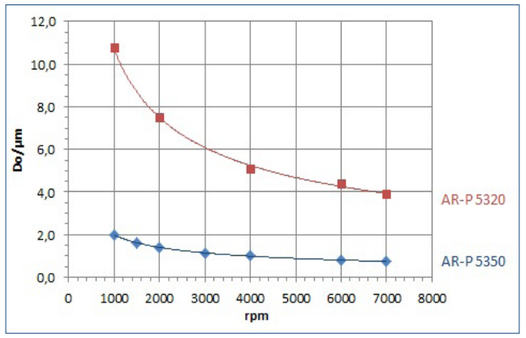
- broadband UV, i-line, g-line
- high photosensitivity, high resolution
- good adhesion properties
- for undercut structures for the production of evaporation samples, in particular of metal using lift-off techniques e.g. for conductor paths
- plasma etching resistant, temperature stable up to 120 °C
- combination of novolac and naphthoquinone diazide
- safer solvent PGMEA

Properties I

Parameter / AR-P	5320	5350
Solids content (%)	39	28
Viscosity 25 °C (mPas)	250	13
Film thickness/ 4000 rpm (µm)	5.0	1.0
Resolution (µm)	2.0	0.5
Contrast	4.0	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.

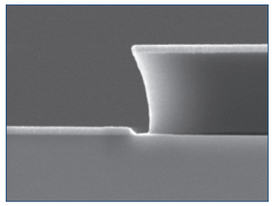
Spin curve



Properties II

Glass transition temperature	108	
Dielectric constant	3.1	
Cauchy coefficients	N_0	1.623
	N_1	166.8
	N_2	10
Plasma etching rates (nm/min) (5 Pa, 240-250 V bias)	Ar-sputtering	7
	O_2	161
	CF_4	39
	80 CF_4 + 16 O_2	90

Lift-off resist structures



AR-P 5350

Lift-off resist structure after metal evaporation

Resist structures

AR-P 5320

Lift-off resist structure after development

Process parameters

Substrate	Si 4“ wafer
Tempering	105 °C, 4 min, hot plate
Exposure	g-line stepper (NA: 0.56)
Development	AR 300-35, 1 : 2, 60 s, 22 °C

Process chemicals

Adhesion promoter	AR 300-80
Developer	AR 300-26, 300-35
Thinner	AR 300-12
Remover	AR 300-76, AR 600-71

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Positive Photoresist for Lift-off AR-P 5300

Photoresists

Process conditions

This diagram shows exemplary process steps for AR-P 5300 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”.

	AR-P 5320	AR-P 5350
Coating	6000 rpm, 60 s 4.0 µm	4000 rpm, 60 s 1.0 µm
Tempering (± 1 °C)	105 °C, 4 min hot plate or 100 °C, 40 min convection oven	
UV exposure	Broadband UV, 365 nm, 405 nm, 436 nm Exposure dose (E_0, broadband UV stepper):	
	58 mJ/cm²	55 mJ/cm²
Development (21-23 °C ± 0,5 °C) puddle	AR 300-26, 3 : 2 2 min	AR 300-35, 1 : 2 60 s
Rinse	DI-H_2O, 30 s	
Post-bake (optional)	Not required	
Customer-specific technologies	Generation of e.g. semiconductor properties or lift-off	
Removal	AR 300-76 or O_2 plasma ashing	

Processing instructions

Tempering: Higher tempering temperatures are required to produce the undercut.

Development: The undercut of resist structures is generated during aqueous-alkaline development.

Development recommendations

Resist / Developer	AR 300-26	AR 300-35	AR 300-40
AR-P 5320	2 : 1 to 3 : 2 (1-3 min)	-	-
AR-P 5350	1 : 7	1 : 2	300-47, 2 : 3

Positive Photoresist for Holography SX AR-P 3500/6

Positive photoresist, also for long-wave exposure

Experimental sample/custom-made product

Characterisation

- broadband, i-line, g-line
- sensitive up to a wavelength of 500 nm
- suitable for the production of holographic structures
- processing in BB-UV possible, like AR-P 3510
- plasma etching stable, thermally stable up to 120 °C
- combination of novolac and naphthoquinone diazide
- safer solvent PGMEA

Properties I

Parameter / SX AR-P	3500/6
Solids content (%)	36
Viscosity 25 °C (mPas)	29
Film thickness/4000 rpm (µm)	2.0
Resolution (µm)	0.8
Contrast	3.0
Flash point (°C)	42
Storage temperature (°C)*	10 - 18

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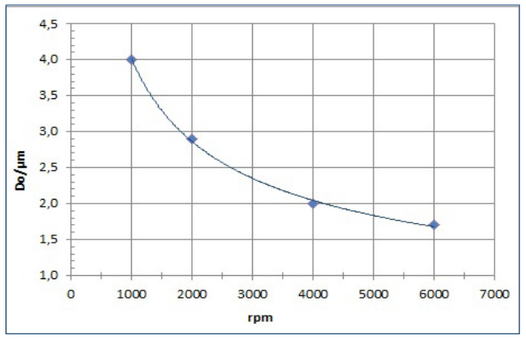
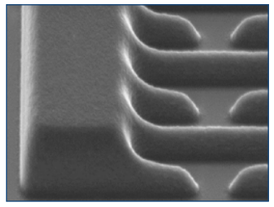
Spin curve



Properties II

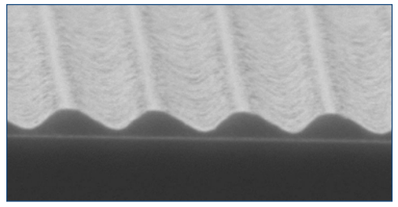
Glass transition temperature (°C)	108	
Dielectric constant	3.1	
Cauchy coefficients	N_0	1.625
	N_1	77.0
	N_2	160.5
Plasma etching rates (nm/min) (5 Pa. 240-250 V Bias)	Ar-sputtering	8
	O_2	163
	CF_4	37
	80 CF_4 + 16 O_2	87

Structure resolution



7 µm Gräben mit dem SX AR-P 3500/8

Resist structures



10 µm Steg des SX AR-P 3500/8 nach einem Hard-Bake von 280 °C

Process parameters

Substrate	Si 4“ wafer
Tempering	95 °C, 2 min, hot plate
Exposure	Laser 488 nm
Development	AR 300-26. 2 : 1, 1 min. 22 °C

Process chemicals

Adhesion promoter	AR 300-80 new
Developer	AR 300-26
Thinner	AR 300-12
Remover	AR 300-76, AR 600-70

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Positive Photoresist for Holography SX AR-P 3500/6

Photoresists

Process conditions

This diagram shows exemplary process steps for resist SX AR-P 3500/6. 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 with SX AR-P 3500/6	4000 rpm, 60 s 2.0 µm
Tempering (± 1 °C)	100 °C, 2 min, hot plate 95 °C, 30 min, convection oven
UV exposure	Broadband UV: bis 490 nm Exposure dose (E_0, BB-UV stepper): 488 nm Laser 40 mJ/cm²: 2 J/cm²
Development (21-23 °C ± 0.5 °C) puddle	AR 300-26, 1 : 1 60 s
Rinse	DI-H_2O, 30 s
Customer-specific technologies	Generation of e.g. semi-conductor properties
Removal	AR 300-76 or O_2 plasma ashing

Supplementary information

For the production of holographic reliefs or structures, exposure wavelengths up to 500 nm and in particular the 488 nm laser wavelength may be used. Sensitivity is in this case however low, as compared to i- or g-line exposure. The resist may also be used without restrictions in the BB-UV.

This resist formulation is currently successfully processed by our customers, may however also be modified according to new customer’s requirements.

Development recommendations

Resist / Developer	AR 300-26
SX AR-P 3500/6	undiluted up to 1 : 1

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

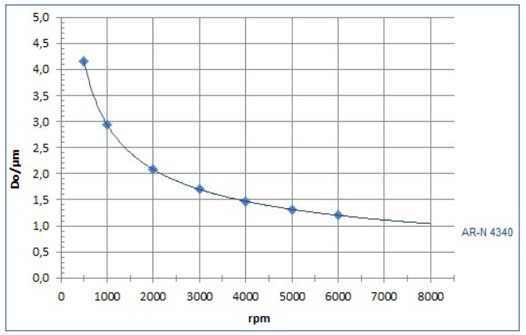
- i-line, g-line
- highest sensitivity, excellent resolution
- good adhesion, high contrast, chemically enhanced
- undercut profiles (lift-off) are possible
- plasma etching resistant, temperature-stable up to 220 °C after subsequent treatment
- novolac with photochemical acid generator and amine-based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

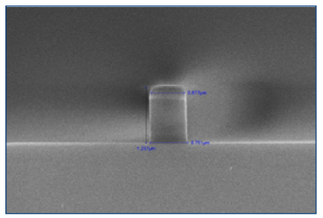
Spin curve



Properties II

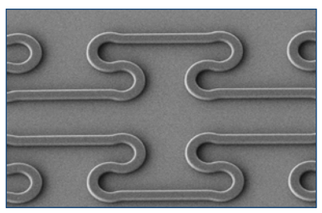
Glass transition temperature	102		
Dielectric constant	3.1		
Cauchy coefficients unexposed / exposed	N_0	1.593	1.599
	N_1	75.4	81.4
	N_2	80.0	81.4
Plasma etching rates (nm/min) (5 Pa, 240-250 V Bias)	Ar-sputtering	8	
	O_2	173	
	CF_4	33	
	80 CF_4 + 16 O_2	93	

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

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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
Rinse	AR 300-475, 60 s 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

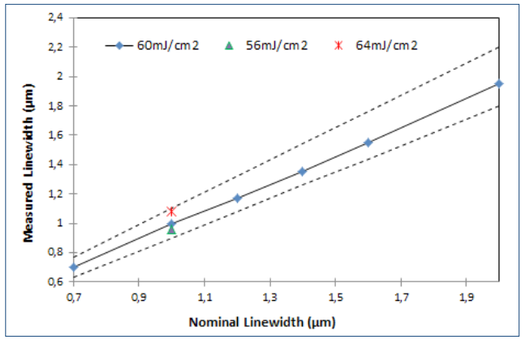
Developer	AR 300-26	AR 300-35	AR 300-40
AR-N 4340	1 : 1	undil.	300-475

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.

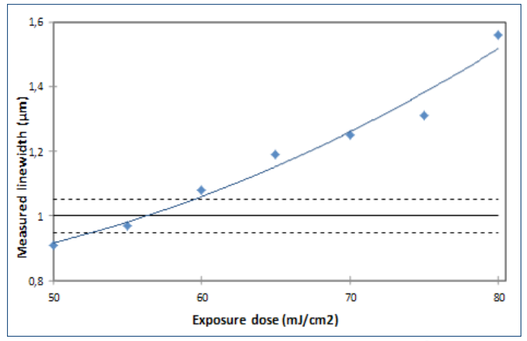
Negative Photoresist AR-N 4300

Linearity



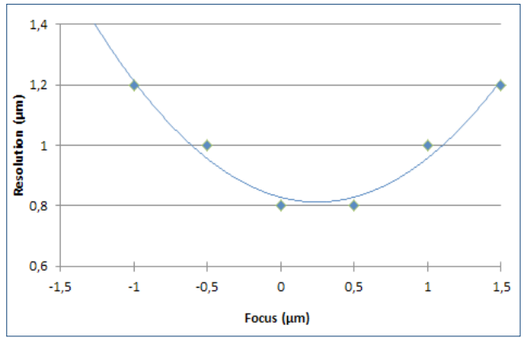
Up to a line width of 0.7 µm, the linearity is in the desired range (parameter see grafic Focus variation).

Optimum exposure dose



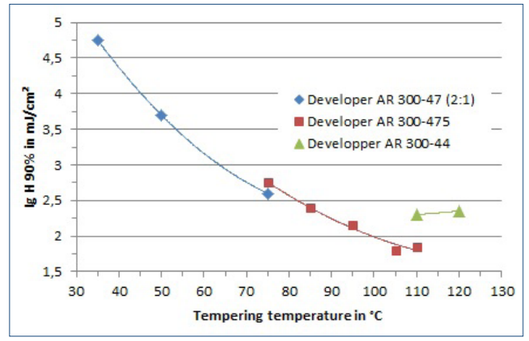
The optimum exposure dose for 1 µm-bars is 56 mJ/cm² (parameter see grafic Focus variation).

Focus variation



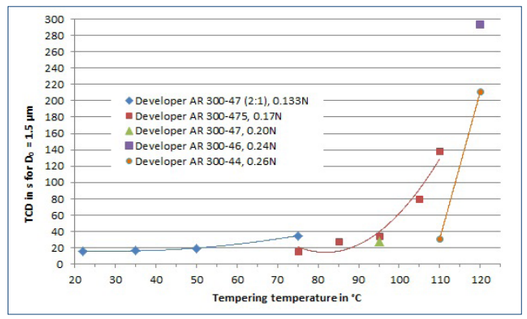
The resist achieves a resolution of 0.8 µm optimal focus adjustment REM measurement: Thickness 1,5 µm, PEB 105 °C, 180 s, I-line stepper (NA: 0,65), Developer AR 300-475.

Sensitivity in dependency on the bake



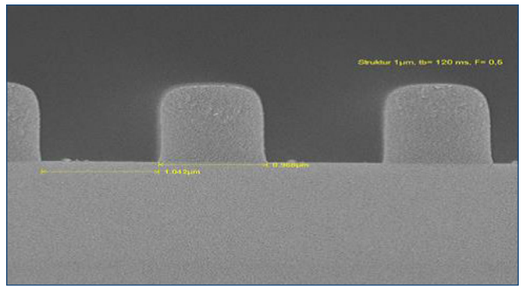
Samples were both dried and crosslinked at temperatures as indicated. The optimum working range is between 90 and 110 °C.

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.

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Negative Photoresists AR-N 4400 (CAR 44)

AR-N 4400 photoresist series for high film thickness values

Thick negative resists for electroplating, microsystems technology and LIGA ≤ 20 µm

Characterisation

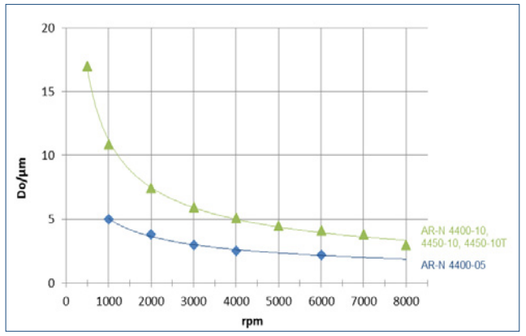
- i-, g-line, e-beam, broadband UV
- chemically enhanced, very good adhesion, electro plating-stable
- very high sensitivity, easy removal
- profiles with high edge steepness for excellent resolution, covering of topologies
- 4400-05/-10 for films up to 10 µm/ 20 µm (250 rpm)
- 4450-10T for film thicknesses up to 20 µm and lift-off
- novolac, crosslinking agent, amine-based acid generator
- safer solvent PGMEA

Properties I

Parameter / AR-N	4400 -05	4400 -10	4450 -10T
Solids content (%)	33	45	41
Film thickness/1000 rpm (µm)	5	10	10
Resolution (µm)	1.0	2.0	3.5
Contrast	4.0	4.0	10
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.

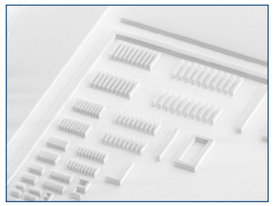
Spin curve



Properties II

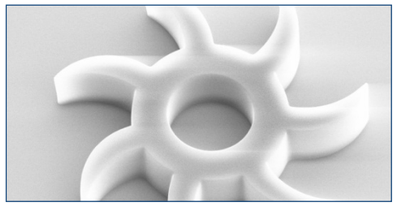
Glass transition temperature	102	
Dielectric constant	3.1	
Cauchy coefficients	N_0	1.615
	N_1	77.6
	N_2	64.1
Plasma etching rates (nm/min) (5 Pa, 240-250 V Bias)	Ar-sputtering	3
	O_2	122
	CF_4	31
	80 CF_4 + 16 O_2	81

Structure resolution



AR-N 4400-10
3 µm resolution at a film thickness of 15 µm

Resist structures



Turbine wheel produced with AR-N 4400-10

Process parameters

Substrate	Si 4“ wafer
Tempering	95 °C, 10 min, hot plate
Exposure	Maskaligner MJB 3, contact exposure
Development	AR 300-47, undil., 3 min, 22 °C

Process chemicals

Adhesion promoter	AR 300-80
Developer	AR 300-47, AR 300-44
Thinner	AR 300-12
Remover	AR 600-71, AR 600-70

Negative Photoresists AR-N 4400 (CAR 44)

AR-N 4400 photoresist series for high film thickness values

Thick negative resists for electroplating, microsystems technology and LIGA ≥ 50 µm

Characterisation

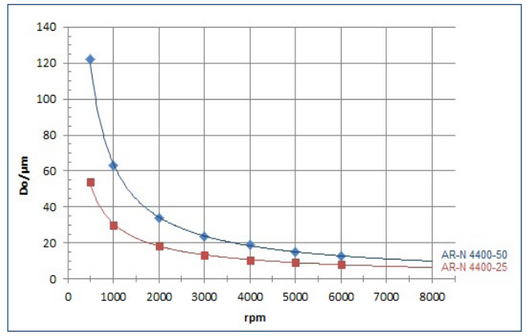
- i-, g-line, e-beam, broadband UV
- chemically enhanced, very good adhesion, electro plating-stable
- very high sensitivity, easy removal
- profiles with high edge steepness for excellent resolution, covering of topologies
- 4400-25 for very thick films up to 50 µm (250 rpm)
- 4400-50 for highest film thicknesses up to 100 µm
- novolac, crosslinking agent, amine-based acid generator
- safer solvent PGMEA

Properties I

Parameter / AR-N	4400-25	4400-50
Solids content (%)	52	58
Film thickness/1000 rpm (µm)	25	50
Resolution (µm)	3.5	5.0
Contrast	5.0	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.

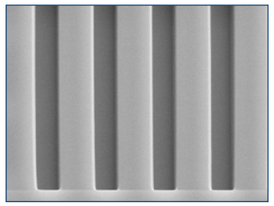
Spin curve



Properties II

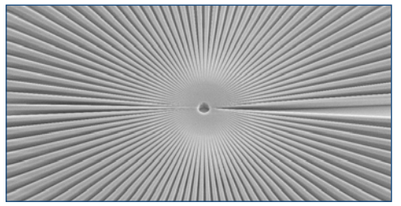
Glass transition temperature	102	
Dielectric constant	3.1	
Cauchy coefficients	N_0	1.615
	N_1	77.6
	N_2	64.1
Plasma etching rates (nm/min) (5 Pa, 240-250 V Bias)	Ar-sputtering	3
	O_2	122
	CF_4	31
	80 CF_4 + 16 O_2	81

Structure resolution



AR-N 4400-25
5 µm trenches at a film thickness of 40 µm

Resist structures



Siemens star produced with AR-N 4400-25 (30 µm thickness)

Process parameters

Substrate	Si 4“ wafer
Tempering	95 °C, 10 min, hot plate
Exposure	Maskaligner 150
Development	AR 300-44, undil., 90 min, 22 °C

Process chemicals

Adhesion promoter	AR 300-80
Developer	AR 300-46, AR 300-44
Thinner	AR 300-12
Remover	AR 600-71, AR 600-70

Negative Photoresists AR-N 4400 (CAR 44)

Process conditions

This diagram shows exemplary process steps for AR-N 4400 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".

		4400-05	4400-10	4400-25	4400-50
Coating (open chuck)		1000 rpm 5 µm	1000 rpm 10 µm	1000 rpm 25 µm	1000 rpm 50 µm
Tempering (± 1 °C) H* = Hot plate or C* = Convection oven	H*	90 °C 4 min	90 °C 15 min	90 °C 30 min	90 °C 90 min
	C*	85 °C 30 min	85 °C 60 min	85 °C 2 h	85 °C 3 h
UV exposure	Maskaligner, broadband UV				
	Exposure dose (E_0, broadband UV):				
		22 mJ/cm²	26 mJ/cm²	33 mJ/cm²	52 mJ/cm²
Crosslinking bake (+/- 1 °C) H* = Hot plate or C* = Convection oven	H*	100 °C 5 min	100 °C 10 min	100 °C 10 min	100 °C 10 min
	C*	95 °C 30 min	95 °C 40 min	95 °C 60 min	95 °C 80 min
Development (21-23 °C ± 0,5 °C) puddle		300-47 1 min	300-47 4 min	300-46 9 min	300-44 18 min
Rinse		DI-H_2O, 30 s and dry with caution			
Hardening of structures up to 300 °C (optional)		Flood exposure 100 mJ/cm²; bake 120 °C, 5 min hot plate			
Customer-specific technologies		Generation of e.g. semiconductor properties and galvanic, MEMS			
Removal		AR 300-76 for low crosslink density, AR 600-71 for high crosslink density, O_2 plasma ashing is also possible for high film thicknesses.			

Development recommendations

Resist / Developer	AR-N 4400-05 3-10 µm	AR-N 4400-10 5 - 20 µm	AR-N 4400-25 13 - 25 µm	AR-N 4400-50 25 - 100 µm
AR 300-44	-	-	-	8 : 1 to undil.
AR 300-46	-	-	5 : 1 to undil.	undil.
AR 300-47	6 : 1 to undil.	3 : 2 to undil.	undil.	-
AR 300-475	undil.	-	-	-

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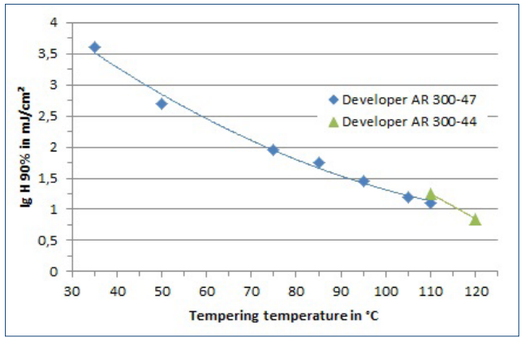
Negative Photoresists AR-N 4400 (CAR 44)

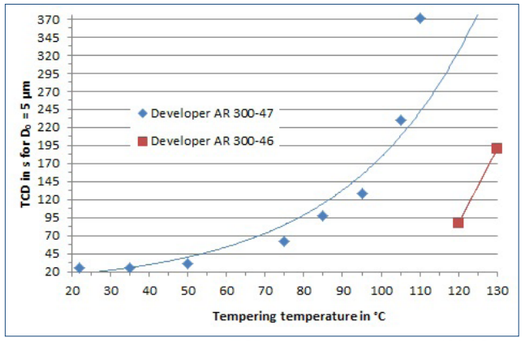
Photoresists

Sensitivity of AR-N 4400-05



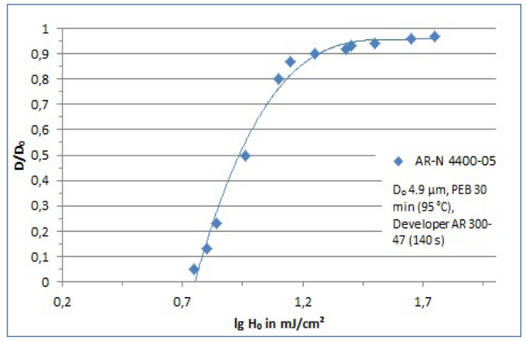
The sensitivity increases constantly with increasing bake temperatures (broadband UV Maskeliner, thickness 5.0 µm)

Time for complete development of AR-N 4400-05



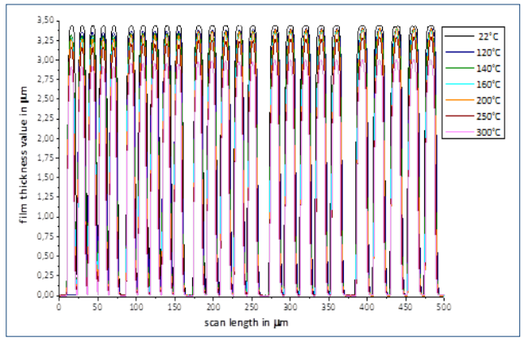
With increasing temperature, the TCD increases considerably. > 130 °C, no development is possible even if strong developers (AR 300-44) are used.

Gradation curve of AR-N 4400-05



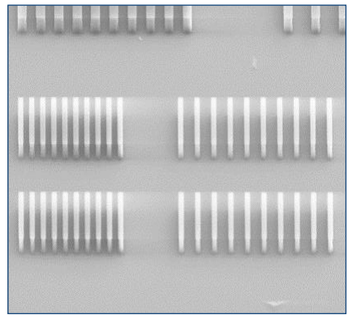
The gradation (contrast) is 3.5, the sensitivity was determined to 21.5 mJ/cm² for a structure buildup of 90 % ($H_0$90).

Thermal stability and shrinking up to 300 °C



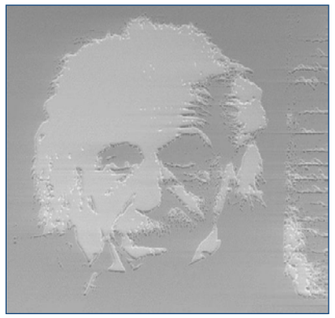
Developed lines with a width of 10 – 20 µm were hardened by flood exposure and subsequent bake step. These lines were tempered stepwise until 300 °C. Up to a temperature of 200 °C, structures remain more or less unchanged.

Resolution of AR-N 4400-05



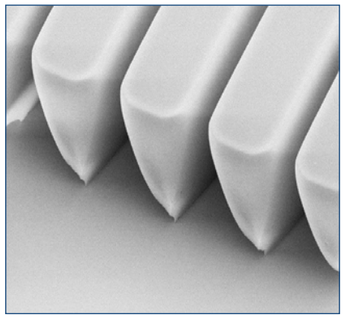
At a film thickness of 5 µm, 1.0 µm bars were produced

Picture of Albert Einstein



Test structure produced on the occasion of the "Einsteinjahr" in 2006

Lift-off structures



Undercuts produced with low exposure dose (AR-N 4450-10T)

As of January 2021

Negative Photoresists AR-N 4400 (CAR 44)

Processing instructions for the handing of thick films

Coating: In order to avoid the formation of bubbles, the resist should be left undisturbed for at least one day prior to processing. For resist with higher viscosity from AR-N 4400-25 onwards, degassing with ultrasound or vacuum is advisable.

The resist should be applied slowly, from a low height and always using the same amount of resist (e.g. 100 ml for 4-inch-wafers) onto the standing wafer. Subsequently, a formation for 10 s a low rotational speed (250 - 400 rpm) is recommended, followed by slow increase of the spin speed up to the desired final speed. To achieve a high resist film quality, rotational speeds above 2000 rpm should be avoided for the highly viscous AR-N 4400-50.

☞ Shorter coating times at final spin speed will increase the film thickness.

Multiple coating steps (up to 4 x) are possible for film thicknesses between 50 and 150 µm. A particularly high edge steepness of structures results in this case from an improved drying procedure. After each coating step, the resist is dried at 85 °C (hot plate) or 90 °C (convection oven) according to the specifications as given in the process conditions.

Tempering: The required tempering times are highly dependent on the respective film thickness:

Drying times hot plate/convection oven:

10 µm: 10 min/1h; 25 µm: 45 min/4 h; 50 µm: 90 min/7 h. The use of temperature ramps is highly recommended, since too fast cooling may lead to tension cracks.

☞ Long intensive drying procedures result in decreased sensitivities and prolonged development times.

Crosslinking: The crosslinking temperature can be varied in the range from 85 °C to 105 °C. The bake can be performed a few days after exposure without loss of sensitivity.

☞ Higher temperaturs lead to a slower development.

Development: longer development times with weaker developer provide a higher imaging quality.

Removal: Crosslinked structures can easily be removed by wet- or plasma chemical procedures using removers AR 600-71 and AR 300-76. Complicated electroplating structures as well as substrates treated with high temperatures require removers AR 600-71 or AR 600-70.

Comparison CAR44 and SU-8

CAR 44	Resist properties – Suitability	SU-8
✓	thick films	✓✓
✓	high resolution	✓
✓	excellent aspect ratio	✓
✓	high sensitivity at i-line, deep UV, e-beam	✓✓
✓	good sensitivity at g-line	×
✓	low-stress tempering – easy handling	×
✓	aqueous-alkaline development	×
✓	easy removal	×

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Negative Photoresist AR-N 4600 (Atlas 46)

AR-N 4600 Photo resist for high film thicknesses

Thick negative resist for electroplating, microsystems technologies and LIGA < 20 µm

Characterization

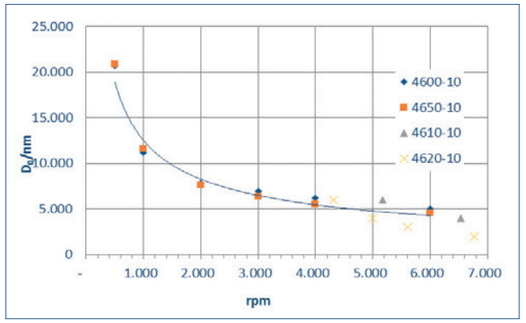
- i-line, broadband UV
- very good adhesion properties
- very high sensitivity
- AR-N 4600-10 for stable layers of 5 µm - 15 µm
- poly[(o-cresyl glycidyl ether)-co-formaldehyde] and acid generator
- safer solvent PGMEA

Properties I

Parameter / AR-N	4600-10
Solids content (%)	50
Viscosity 25°C (mPas)	172
Film thickness/1000 rpm (µm)	10
Resolution (µm)	2
Contrast	4
Flash point (°C)	46
Storage temperature (°C)*	10-22

* 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.

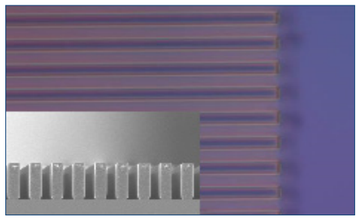
Spin curve



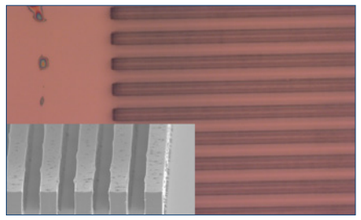
Properties II

Glass trans. temperature (°C)	34-44	
Softening point (°C)	99	
Dielectric constant	3 - 3,3	
Cauchy coefficients	N_0	1,675
	N_1	67
	N_2	101
Plasma etching rates (nm/min)	O_2	400
(1 Pa, O_2 plasma, 230 W (ICP), 160 W (HF))	5 CF_4 + 30 O_2	450

Resist structures



Atlas intensely exposed and very stable



Atlas slightly exposed and removable

Process parameter

Substrate	Si 4“ wafer
Softbake	95°C, 5 min, hot plate
Exposure	BB UV, Soft-contact
Development	AR 300-12 pure, 120 s, 20°C

Process chemicals

Remover	AR 300-12
Thinner	AR 300-12
Developer	AR 300-12
Stopper	AR 600-60

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Negative Photoresist AR-N 4600 (Atlas 46)

Photoresists

Process conditions

This diagram shows exemplary process steps for resist AR-N 4600. 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 (open chuck)	1.000 rpm, 10 µm
Softbake	Hot plate: 95°C, 5 min (65°C, 2 min - 95°C, 4 min) optional ramp
UV exposure	Broadband UV, i-line Exposure dose (E_0, BB-UV): 120 mJ/cm²
Crosslinking bake	Hot plate: 105°C, 5 min (65°C, 2 min - 95°C, 2 min - 7 min 105°C) optional ramp
Development (21-23°C ± 0,5°C) Puddle	AR 300-12, 2 min
Rinse	AR 600-60, H_2O -drying (hot plate)
Customer-specific Technologies	Hardbake (optional) (95°C, 10 min / 105°C, 5 min) up to 200°C (gradually)
Removing	O_2 plasma ashing

Development recommendations

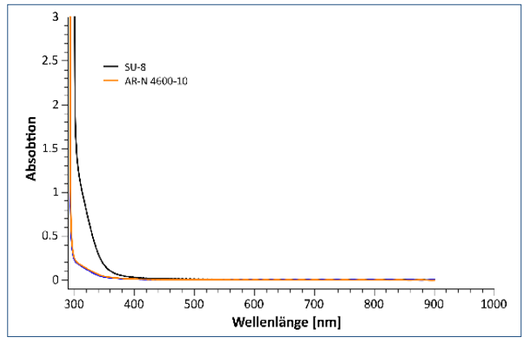
Resist / Developer	AR-N 4600-10
AR 300-12	middle
AR 600-07	slow

Photoresists

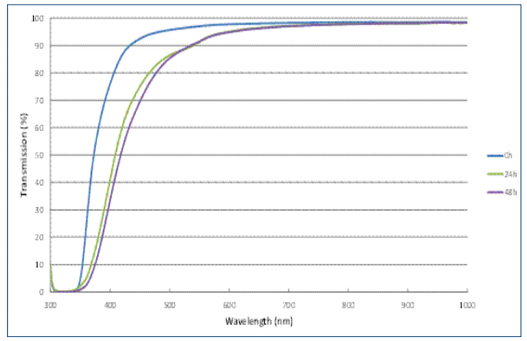
As of: January 2021

Negative Photoresist AR-N 4600 (Atlas 46)

UV/VIS NIR

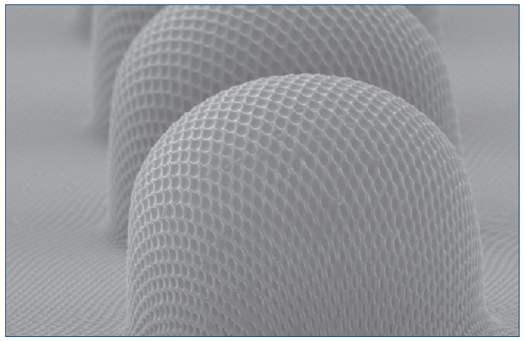


UV/VIS spectra of 10 µm layers Atlas in comparison to SU-8

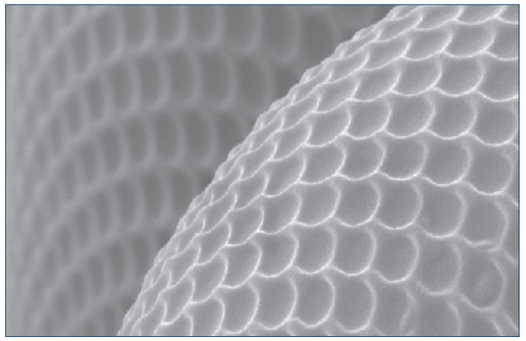


UV/VIS spectra of Atlas 46. Yellowing caused by varying the duration of broadband UV exposure after curing.

Embossing

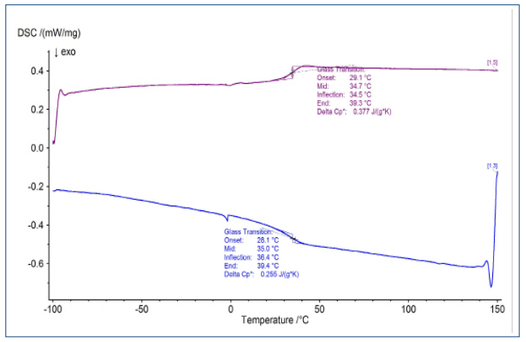


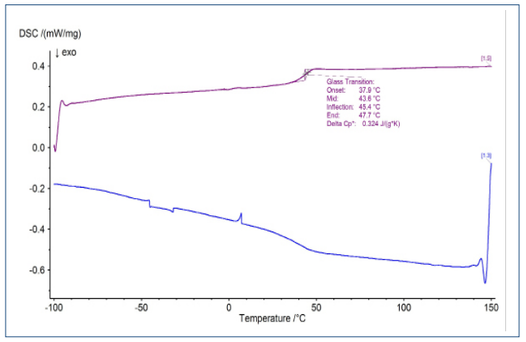
Combined nano- and microstructures, produced by embossing of AR-N 4600 (© Uni Wuppertal)



Close-up view of AR-N 4600 (© Uni Wuppertal)

DSC





Dynamic differential scanning calorimetry (DSC) of polymers used

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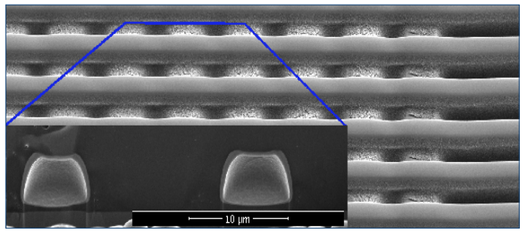
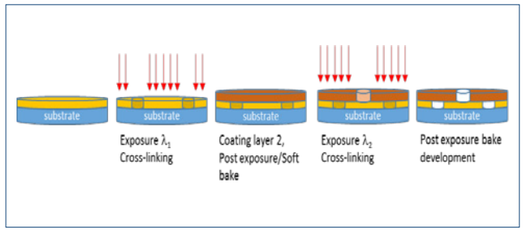
Negative Photoresist AR-N 4600 (Atlas 46)

Photoresists

Bridges



Bridge structure of two-layer system with AR-N 4600-10 (bottom) and SX AR-N 4620-10/1 (top)



Process description of "bridge construction" with AR-N 4600-10 (bottom, BB-UV) and SX AR-N 4620-10/1 (top, g-line)

Additional information

Processing

Layer thickness values of Atlas R and Atlas S are pre-adjusted to 10 µm at a spin speed of 1000 rpm. It is recommended to perform the subsequent tempering step on the hotplate at 95 °C for 5 min. Temperature ramps or stepwise drying, e.g. 65 °C for 2 minutes, followed by 95 °C for 4 minutes, can improve the resolution.

Both resists can be structured by i-line or broadband UV exposure. Prior to irradiation, substrates should be cooled to room temperature. It is recommended to perform the following tempering step for cross-linking on the hotplate at 105 °C for 2 min.

Ramps or stepwise cross-linking procedures like e.g. 65 °C for 2 minutes, followed by 95 °C for 7 minutes and 105 °C for 2 minutes, can improve the resolution. In general, the stability of resists increases with higher temperatures and longer bake times, but this requires on the other side longer development times. The use of temperature ramps is also recommended for cooling since cooling too fast may result in stress cracking.

Development

AR 300-12 is recommended as standard developer, but also AR 600-07 (fast development) or AR 600-70 (gentle development) is suitable. If AR-N 4600-10 is used for development, no dark erosion is observed even after comparably long development times. Too long developing with the AR 300-12 and the slightly exposed atlas can lead to increased dark erosion. The AR 600-70 can even be completely removed.

Stopper AR 600-60 is recommended for a particularly residue-free rinsing after development, followed by rinsing with DI water. It is also possible to rinse resist layers immediately after development directly with DI water and to dry them on the hotplate.

The sensitivity for a layer thickness of 10 µm is about 110 – 160 mJ/cm^2 in the broadband UV range (process description on page 3).

As of: January 2021

Negative Photoresist AR-N 4600 (Atlas 46)

Dyed and fluorescent films with Atlas 46

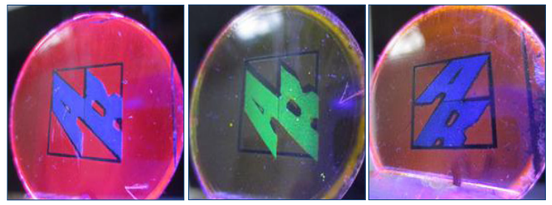
Different coloured, optionally also fluorescent dyes can be embedded into the negative-working Atlas 46 S. These dyes are process-stable, and structuring is performed in the same manner as in standard processes with uncoloured Atlas 46 S films.

The use of different fluorescent dyes allows a defined adjustable emission in variable wavelength ranges. Fluorescent resist films are e.g. applied in microscopy. By embedding dyes into Atlas 46, resist films can be created that optionally show violet, blue, green, yellow, orange or red fluorescence. The intense fluorescence is retained even after a tempering at 150 °C, and the intense UV exposure required for cross-linking of Atlas films exhibits no adverse effect on the emission properties of these layers.

Differently fluorescing Atlas 46 films (irradiation with black light)

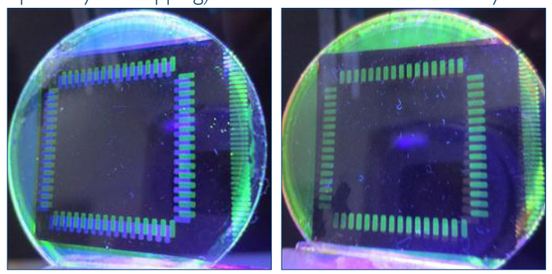
Also two-colour fluorescent resist architectures could be realized. For this purpose, glass panes were pre-treated with AR 300-80 new to optimize the adhesive properties and subsequently coated with different fluorescent Atlas 46 variants. Exposure was carried out using different masks. After the following PEB, development was carried out with AR 300-12 and films were dried. The developed structures were then coated with a second, differently coloured resist variant with the greatest possible colour contrast, e.g. blue – yellow or red – yellow.

No mixing occurred since the already produced structures turned out to be highly stable. The second exposure and PEB step analogous to the first step allowed a selective structuring of the upper layer. After development with AR 300-12, the differently fluorescing areas on the substrate become visible in black light:



AR logo realised with two-coloured emission in black light

Also differently fluorescent lines adjacent to each other (or optionally overlapping) can be created in the same way:



Different fluorescent line patterns, left: parallel arrangement, right: overlapping lines

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2L-Lift-off System with AR-BR 5400 (positive or negative)

AR-BR 5400 bottom resist for two-layer lift-off systems

Positive or negative system for optically transparent and thermally resistant structures

Characterisation

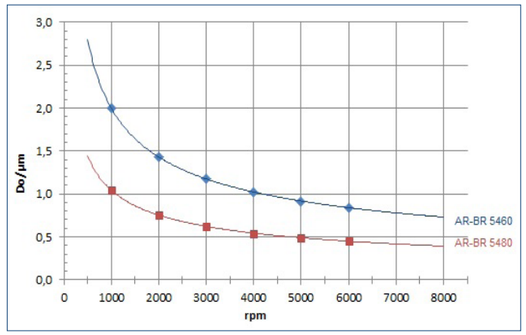
- bottom resist not light sensitivity
- broadband UV, i-line, g-line for top resist
- for lift-off structures
- for optically transparent structures from 270 nm to IR with thermally stable structures up to 250 °C
- aqueous-alkaline development
- temperature-stable up to 140 °C (with AR-P 3500)
- 5400 copolymer methyl methacrylate/methacrylic acid
- 3- safer solvent PM (5400), PGMEA (3500, 4340)

Properties I

Parameter / AR-BR	5460	5480
Solids content (%)	12	9
Viscosity 25 °C (mPas)	73	33
Film thickness/4000 rpm (µm)	1.0	0.5
Resolution top resist 2 L (µm)	3.0	1.5
Contrast	lift-off	lift-off
Flash point (°C)	30	30
Storage temperature (°C)*	10 - 22	

* 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.

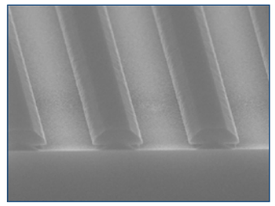
Spin curve



Properties II

Glass transition temperature	125	
Dielectric constant	2.9	
Cauchy coefficients	N_0	1.526
	N_1	0
	N_2	117
Plasma etching rates (nm/min) (5 Pa, 240-250 V Bias)	Ar-sputtering	14
	O_2	283
	CF_4	51
	80 CF_4 + 16 O_2	133

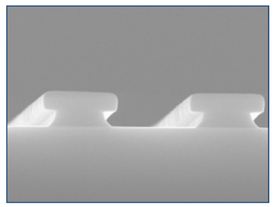
Structure resolution of positive system



AR-BR 5460 - AR-P 3510

5 µm-bars of positive two-layer system after development

Structure resolution of negative system



AR-BR 5480 - SX AR-N 4340/7

Finely adjusted lift-off undercut with negative resist

Process parameters

Substrate	Si 4“ wafer
Tempering	150 °C, 5 min, hot plate
Exposure	Maskaligner MJB 3
Development	AR 300-47, 1 : 1, 2 min, 22 °C

Process chemicals

Adhesion promoter	AR 300-80
Developer	AR 300-47
Thinner	AR 600-07
Remover	AR 300-76, AR 300-73

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2L-Lift-off System with AR-BR 5400 - AR-P 3500

Photoresists

Process conditions positive process

This diagram shows exemplary process steps for the positive system AR-BR 5400 – AR-P 3540. 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”.

	AR-BR 5460 (bottom resist for lower layer)	AR-BR 5480 (bottom resist for lower layer)
1. Coating	2000 rpm, 60 s 1.4 µm	2000 rpm, 60 s 0.7 µm
1. Tempering (± 1 °C)	150 °C, 5 min hot plate or 145 °C, 30 min convection oven	
2. Coating	AR-P 3540 (top resist for upper layer) 4000 rpm, 60 s 1.4 µm	
2. Tempering	100 °C, 2 min hot plate or 95 °C, 30 min convection oven	
UV exposure	Broadband UV, 365 nm, 405 nm, 436 nm Exposure dose (E_0, bb UV st.): 42 mJ/cm^2, 1.4 µm (upper layer)	
Development (21-23 °C ± 0,5 °C) puddle	AR 300-47, 1 : 1 50 s	AR 300-47, 1 : 1 35 s
Rinse	DI-H_2O, 30 s	
Selective removal of the photoresist film (optional)	AR 600-70 10 s	AR 600-70 10 s
Post-bake (optional)	Not required	
Customer-specific technologies	Evaporation / sputtering of metal onto lift-off structures	
Lifting / Removal	AR 300-76	

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

2 L-Lift-off Positive System AR-BR 5400 - AR-P 3500

Processing instructions for positive two-component system

Coating: The substrate is at first coated with the copolymer AR-BR 5400 and tempered. After cooling to room temperature, the photoresist is applied onto the copolymer. Dwell times are to be avoided; the liquid photoresist should not be left for more than 10 s on the standing wafer. The film thickness may be varied in a range between 1.6 - 4.0 µm. Subsequently, the two-component system is tempered.

Note: The ratio of film thicknesses of both films will affect structural geometry. For a strong lift-off effect, a thin photoresist layer and a thick copolymer layer is advantageous. For a dimensionally accurate transfer of structures into the copolymer layer however, both layers should have approximately the same thickness. The entire system always has to be optimised for the particular application.

Exposure:

AR-P 3500: Exposure and aqueous-alkaline development are carried out as usual (☞ Product information AR-P 3500). AR-BR 5400: The copolymer itself is not sensitive in the UV-range between 300-450 nm. The properties of the layer are however adjusted such that the polymer will dissolve quickly in the recommended aqueous-alkaline developer.

Development: After the upper photoresist layer is entirely developed in exposed areas, the developer begins to dissolve the copolymer.

The dissolution process now takes place in undirected manner (isotropic).
AR-BR 5400 is in this process removed both towards the bottom and towards the left or right side so that the undercut is formed. The longer the developer can exerts its effect, the more of the copolymer under the photoresist film is removed by dissolution. For a reduction of the dissolving rate, a higher temperature of up to 180 °C has to be chosen (instead of 150 °C). The desired undercut can thus be adjusted via the parameters temperature and development time (☞ see images below).

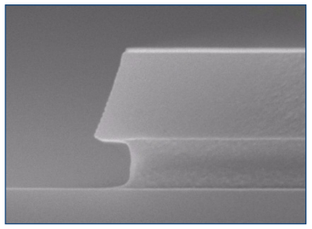
Selective removal of the photoresist layer (optional):

For transparent and temperature-stable films, the copolymer layer is used alone. In this case, the residual photoresist is selectively removed after development with remover AR 600-70. The substrate is briefly immersed in remover AR 600-70 and dried immediately with compressed air.

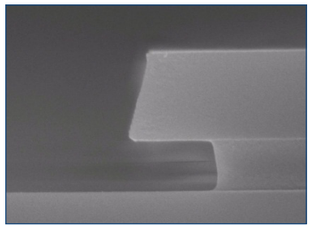
Lifting / Removal:

Removers AR 300-73 and AR 300-76 are both suitable for lifting undil.poses. If lift-off structures are not thermally stressed during evaporation or sputtering, lifting will take place within a minute.
After high thermal load (> 150 °C), the time required for lifting increased considerably. Ultra sound and heating facilitate a removal. Remover AR 300-73 may in this case be heated up to 50 °C max.

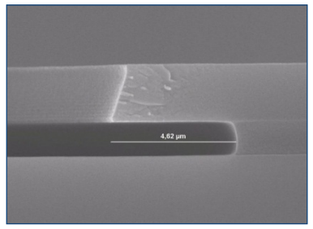
Adjustment of the undercut via development time



25 s development
0.8 µm undercut



40 s development
1.6 µm undercut



90 s development
4.6 µm undercut

2L-Lift-off Negative System AR-BR 5400 - SXAR-N 4340/7

Process conditions negative process

This diagram shows exemplary process steps for the positive system AR-BR 5400 – AR-P 4340/7. 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".

1. Coating	AR-BR 5460 (bottom resist for lower layer)	AR-BR 5480 (bottom resist for lower layer)
	2000 rpm, 60 s, 1.4 µm	2000 rpm, 60 s, 0.7 µm
1. Tempering (± 1 °C)	150 °C, 5 min hot plate or	
	145 °C, 30 min convection oven	
2. Coating	SX AR-N 4340/7 (top resist for upper layer)	
	4000 rpm, 60 s, 1.4 µm	
2. Tempering (± 1 °C)	90 °C, 2 min hot plate or	
	85 °C, 30 min convection oven	
UV exposure	Broadband UV, 365 nm, 405 nm, 436 nm	
	Exposure dose (E_0, bb UV st.): 20 mJ/cm², 1.4 µm (upper layer)	
3. Tempering (± 1 °C) Crosslinking bake	95 °C, 2 min hot plate or	
	90 °C, 30 min convection oven	
Development (21-23 °C ± 0,5 °C) puddle	AR 300-47, 1 : 1	AR 300-47, 1 : 1
	50 s	35 s
Rinse	DI-H_2O, 30 s	
Selective removal of the photoresist film (optional)	AR 600-70	AR 600-70
	10 s	10 s
Post-bake (optional)	Not required	
Customer-specific technologies	Evaporation/sputtering of metal onto lift-off structures	
Lifting / Removal	AR 300-73 or AR 300-76	

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

2L-Lift-off Negative System AR-BR 5400 - SXAR-N 4340/7

Processing instructions for negative two-component system

The negative two-layer lift-off system is characterised by a particularly high temperature resistance up to 250 °C after development.

Coating: The substrate is at first coated with the copolymer AR-BR 5400 and tempered. After cooling to room temperature, the negative resist SX AR-N 4340/7 which was specifically designed for two-layer systems is applied onto the copolymer. Dwell times are to be avoided; the liquid photoresist should not be left for more than 10 s on the standing wafer. The film thickness may be varied in a range between 1.0 – 2.5 µm. Subsequently, the two-component system is tempered.

Note: The ratio of film thicknesses of both films will affect the structural geometry. For a strong lift-off effect, a thin photoresist layer and a thick copolymer layer is advantageous. For a dimensionally accurate transfer of structures into the copolymer layer however, both layers should have approximately the same thickness. The entire system always has to be optimised for the particular application.

Exposure:
SX AR-N 4340/7: Exposure and aqueous-alkaline development are carried out according to the general process descriptions which require an additional cross-linking bake in the negative mode.

AR-BR 5400: The copolymer itself is not sensitive in the UV-range between 300-450 nm. The properties of the layer are however adjusted such that the polymer will dissolve quickly in the recommended aqueous-alkaline developer.
Development: After the upper photoresist layer is entirely developed in exposed areas, the developer begins to dissolve the copolymer. The dissolution process now takes place in undirected manner (isotropic).

AR-BR 5400 is in this process removed both towards the bottom and towards the left or right side so that the undercut is formed. The longer the developer can exerts its effect, the more of the copolymer under the photoresist film is removed by dissolution. For a reduction of the dissolving rate, a higher temperature of up to 180 °C has to be chosen (instead of 150 °C). The desired undercut can thus be adjusted via the parameters temperature and development time (☞ see images below). In addition, the steepness can be influenced by the exposure time of the negative resist.

Selective removal of the photoresist layer (optional):

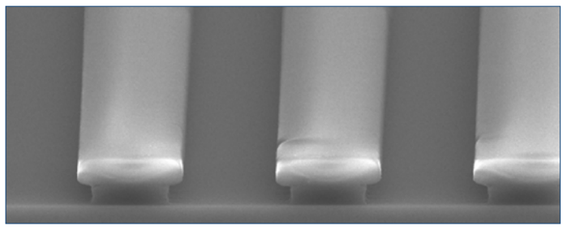
For transparent and temperature-stable films, the copolymer layer is used alone. For this undil.pose, the residual photoresist is selectively removed after development with remover AR 600-70. The substrate is briefly immersed in remover AR 600-70 and dried immediately with compressed air.

Lifting / Removal:

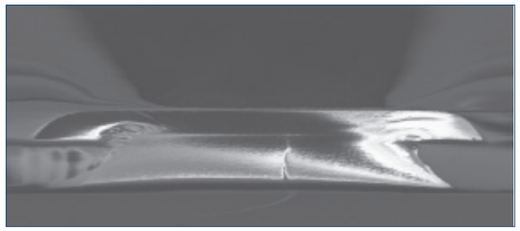
Removers AR 300-73 and AR 300-76 are both suitable for lifting. If lift-off structures are not thermally stressed during evaporation or sputtering, lifting will take place within a minute.

After high thermal load (> 250 °C), the time required for lifting increased considerably. Ultra sound and heating facilitate a removal. Remover AR 300-73 may in this case be heated up to 50 °C max.

Two layer lift-off system AR-BR 5400 – SX AR-N 4340/7



Steep edges due to optimised exposure times of the negative system



Negative lift-off structures after tempering at 200 °C

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Protective Coatings AR-PC 500(0)

AR-PC 504, 5040 adhesion-enhanced KOH-resistant resists

Wafer backside protection during front side etchings for the production of deep structures in silicon

Characterisation

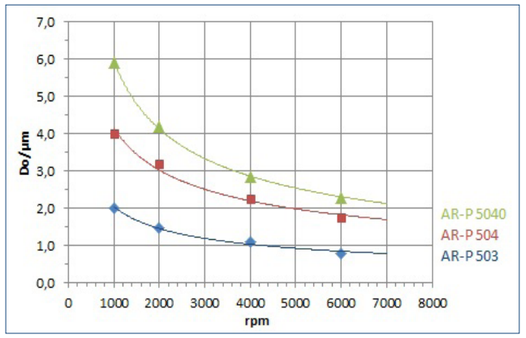
- not light-sensitive > 300 nm, no yellow light required
- protection of wafer backside when etching the front side
- offers reliable protection against mechanical damage during handling and transport
- temperature-stable up to 250°C
- PMMA with different molecular weights,
- solvent 504 chlorobenzene; 5040 anisole

Properties I

Parameter / AR-PC	504	5040
Solids content (%)	13	17
Viscosity 25 °C (mPas)	350	550
Film thickness/4000 rpm (µm)	2.2	2.8
Resolution (µm)	-	-
Contrast	-	-
Flash point (°C)		42
Storage temperature (°C)*	10 - 25	

* 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.

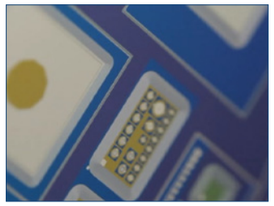
Spin curve



Properties II

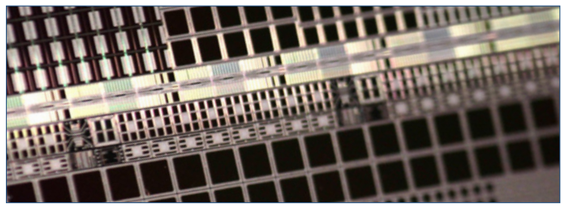
Glass transition temperature	105	
Dielectric constant	2.6	
Cauchy coefficients AR-PC 503	N_0	1.528
	N_1	34.6
	N_2	0
Plasma etching rates (nm/min) (5 Pa, 240-250 V Bias)	Ar-sputtering	20
	O_2	340
	CF_4	61
	80 CF_4 + 16 O_2	160

Photo of coated wafer

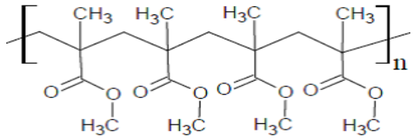


Protective coating AR-P 503 covering sensitive structures

Topology of the backside



Structural formula poly(methyl methacrylate)



Process chemicals

Adhesion promoter	AR 300-80
Developer	-
Thinner	AR 600-01
Remover	AR 300-76, AR 600-71

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Protective Coatings AR-PC 500(0)

Photoresists

Process conditions

This diagram shows exemplary process steps for AR-PC 500(0) 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".

Pre-coating with AR 300-80	Adhesive bonding, resulting film thickness 15 nm
1. Tempering	180 °C, 2 min hot plate or 180 °C, 25 min convection oven
Coating protective film	1000 rpm, 60 s, 4.5 µm
2. Tempering (± 1 °C)	140 °C, 1.5 min hot plate or 135 °C, 60 min convection oven
Fabrication of etch mask on the backside	Customer-specific process to generate the hard mask
Customer-specific technologies	Etching: 40 % KOH, 85 °C
Removal of protective coating	AR 300-76 or O_2 plasma ashing

Processing instructions

Pre-treatment prior to coating: The protective effect during etching can be extended to up to 8 hours if the surface is pre-treated with adhesion promoter AR 300-80. The coating is preferably performed at 4000 rpm. After tempering at 180 °C for 2 min (hot plate), a uniform, 15 nm thin layer of adhesion promoter is formed (-> Product information AR 300-80).

Coating: A rotational speed of 1000 rpm is recommended for protective coatings, since at a film thickness of 2 - 5 µm wafer edges are best protected due to a certain "edge wrapping" of the resist. At higher spin speeds or if 6-inch wafers and above are used, the relatively high amount of resist which is deposited on the wafer may cause the so-called candy-floss effect. Low spin speeds, local exhaustion or removal of the "candy floss" with a glass rod during coating reduces these highly disturbing effects.

Tempering: To obtain a particularly high protective effect for the fabrication of hard-baked films, tempering temperatures of 190 °C are recommended.

Etch process: The protective coating is even after hours not attacked by 40 % KOH. Possibly occurring problems only derive from insufficient adhesive strength and can be significantly reduced with a pre-treatment with AR 300-80.

Photoresists

Protective Coating SX AR-PC 5000/41

KOH and HF resistant protective coating for wafer backside protection

Experimental sample/custom-made product

Characterisation

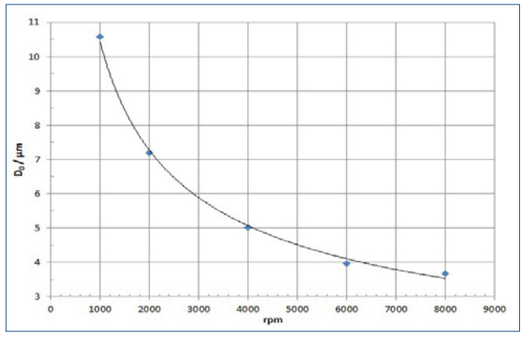
- not light-sensitive > 300 nm, no yellow light required
- stable protective film for protecting the wafer backside during etching of the front up to 80 °C, e.g. with 40 % caustic potash, 50 % hydrofluoric acid, BOE
- in two-layer system structurable with AR-P 3250 or AR-N 4400-05/10; plasma etching resistant
- high-melting modified hydrocarbons
- solvent ethylbenzene

Properties I

Parameter / AR-PC	5000/41
Solids content (%)	50
Viscosity 25°C (mPas)	45
Film thickness/4000 rpm (µm)	5.0
Resolution (µm. 2-Layer)	20
Contrast (2-Layer)	1
Flash point (°C)	15
Storage temperature (°C)*	15 - 22

* 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.

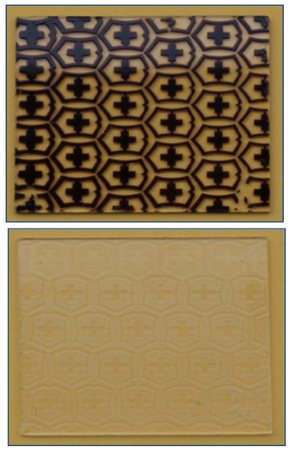
Spin curve



Properties II

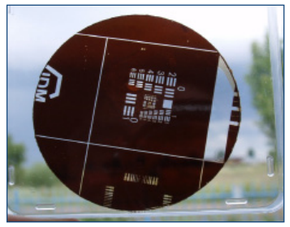
Glass transition temperature °C	130	
Dielectric constant	-	
Cauchy-Koeffizienten	N_0	-
	N_1	-
	N_2	-
Plasma etching rates (nm/min)	Ar-sputtering	-
(5 Pa. 240-250 V Bias)	O_2	185
	CF_4	68
	80 CF_4 + 16 O_2	120

Resist structures



Two-layer structuring with SX AR-PC 5000/41 and AR-P 3250 (on the left resist mask, on the right after etching in glass)

Structurable glass wafer



5 µm thick layer with glass wafer provided by the IDM

Process chemicals

Adhesion promoter	AR 300-80 new
Developer	X AR 300-74/1
Thinner	X AR 300-74/1
Remover	

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Protective Coating SX AR-PC 5000/41

Photoresists

Process conditions - One-layer process

This diagram shows exemplary process steps for the protective coating SX AR-PC 5000/41. All specifications are guideline values which have to be adapted to own specific conditions.

Pre-coating with AR 300-80 new	Adhesive bonding at 2000 rpm, resulting film thickness 15 nm
1. Soft bake (± 1 °C)	95 °C, 2 min hot plate or 95 °C, 25 min convection oven
Coating protective film with SX AR-PC 5000/41	3500 rpm, 60 s , 5.5 µm
2. Softbake (± 1 °C)	95 °C, 5 min hot plate 95 °C, 25 min convection oven
Hard bake (optional)	120 °C, 5 min hot plate or 25 min convection oven for higher etch stability
Removal AR-PC 5000/41	X AR 300-74/1, 30 s

Processing instructions

Coating: A spin speed of 1000 rpm is recommended, since wafer edges are optimally protected due to the slight wrapping effect at a film thickness of approx. 10 µm during spin deposition.

Etch process: The protective layer is not attacked over hours.

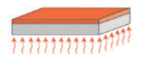
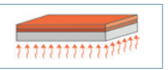
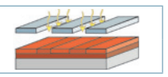
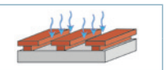
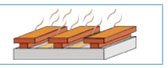
Note: The protective film is not dissolved in acetone or isopropanol. For removal or cleaning of equipment, the respective thinner has to be used.

As of: January 2019

Protective Coating SX AR-PC 5000/41

Process conditions - Two-layer process

This diagram shows exemplary process steps for the protective coating SX AR-PC 5000/41. All specifications are guideline values which have to be adapted to own specific conditions.

Pre-coating with AR 300-80 new 	Adhesive bonding at 2000 rpm, resulting film thickness 15 nm
1. Soft bake (± 1 °C) 	95 °C, 2 min hot plate or 95 °C, 25 min convection oven
Coating protective film with SX AR-PC 5000/41 	3500 rpm, 60 s , 5.5 µm
2. Soft bake (± 1 °C) 	95 °C, 5 min hot plate 95 °C, 25 min convection oven
Coating AR-P 3250 	1000 rpm, 10 µm
3. Tempering (± 1 °C) 	50 °C, 5 min hot plate or 50 °C, 40 min, convection oven
UV exposure 	Broadband UV, 365 nm, 405 nm, 436 nm Exposure dose (E_0, BB-UV stepper): 450 mJ/cm^2
Development (21-23 °C ± 0.5 °C) puddle 	1. AR-P 3250 with AR 300-26 (1 : 1), 60 s 2. SX AR-PC 5000/41 with X AR-300-74/1, 10 s
Rinse / Stop	DI-H_2O, 30 s / stopper AR 600-60/1, 30 s
Removal AR-P 3250 (optional)	AR 300-73, 60 s
Customer-specific technologies 	Etching with 50 % hydrofluoric acid
Removal AR-PC 5000/41 	X AR 300-74/1, 30 s

Processing instructions

Coating: A spin speed of 1000 rpm is recommended, since wafer edges are optimally protected due to the slight wrapping effect at a film thickness of approx. 10 µm during spin deposition.

Etch process: The protective layer is not attacked over hours up to 80 °C.

Note: The protective film is not dissolved in acetone or isopropanol. For removal or cleaning of equipment, the respective thinner has to be used.

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Thermostable Positive Photoresist SX AR-P 3500/8

Positive photoresist for high-temperature application up to 300 °C

Experimental sample/custom-made product

Characterisation

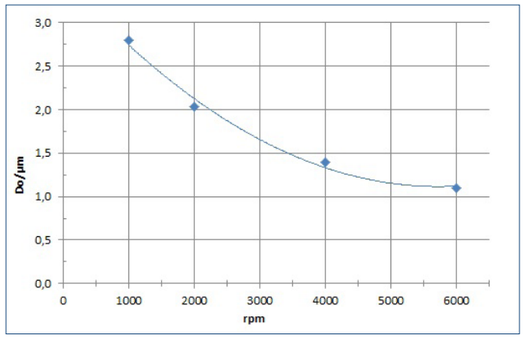
- broadband, i-line, g-line
- high plasma resistant, thermally stable up to 300 °C
- suitable for:
  high-temperature 2-layer lift-off processes as well as plasma etching and implantation processes
- combination of poly(hydroxystyrene-co-MMA)-naphthoquinone diazide
- safer solvent PGMEA

Properties I

Parameter / SX AR-P	3500/8
Solids content (%)	27
Viscosity 25 °C (mPas)	20
Film thickness/4000 rpm (µm)	1.4
Resolution (µm)	0.8
Contrast	3.0
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.

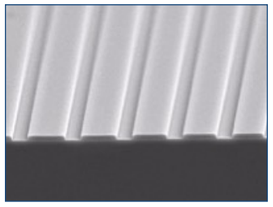
Spin curve



Properties II

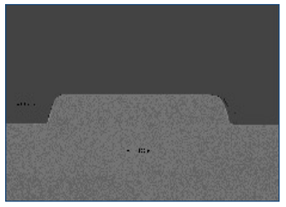
Glass transition temperature (°C)	120	
Dielectric constant	3.1	
Cauchy coefficients	N_0	1.559
	N_1	144.0
	N_2	13.6
Plasma etching rates (nm/min) (5 Pa. 240-250 V Bias)	Ar-sputtering	10
	O_2	
	CF_4	
	80 CF_4 + 16 O_2	120

Resist structures



7 µm trenches with SX AR-P 3500/8

Resist structures (thermally stable)



10 µm webs of SX AR-P 3500/8 after a hard bake of 280 °C

Process parameters

Substrate	Si 4“ wafer
Tempering	95 °C, 2 min, hot plate
Exposure	i-line stepper (NA: 0,65)
Development	AR 300-47, 1 : 1, 1 min, 22 °C

Process chemicals

Adhesion promoter	AR 300-80 new
Developer	AR 300-47
Thinner	AR 300-12
Remover	AR 300-76, AR 600-70

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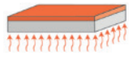
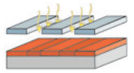
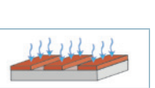
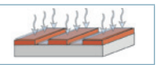
Thermostable Positive Photoresist SX AR-P 3500/8

Photoresists

Process conditions

This diagram shows exemplary process steps for resist SX AR-P 3500/8 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
Tempering (± 1 °C) 	100 °C, 2 min, hot plate 95 °C, 30 min, convection oven
UV exposure 	Broadband UV Exposure dose (E_0, BB-UV stepper) 200 mJ/cm²
Development (21-23 °C ± 0.5 °C) puddle  Rinse	AR 300-47, 1 : 1 60 s DI-H_2O, 30 s
Customer-specific technologies 	Generation of e.g. semi-conductor properties
Removal 	AR 300-76 or O_2 plasma ashing

Development recommendations

Resist / Developer	AR 300-35	AR 300-47
SX AR-P 3500/8	1 : 1	1 : 1

Thermostable Negative Resist SX AR-N 4340/7

Negative photoresist for one- and two-layer systems

Experimental sample/custom-made product

Characterisation

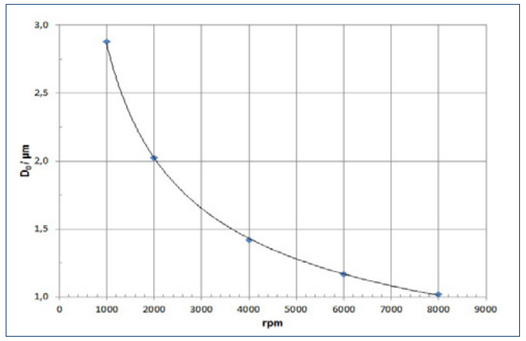
- i-line, g-line, deep UV (248 – 266 nm)
- highest sensitivity, high resolution
- good adhesion properties, high contrast, chemically enhanced
- undercut profiles (lift-off) possible
- may be used with AR-BR 5400 as 2-layer system
- plasma etching stable, thermostable up to 300 °C
- polyhydroxystyrene polymer, higher photosensitivity
- acid generator and aminic crosslinker
- safer solvent PGMEA

Properties I

Parameter / SX AR-N	4340/7
Solids content (%)	25
Viscosity 25 °C (mPas)	38
Film thickness/4000 rpm (nm)	1.4
Resolution (µm)	0.7
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.

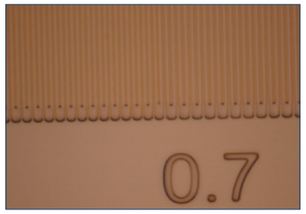
Spin curve



Properties II

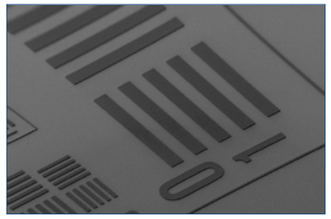
Glass transition temperature (°C)	118	
Dielectric constant	3.1	
Cauchy-Koeffizienten	N_0	1.55
	N_1	82.6
	N_2	0
Plasma etching rates (nm/min) (5 Pa. 240-250 V Bias)	Ar-sputtering:	7
	O_2	175
	CF_4	45
	80 CF_4 + 16 O_2	98

Structure resolution



SX AR-N 4340/7
0.7 µm resolution at a film thickness of 1.4 µm

Resist structures



Resist structures of SX AR-N 4340/7 after tempering at 300 °C

Process parameters

Substrate	Si 4“ wafer
Soft bake	90 °C, 60 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 new
Developer	AR 300-47
Thinner	AR 300-12
Remover	AR 600-71, AR 600-70

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Thermostable Negative Resist SX AR-N 4340/7

Photoresists

Process conditions

This diagram shows exemplary process steps for resist SX AR-P 4340/7. 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 with SX AR-N 4340/7	4000 rpm, 60 s, 1.4 µm
Soft bake (± 1 °C)	90 °C, 2 min hot plate or 85 °C, 30 min convection oven
UV exposure	i-line stepper Exposure dose (E_0, i-line stepper): 25 mJ/cm²
Crosslinking bake	95 °C, 2 min hot plate or 90 °C, 30 min convection oven
Development (21-23 °C ± 0.5 °C) puddle	AR 300-47 60 s
Rinse	DI-H_2O, 30 s
Customer-specific technologies	Generation of e.g. semi-conductor properties or lift-off
Removal	AR 600-71 or O_2 plasma ashing

Processing instructions for the generation of lift-off structures and supplementary information

An undercut of the resist structure (lift-off) can be obtained with a prolonged development after minimum exposure. The undercut and structures with vertical side walls remain even at high temperatures of up to 300 °C. This high temperature stability is also used in the two-layer system with AR-BR 5400 and allows intensive sputtering processes at very high temperatures (see product information AR-BN 5400).

This resist formulation is currently successfully processed by customers, may however also be modified according to new customer’s requirements.

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Thermostable Negative Resist SX AR-N 4810/1

PMMA negative photoresist for applications in the BB-UV range

Experimental sample/custom-made product

1. General Description

SX AR-N 4810/1 is a negative chemical amplified photoresist (CAR) based on PMMA. This resist can thus be developed in anhydrous solvents and is particularly suitable for the processing of substrates which are sensi-tive to water or moisture and have to be handled without any contact with water. The resist structures show a high thermostability up to about 280°C.
The resist is composed of polymethylmethacrylate (PMMA), a photoactive compound (organic acid genera-tor) and amine components in Anisole. Viscosity: 9.4 mPas at 20°C.

2. Processing

Before handling, the resist has to be adapted to the temperature of the (preferably air-conditioned) working area (recommend is a range of 20 - 25 °C at a relative humidity of 30 - 50 %). The resist is applied under yellow save light using a spin coating procedure. The following layer thickness values can be obtained: 0.65 µm at 1.000 rpm, 0.48 µm at 2.000 rpm, and 0.32 µm at 4.000 rpm.
The spin coated substrates should be baked on a hot plate (85 + 1.0 °C, 3 min) or in a convection oven at a temperature of 85 + 1.0 °C for 30 minutes. Higher soft bake temperatures should be avoided.
The exposure has to be optimised for the equipment used, requiring respective tests. The spectral range for the exposure is approximately 230 - 440 nm. After the exposure a cross-linking bake at 95 °C up to 105 °C for 30 min in a convection oven or 5 minutes on a hot plate is recommended. Higher post exposure bake temper-atures increase the sensitivity and reduce the developing speed.
The development of the exposed resists is carried out with the water-free Developer X AR 300-74/1 (main component ethyl benzene) using immersion development for 30 - 60 s at approx. 21 °C.
Subsequently, the resist is rinsed for 30 s with the stopper X AR 600-60/1 (octane based) or alternatively with heptane or hexane. Immediately after rinsing, the resist layers have to be dried for 30 min at approx. 80 °C in a convection oven or 5 minutes on a hot plate.

3. Cleaning, Removal and Waste Water Disposal

Solvent mixtures such as the Thinner AR 600-02 and the Remover AR 300-76, AR 600-70 and AR 600-71 are recommended for the cleaning of substrates and equipments and for the removal of layers. Liquid or solid wastes have to be disposed of at controlled landfills or by controlled combustion in officially authorized plants.

4. Safety References

Resist, thinner and remover contain organic solvents, requiring adequate ventilation in the working area. Avoid direct contact with products and their vapours! Wear safety glasses and protective gloves! Please ask for our safety data sheet.

Polyimide Resist SX AR-PC 5000/80.2

Thermally stable resist, also applicable as protective coating

Experimental sample/custom-made product

Characterisation

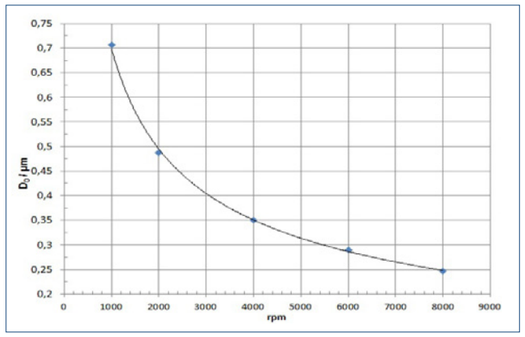
- not light-sensitive > 300 nm, no yellow light required
- thin protective film for surface protection
- plasma etching resistant, thermally stable up to 450 °C
- applicable as sensor material or insulating layer
- structurable in two-component system with AR-P 3500 T
- polyimide
- safer solvent PGMEA and N-methyl pyrrolidone

Properties I

Parameter / AR-PC	5000/80.2
Solids content (%)	10
Viscosity 25°C (mPas)	19
Film thickness/4000 rpm (µm)	0.4
Resolution (µm)	-
Contrast	-
Flash point (°C)	52
Storage temperature (°C)*	8 - 12

* 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.

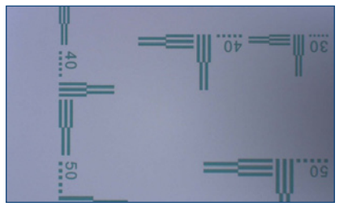
Spin curve



Properties II

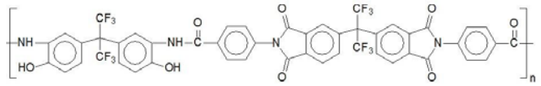
Glass transition temperature °C	170	
Dielectric constant	2.9	
Cauchy-Koeffizienten	N_0	1.581
	N_1	146.7
	N_2	0
Plasma etching rates (nm/min) (5 Pa. 240-250 V Bias)	Ar-sputtering	5
	O_2	208
	CF_4	43
	80 CF_4 + 16 O_2	186

Resist structures



Resist structures of AR-PC 5000/80.2 After processing in two-component system with AR-P 3510 T

Structural formula



Process parameters

Substrat	Si 4“ wafer
Soft bake	150 °C, 2 min, hot plate

Process chemicals

Adhesion promoter	AR 300-80 new
Developer	1-layer system: - 2-layer system: AR 300-46
Thinner	X AR 300-12/3
Remover	AR 300-76, 300-47

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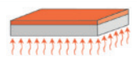
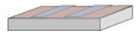
Polyimide Resist SX AR-PC 5000/80.2

Photoresists

Process conditions - One-layer process

This diagram shows exemplary process steps for resist SX AR-PC 5000/80.2. All specifications are guideline values which have to be adapted to own specific conditions.

Pre-coating with AR 300-80 	Adhesive bonding at 2000 rpm, resulting film thickness 15 nm
1. Soft bake 	180 °C, 2 min hot plate or 180 °C, 25 min convection oven
Coating protective film with SX AR-PC 5000/80.2 	1000 rpm, 60 s, 0.8 µm
2. Soft bake (± 1 °C) 	100 °C, 2 min hot plate or 95 °C, 30 min convection oven
Removal AR-PC 5000/80.2 (optional) 	AR 300-76 or O_2 plasma ashing

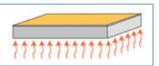
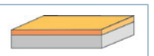
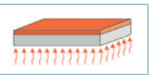
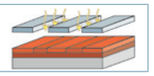
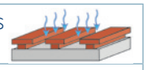
Processing instructions

If SX AR-PC 5000/80.2 is only required as protective coating, as sensor material or for insulation purposes, the process is finished after the 2nd tempering step.

Polyimid Photoresist SX AR-PC 5000/80.2

Process conditions - Two-layer process

Dieses Schema zeigt ein Prozessierungsbeispiel für den Resist SX AR-PC 5000/80.2. Die Angaben sind Richtwerte, die auf die eigenen spezifischen Bedingungen angepasst werden müssen.

Pre-coating with AR 300-80 	Adhesive bonding at 2000 rpm, resulting film thickness 15 nm
1. Soft bake 	180 °C, 2 min hot plate or 180 °C, 25 min convection oven
Coating protective film with SX AR-PC 5000/80.2 	1000 rpm, 60 s, 0.8 µm
2. Soft bake (± 1 °C) 	100 °C, 2 min hot plate or 95 °C °C, 30 min convection oven
Coating AR-P 3540 T 	4000 rpm, 1.4 µm
3. Soft bake (± 1 °C) 	100 °C, 2 min hot plate or 95 °C, 30 min convection oven
UV exposure 	Broadband UV, 365 nm, 405 nm, 436 nm Exposure dose (E_0, BB-UV stepper): 120 mJ/cm^2, 1,4 µm
Development of both resist films (21-23 °C ± 0.5 °C) puddle 	AR 300-46, 40 s
Rinse	DI-H_2O, 30 s
Flood exposure 	Broadband UV, 240 mJ/cm^2
Removal AR-P 3540 T 	AR 300-47, 20 s Only polyimide structures remain
Removal AR-P 5000/80.2 (optional) 	AR 300-76 or O_2 plasma ashing

Processing instructions

For a two-component structuring however, an additional coating with photoresist is necessary. The two-component system can be developed in one step after exposure.

Developer AR 300-46 begins to dissolve exposed areas of AR-P 3540 T as usual and then attacks the underlying polyimide in anisotropic manner, i.e. the structures in polyimide widen only marginally. A prolonged exposure (> 1.5 min) however results in a pronounced undercut.

Polyimide Photoresist SX AR-P 5000/82.7

Thermally stable positive resist for plasma/implantation processes

Experimental sample/custom-made product

Characterisation

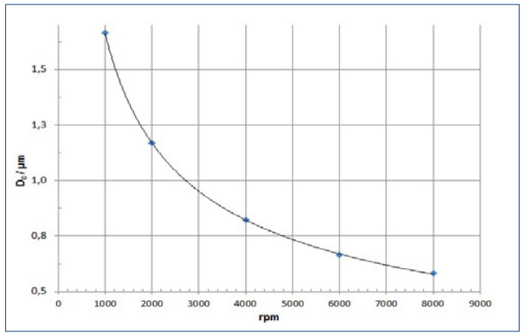
- i-line, g-line, BB-UV
- very high plasma etching stability, thus well suited for plasma and implantation processes
- thermally stable up to 450 °C
- no curing required
- combination of polyimide and naphthoquinone diazide
- safer solvent PGMEA and N-Ethylpyrrolidon

Properties I

Parameter / SX AR-P	5000/82.7
Solids content (%)	15
Viscosity 25°C (mPas)	25
Film thickness/4000 rpm (µm)	0.8
Resolution (µm)	1.5
Contrast	2
Flash point (°C)	53
Storage temperature (°C)*	8 - 12

* 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.

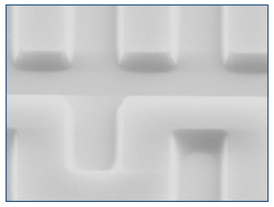
Spin curve



Properties II

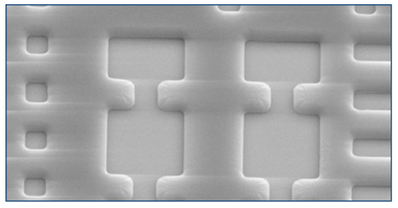
Glass transition temperature °C	170	
Dielectric constant	2.9	
Cauchy coefficients	N_0	1.609
	N_1	58.9
	N_2:	248.3
Plasma etching rates (nm/min) (5 Pa. 240-250 V Bias)	Ar-sputte-ring	5
	O_2	199
	CF_4	41
	80 CF_4 + 16 O_2	188

Structure resolution



SX AR-P 5000/82.7
1.5 µm resolution after development of a 0.8 µm film

Resist structures



Resist structures at film thickness of 10 µm

Process parameters

Substrate	Si 4“ wafer
Soft bake	85 °C, 2 min, hot plate
Exposure	Maskaligner MJB 3, contact exposure
Development	AR 300-26, 1 : 2, 90 s, 22 °C

Process chemicals

Adhesion promoter	AR 300-80 new
Developer	AR 300-26
Thinner	X AR 300-12/3
Remover	AR 300-76, 300-73

ALLRESIST
Innovation
Creativity
Customer-specific solutions

Polyimide Photoresist SX AR-P 5000/82.7

Photoresists

Process conditions

This diagram shows exemplary process steps for resist SX AR-P 5000/82.7. All specifications are guideline values which have to be adapted to own specific conditions. For recommendations on waste water treatment and general safety instructions ☞ "General product information on Allresist photoresists".

Pre-coating with AR 300-80	Adhesive bonding, resulting film thickness 15 nm
1. Soft bake	180 °C, 2 min hot plate or 180 °C, 25 min convection oven
Coating with SX AR-P 5000/82.7	4000 rpm, 60 s , 0.8 µm
2. Soft bake (± 1 °C)	95 °C, 2 min hot plate or 85 °C, 30 min convection oven
UV exposure	g-line Stepper (Broadband UV, 365 nm) Exposure dose (E_0, BB-UV stepper): 200 mJ/cm², 1.6 µm
Development (21-23 °C ± 0.5 °C) puddle	AR 300-26, 1 : 2 2 min
Rinse	DI-H_2O, 30 s
Post-bake	Up to 170 °C, 1 min hot plate (removal just still possible) (up to 300 °C possible, but no removal any more)
Customer-specific technologies	Generation of e.g. semi-conductor properties
Removal	AR 300-76 or O_2 plasma ashing

Processing instructions

The addition of the photosensitive component generates a photo-structurable polyimide. The first tempering step (softbake) may thus not be performed at temperatures above 100 °C.

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