

*Innovation  
Creativity  
Customer-specific solutions*



## **Product information**

**Positive E-Beam Resists AR-P 6200 (CSAR 62)**





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Creativity  
Customer-specific solutions**

# THE ALLRESIST GMBH

Company for chemical Products



The executive board

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 : 2008).

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.

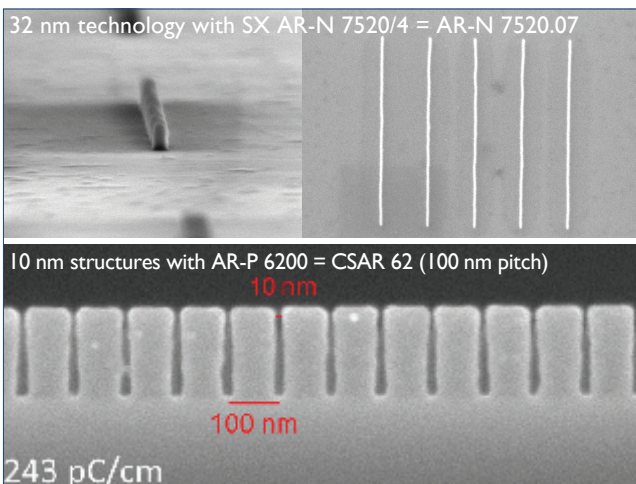
The company is represented worldwide with an extensive product range. In addition to our standard products, we also manufacture customer-specific products on request.

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 AR-N 7520 meet these demands, pushing forward innovative technologies with their excellent properties.



Our Team



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 1/4 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, 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 FAQs.

**WWW.ALLRESIST.DE**



# OUR NEWS

## for Microstructuring

### 2014

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 equivalent properties with respect to dissolving power.

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

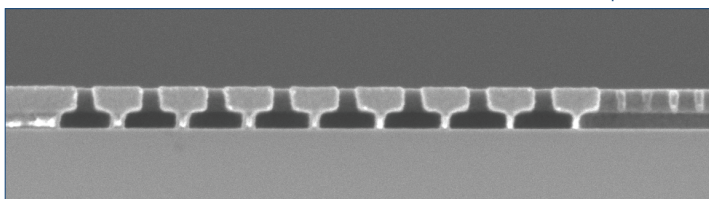
### 2013

The new 5  $\mu\text{m}$ -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  $\mu\text{m}$  to 100  $\mu\text{m}$ .

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 (210 °C or 170 °C, respectively).

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- $\alpha$ -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  $\mu\text{C}/\text{cm}^2$  can be realised. If used in a two-layer system with PMMA, the fabrication of smallest structures with extreme undercuts is possible:



22 nm structures with two-layer system AR-P 6200 / AR-P 679.03

### 2012

With the new e-beam resist **AR-N 7520/4** (replacing resist AR-N 7520), 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  $\mu\text{C}/\text{cm}^2$ .

**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

Allresist offers the new ready-to-use spray resist series **AR-P 1200** and **AR-N 2200** which are suitable for an even coverage of vertical trenches, for etched 54° slopes as well as for the deposition of resists by spin coating.

### 2010

On repeated request by our customers, we developed the 50 % HF-stable protective coating **SX AR-PC 5000/40**.

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

The negative e-beam resists **SX AR-N 7530** (nor CAR, like 7520) and **SX AR-N 7730** (CAR, like 7720) were developed for users of e-beam technologies which have no (or not yet) access to yellow light conditions. These resists can be processed under white light.

The exposure range from > 500 nm up to NIR is covered by the new photoresists **SX AR-N 4420**. Excellent results are obtained with pulsed lasers at 532 nm. The new resists are also well suited for laser interference lithography (LIL) and allow to fabricate vertical and even lift-off structures in the sub-nm range. These resists were specifically designed with flat gradation for sinusoidal three-dimensional structures.

For an efficient dissipation of charges on insulating substrates during e-beam lithography, **SX AR-PC 5000/90.2** was developed which will replace the predecessor product SX AR-PC 5000/90.1. The new conductive protective coating can be used for all resists (PMMA, novolac-based and CSAR 62) and is characterised by a considerably increased conductivity. In addition, it can be removed easily and completely after the process.



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## Positive E-Beam Resists AR-P 6200 (CSAR 62)

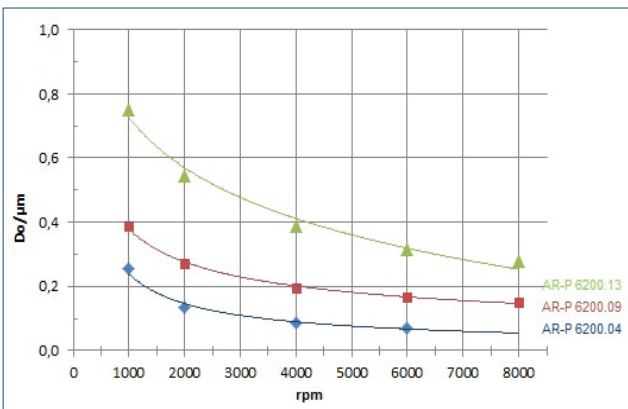
### AR-P 6200 e-beam resists with highest resolution

High-contrast e-beam resists for the production of integrated circuits and masks

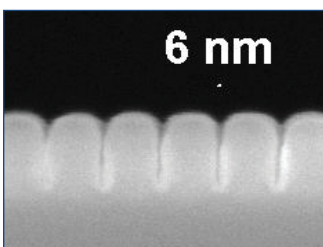
#### Characterisation

- e-beam
- high sensitivity which can be adjusted via the developer
- highest resolution (< 10 nm) and very high contrast
- highly process-stable, high plasma etching resistance
- easy fabrication of lift-off structures
- poly( $\alpha$ -methyl styrene-co- $\alpha$ -chloroacrylate methyl ester) and an enhancer of sensitivity
- safer solvent anisole

#### Spin curve



#### Structure resolution



AR-P 6200.04  
Resolution of up to 6 nm at film thickness of 80 nm

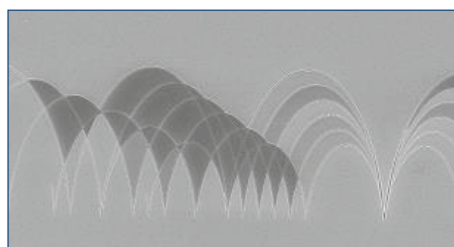
#### Properties I

Parameter / AR-P	6200.13	6200.09	6200.04
Solids content (%)	13	9	4
Viscosity 25 °C (mPas)	11	6	2
Film thickness/4000 rpm (μm)	0.40	0.20	0.08
Resolution best value (nm)	6		
Contrast	14		
Flash point (°C)	43		
Storage 6 month (°C)	8 - 12		

#### Properties II

Glass trans. temperature (°C)	148	
Dielectric constant	2.8	
Cauchy coefficients	N <sub>0</sub>	1.543
	N <sub>1</sub>	71.4
	N <sub>2</sub>	0
Plasma etching rates (nm/min) (5 Pa, 240-250 V Bias)	Ar-sputtering	10
	O <sub>2</sub>	180
	CF <sub>4</sub>	45
	80 CF <sub>4</sub> + 16 O <sub>2</sub>	99

#### Resist structures



AR-P 6200.09  
25-nm structures, film thickness of 180 nm, artwork

#### Process parameters

Substrate	Si 4" waver
Tempering	150 °C, 60 s, hot plate
Exposure	Raith Pioneer, 30 kV
Development	AR 600-546, 60 s, 22 °C

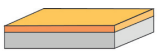
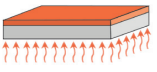
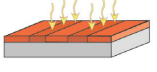
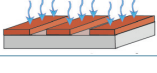
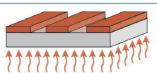
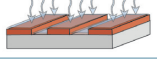

#### Process chemicals

Adhesion promoter	AR 300-80
Developer	AR 600-546, 600-549
Thinner	AR 600-02
Stopper	AR 600-60
Remover	AR 600-71, 300-76

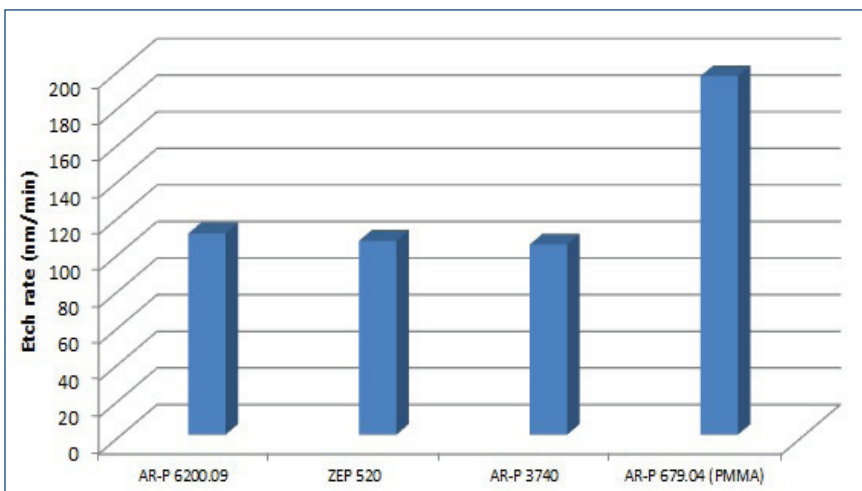
## Positive E-Beam Resists AR-P 6200 (CSAR 62)

### Process conditions

This diagram shows exemplary process steps for AR-P 6200 resists. All specifications are guideline values which have to be adapted to own specific conditions. For further information on processing, ☞ "Detailed instructions for optimum processing of e-beam resists". For recommendations on waste water treatment and general safety instructions, ☞ "General product information on Allresist e-beam resists".

Coating		AR-P 6200.09 4000 rpm, 60 s 0.2 μm
Tempering (± 1 °C)		150 °C, 1 min hot plate or 150 °C, 30 min convection oven
E-beam exposure		Raith Pioneer, 30 kV Exposure dose (E <sub>0</sub> ): 65 μC/cm <sup>2</sup>
Development (21-23 °C ± 0,5 °C) puddle		AR 600-546 1 min
Stopping / Rinse		AR 600-60, 30 s / DI-H <sub>2</sub> O, 30 s
Post-bake (optional)		130 °C, 1 min hot plate or 130 °C, 25 min convection oven for slightly enhanced plasma etching resistance
Customer-specific technologies		Generation of semiconductor properties
Removal		AR 600-71 or O <sub>2</sub> plasma ashing

### Plasma etching resistance



CSAR 62 is characterized by a high plasma etching resistance. In this diagram, plasma etching rates of AR-P 6200.09 are compared with those of AR-P 3740 (photoresist), AR-P 679.04 (PMMA resist) and ZEP 520 in CF<sub>4</sub> + O<sub>2</sub> plasma.

## Positive E-Beam Resists AR-P 6200 (CSAR 62)

### Processing instructions

**E-beam exposure:** The required e-beam exposure dose for structural imaging mainly depends on the desired minimum structure size, the developer, the acceleration voltage (1 - 100 kV), and the film thickness.

The exposure dose for AR-P 6200.09 was in this experiment (☞ diagram comparison of CSAR 62 and PMMA)  $55 \mu\text{C}/\text{cm}^2$  (dose to clear  $D_0$ , 30 kV, 170 nm layer, developer AR 600-546, si wafer). The contrast was determined here to 14.2.

CSAR 62 is thus 3x more sensitive as compared to the standard PMMA resist AR-P 679.03 (developed in AR 600-56), or 6x more sensitive if developed in AR 600-60. Also the contrast is higher by a factor of 2 and 1.4, respectively.

An additional increase in sensitivity due to addition of sensitivity-enhancing components occurs already during exposure. A post-exposure bake is thus not required.

For the fabrication of 10-nm trenches (174 nm film, 100n pitch), AR 6200.09 requires a dose of approx. 220 pC/cm (30 kV, developer AR 600-546)

**Development:** For the development of exposed resist films, developers AR 600-546, 600-548 and 600-549 are recommended. As weaker developer, AR 600-546 provides a wider process window. If the stronger developer AR 600-548 is used, the sensitivity can be increased 6-fold to  $< 10 \mu\text{C}/\text{cm}^2$ . The intermediate developer AR 600-549 renders the CSAR 62 twice as sensitive as compared to AR 600-546, it shows also no dark erosion and has a contrast of 4.

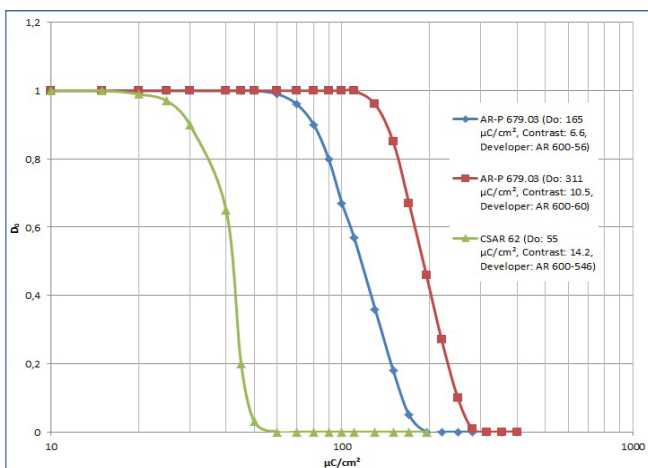
For immersion development, generally development times of 30 - 60 seconds are recommended. If developer AR 600-546 is used, even after 10 minutes at room temperature no erosion of unexposed areas is detected.

Developer AR 600-548 in contrast attacks resist surfaces already after two minutes visibly. If however the development process is carried out at temperatures of approx.  $0^\circ\text{C}$ , no dark erosion is observed even after 5 minutes (which is however associated with a reduction of sensitivity).

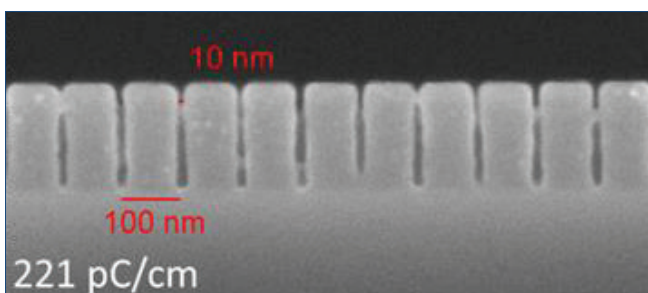
The development procedure should be stopped quickly. For this purpose, the substrate is moved for 30 seconds in stopper AR 600-60. Optionally, the substrate may thereafter be rinsed for 30 seconds with DI water to remove all residual solvent.

Note: Please take into account that rigid rinsing procedures may lead to a collapse of smaller structures (☞ see image below).

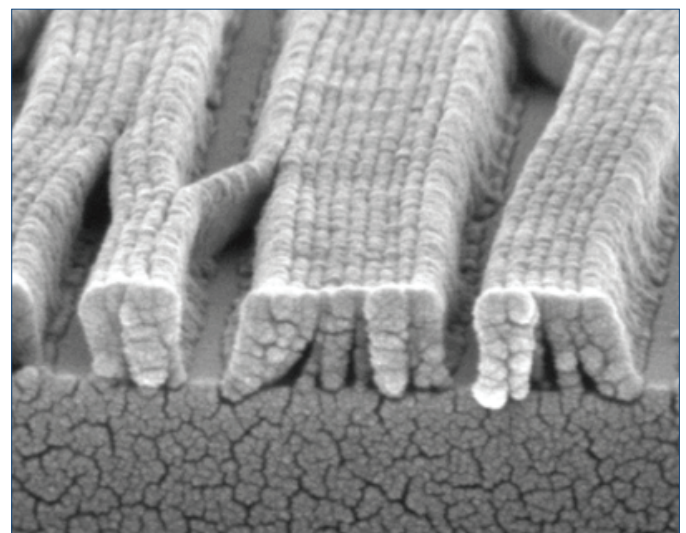
A post-bake for special working steps at max.  $130^\circ\text{C}$  results in a slightly improved etching stability during wet-chemical and plasma-chemical processes.



Comparison  $D_0$  and contrast CSAR 62 and PMMA



Maximum resolution CSAR 62 of 10 nm (180 nm)



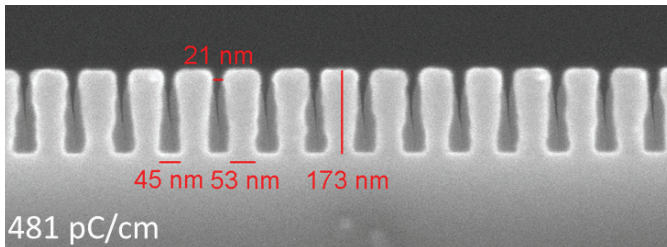
Danger of collapsed lines after too rigid rinsing

## Positive E-Beam Resists AR-P 6200 (CSAR 62)

### Processing instructions

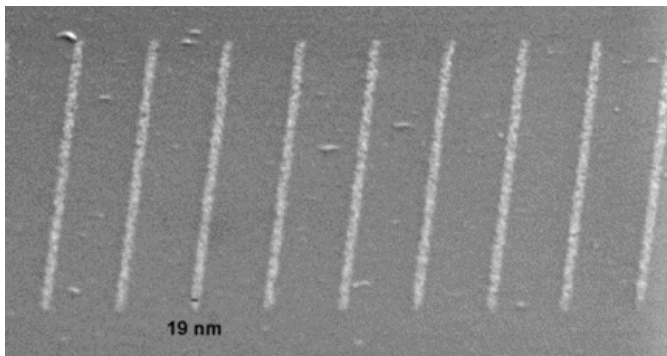
#### Lift-off structures:

Resist CSAR 62 is well suited to generate lift-off structures with a resolution of up to 10 nm. If the dose is increased by a factor of 1.5 - 2, narrow trenches with defined undercut can be fabricated with AR-P 6200.09.

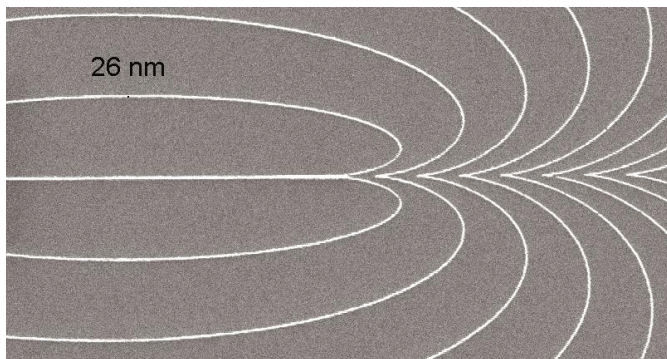


Undercut structures obtained with increased exposure dose

After vapour-deposition of metal and subsequent easy lift-off, metal structures remain



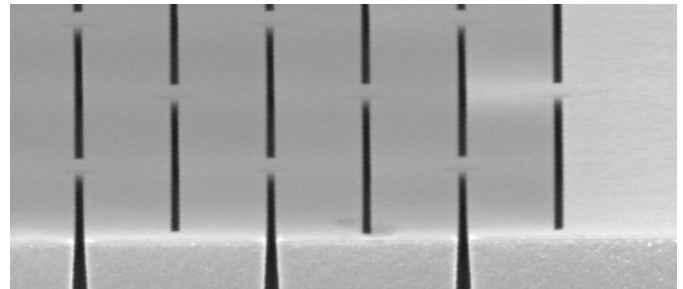
19-nm metal lines after lift-off process with AR-P 6200.09



CrAu test structures with a line width of 26 nm

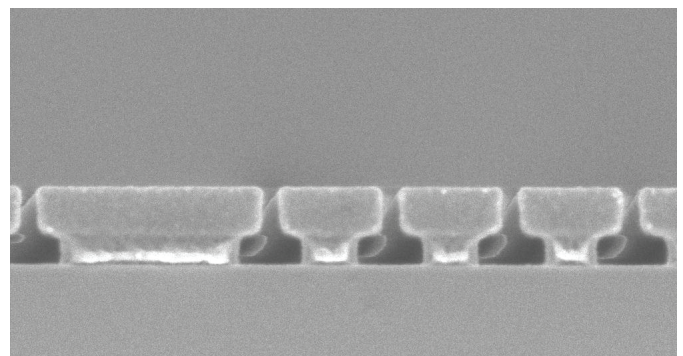
#### High layers for special applications:

Films with a thickness of up to 800 nm can be produced with AR-P 6200.13, and even 1.5- $\mu\text{m}$  films are possible with experimental sample SX AR-P 6200/10.



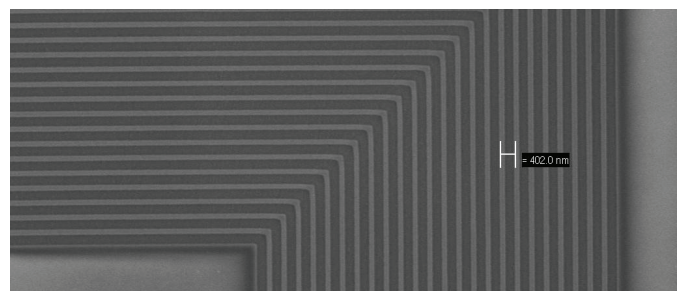
AR-P 6200.13: 100-nm trenches in 830-nm thick layer

CSAR 62 is also applied in various two-layer systems and can be used both as bottom and as top resist.



AR-P 6200.09 as top resist for extreme lift-off applications

Another field of application for CSAR 62 is the production of mask blanks which are coated with our resist and offered by our partners:



At a film thickness of 380 nm, 100-nm lines and spaces can be obtained on a chrome mask with AR-P 6200.13. The sensitivity is 12  $\mu\text{C}/\text{cm}^2$  (20 kV, AR 600-548).



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## Thinner for AR resists


### AR 300-12, 600-01, 600-02, 600-07, 600-09 thinner

For adjusting the film thickness of photoresists and e-beam resists

#### Characterisation

- ultra-filtered, colourless, high-purity organic solvent mixtures
- adjustment of resist film thickness by defined dilution:  
AR 300-12 for photoresists, AR 600-01...09 for e-beam resists
- edge bead removal of coated substrates as well as cleaning of equipment
- AR 300-12: removal of photoresist films tempered at up to 150 °C and of non-tempered e-beam resist films

#### Properties

 safer solvent

Parameter / AR	300-12	600-01	600-02	600-07	600-09
Main component	PGMEA	chlorbenzene	anisole	methoxypropanol	ethyl lactate
Density at 20 °C (g/cm <sup>3</sup> )	0.970	1.108	0.990	0.960	1.036
Refractive index at 20 °C	1.402	1.524	1.517	1.403	1.413
Water content max. (%)	0.1				
Non-volatiles max. (%)	0.002				
Flash point (°C)	42	28	43	38	46
Filtration (µm)	0.2				
Suitable for dilution of AR photoresists	3000, 4000, 5000	-	-	-	-
Suitable for dilution of AR e-beam resists	6510, 7000	631, 641, 661, 671	632, 642, 662, 672, 6200	617	639, 649, 669, 679
Storage 6 month (°C)	10-22				

#### Application properties

Dilution is performed as follows: 1. placing of defined amount of resist, 2. addition of defined amount of thinner, 3. homogenisation by stirring (both liquids should be mixed quickly), and 4. fine filtration (0.2 µm).

#### Information on dilution

Higher dilutions of resists may cause gel formation of the polymers which leads to particle deposition in the resist film during the coating step. Diluted resists should therefore be subjected to ultra-filtration (0.2 µm) prior to use. In most cases it is more advantageous to adjust the desired film thickness by varying the spin speed or to utilise a pre-adjusted resist. Special adjustments of thickness values are possible on request for an additional charge.

#### Formula for dilutions

Example: Starting with a resist with 35 % solids content (AR-P 3510), a solids content of 31 % is desired. Requested is the amount of thinner AR 300-12 in g which has to be added to 100 g resist with 35 % solids content (mass m in g, solids content c /100).

$$m \text{ thinner} = m \text{ resist} \frac{(c \text{ resist} - c \text{ desired})}{c \text{ desired}} = 100.0 \text{ g} \frac{(0.35 - 0.31)}{0.31} = 12.9 \text{ g thinner}$$

If 100.0 g resist (35 % solids content = AR-P 3510) are diluted with 12.9 g thinner in defined manner, 112.9 g diluted resist (31 % solids content = AR-P 3540) will be obtained.

With this dilution, the film thickness is reduced from 2.0 to 1.4 µm at a spin speed of 4000 rpm.



## Developer for AR E-Beam Resists

### AR 600-50, -51, 600-546, -548, -549, 600-55, -56 developer

For the development of e-beam resists films

#### Characterisation

- ultrapure, ultra-filtered (0.2 µm) solvent mixtures
- storage at 10-22 °C for 6 month

#### Properties



safer solvent



optimally suited



suited

AR resist / developer	AR 600-50 (new)	AR 600-51	AR 600-55	AR 600-56
Fields of application/conditions	dip, puddle, spray development at 21-23 °C ± 1 °C			
Main component(s)	methoxypropanol / isopropyl alcohol	butoxyethoxy ethanol	methyl isobutyl ketone (MIBK)	methyl isobutyl ketone (MIBK)
Properties			strong developer	weaker developer
Density at 20 °C (g/cm <sup>3</sup> )	0.871	0.972	0.792	0.788
Refractive index at 20 °C	1.395	1.430	1.384	1.381
Water content max. (%)	0.1	15	0.1	0.1
Flash point (°C)	21	85	12	12
AR-P 617	2-3 min	5 min	3 min	3 min
AR-P 630 - 670 series	-	3 min	1-3 min	1-3 min
AR-P 6500	-	1 h	-	-

AR resist / developer	AR 600-546	AR 600-548	AR 600-549	
Fields of application/conditions	dip, puddle, spray development at 21-23 °C ± 1 °C			
Main component(s)	amyl acetate	diethyl ketone / diethyl malonate	diethyl malonate / anisole	
Properties	weaker developer	strong developer	moderate developer	
Density at 20 °C (g/cm <sup>3</sup> )	0.876	0.917	1.053	
Refractive index at 20 °C	1.402	1.401	1.417	
Water content max. (%)	0.1	0.1	0.1	
Flash point (°C)	41	22	85	
AR-P 6200	1 min	1 min	1 min	

#### Information on developer processing

The choice of the developer strongly influences the development rate, the sensitivity and the profile of the resist structures. Coated and exposed substrates are treated with developers which are suitable for the respective process (puddle, spray, immersion bath) at a temperature of 21-23 °C kept as constant as possible. The required development time depends in each case on the resist film thickness. Films with a thickness of less than 0.2 µm can for example be completely developed after 30 s. The development process can be slowed down for AR 600-50, -55 and -56 by adding 10-20 % of the stopper AR 600-60.

Weaker developers like AR 600-56 and AR 600-546 provide a higher resolution without dark erosion, while a significantly higher sensitivity with at the same time higher dark erosion can be obtained with developers AR 600-55 and AR 600-548. If CSAR 62 is processed with developer AR 600-548 at a development temperature of about 0 °C, even after 10 minutes no erosion is observed at the prolonged development time. Substrates have to be rinsed immediately after development for 30 seconds with stopper and are subsequently dried.



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## Stopper for AR Resists

### AR 600-60, 600-61 stopper

For the stopping of e-beam resist film development with solvents

#### Characterisation

- immediate interruption of the development process
- ultrapure solvent mixtures for residue-free removal of remaining developer
- AR 600-60 for AR-P 617, 630-670er, 6200
- AR 600-61 for AR-P 6510

#### Properties I

Parameter / AR	600-60	600-61
Density at 20 °C (g/cm <sup>3</sup> )	0.785	0.964
Water content max. (%)	0.1	20
Non-volatiles max. (%)	0.002	0.002
Flash point (°C)	12	105
Filtration (µm)	0.2	
Storage up to 6 month (°C)	10-22	

#### Information on remover processing

The addition of stopper for approximately 30 s after development interrupts the development process and leads to a rapid rinsing of residual developer.

Due the processing regime however, constantly developer is transferred into the stopper bath. Already small amounts of the developer will affect the efficiency of the stopping process. It is thus highly recommended to constantly exchange the stopper or to use two stopper baths which are arranged consecutively.

If 10-20 % of stopper AR 600-60 is added to developers AR 600-50, 600-55 and 600-56, the development process is slowed down.

If the stopper AR 600-60 is used for developers AR-P 630-670, higher contrast values up to 10 are possible, while the sensitivity of the PMMA resists is at the same time decreased. Higher exposure doses and prolonged development times are thus required in this case.

## Remover for AR Resists

### AR-P 600-70, 600-71, 300-76, 300-70, 300-72, 300-73 remover

For the stripping of tempered photoresist and e-beam resist films

#### Characterisation

- aqueous-alkaline solution (AR 300-73) or organic solvents (all others)

Remover recommendations after tempering:

- photoresists up to 180 °C: AR 600-71, 300-76
- photoresists up to 200 °C: AR 300-76, 300-71
- PMMAs up to 200 °C: AR 600-71, 300-76
- copolymers up to 210 °C: AR 600-71, 300-76
- CSAR 62 up to 200 °C: AR 600-71, 300-76
- novolac e-beam resists 150 °C: AR 300-73, 300-76

#### Properties

Parameter / AR	600-70	600-71	300-76 new	300-70, -72	300-73
Main component	acetone	dioxolane	DMG	NEP	TMAH
Density at 20 °C (g/cm <sup>3</sup> )	0.79	1.02	1.08	1.03	1.00
Non-volatiles max. (%)	0.002				
Flash point (°C)	-16	-4	103	98	-
Filtration (µm)	0.2				
Storage up to 6 month (°C)	10-22	10-18	15-25	10-22	10-22

#### Remover recommendations

  optimally suitable  
   suitable  
   limited suitability  
   unsuitable

Properties / Remover AR	600-70	600-71	300-76 new * heated to 80 °C	300-70, 300-72 * heated to 80 °C	300-73 + heated to 50 °C			
average time for removal at 1.5 µm								
Suitability for tempered photoresist films (21 °C)	inexpensive, commonly used	efficient all-rounder	universal, replacing the reprod. toxic, NEP: = AR 300-70, -72	universal, especially for thin films, but toxic for reproduction	special: AR-BR 5400, AR-P 3100, 3500, 3700			
120 °C	15 s	10 s	25 s	20 s	30 s			
150 °C	20 s	15 s	3 min	25 s *	2 min	20 s *	2 min	60 s +
180 °C	5 min	4 min	2 h	60 s *	2 h	50 s *	2 h	2 min +
200 °C			30 min *		25 min *			30 min +
Suitability for tempered e-beam resist films (21 °C)	inexpensive, commonly used	efficient all-rounder	universal, replacing reprod. -toxic NEP:	universal, but toxic for reproduction	special: AR-N 7520, 7700			
PMMA 150 °C	25 s	20 s	20 min	10 s *	18 min	10 s *		15 min +
PMMA 180 °C	2 min	2 min	30 min	30 s *	28 min	30 s *		25 min +
PMMA 200 °C	3 min	3 min	42 min	50 s *	40 min	50 s *		
Copolymer 190 - 210 °C	10 s	5 s		60 s *		50 s *		20 min +
CSAR 62 150 °C		30 s		60 s *		50 s *		10 min +
CSAR 62 180 - 200 °C		40 - 60 s		5 min *		4 min *		15 - 25 min +
Novolac-based 85 - 120 °C	5 - 60 s except 7700	3 - 50 s except 7700		5 s * except 7520, 7700		5 s * except 7520, 7700		25 s - 3 min +
Novolac-based 150 °C	10 s - 9 min except 7520, 7700	5 s - 7 min except 7520, 7700		30 s * except 7520, 7700		10 s * except 7520, 7700		10 s - 50 min +

#### Processing instructions for removers

Substrates coated with resist are exposed to the effect of the remover by immersion (puddle or dip). To reduce the dissolution time for tempered layers, removers AR 300-70, 300-72 and 300-76 may be heated to up to 80 °C, remover AR 300-73 to up to 50 °C or megasond may be helpful in this case. It is recommended to rinse off the remover with DI water, clean remover or with a suitable thinner. A stripping of very hard-baked layers (> 220 °C) with remover is hardly possible any more. In this case, oxidizing acids or oxygen plasma may be used for stripping. Further detailed remover specifications for a large variety of resists are listed on the following pages.



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## Remover for A Resists

Remover recommendations				<20/60s	optimally suitable	<5/30min	suitable	<1-6h	limited suitability	≥6h	unsuitable	
Product AR	Film thickness (µm)	Tempering (°C)	Recom-mend.	600-70	600-71	300-76 new		300-70, 300-72		300-73		
				21 °C	21 °C	21 °C	80 °C	21 °C	80 °C	21 °C	50 °C	
AR-P 3100 Example 3110	1.5	95 - 120	300-76 300-73 (300-72)	< 20 s	< 20 s	< 20 s		< 20 s		< 20 s		
					3 h	< 20 s		< 20 s		< 60 s		
					6 h	< 5 min	< 60 s	< 5 min	< 60 s	1 h	< 60 s	
							< 30 min		< 30 min		< 30 min	
AR-P 3200 Example 3220	10	95	600-71 300-76 300-73	< 20 s	< 20 s	< 20 s		< 20 s		< 5 min	< 60 s	
				< 20 s	< 20 s	< 60 s		< 60 s		< 30 min	< 5 min	
				< 60 s	< 20 s	< 5 min	< 60 s	< 5 min	< 60 s	< 30 min	< 5 min	
					4 h	1 h	< 30 min	1 h	< 30 min		< 30 min	
							1 h		1 h		2 h	
AR-P 3500 Example 3540	1.5	95 - 150	600-71 300-73 300-76	< 20 s	< 20 s	< 20 s		< 20 s		< 20 s		
				< 30 min	< 5 min	< 5 min	< 20 s	< 5 min	< 20 s	< 60 s	< 20 s	
							< 1 h		< 1 h	3 h	< 30 min	
AR-P 3500T Example 3540T	1.5	95 - 120	600-71 300-76 (300-72)	< 20 s	< 20 s	< 20 s		< 20 s		< 20 s		
				4 h	< 5 min	< 60 s	< 20 s	< 5 min	< 20 s	< 30 min	< 5 min	
						< 30 min	< 5 min		< 5 min		< 30 min	
							1 h		1 h			
AR-P 3700 / 3800 Example 3740	1.5	95	600-71 300-76 300-73	< 20 s	< 20 s	< 20 s		< 20 s		< 60 s		
				< 20 s	< 20 s	< 20 s		< 20 s		< 5 min	< 20 s	
				< 60 s	< 20 s	< 60 s		< 60 s		< 5 min	< 20 s	
				< 30 min	< 30 min	< 5 min	< 60 s	< 5 min	< 60 s	< 30 min	< 60 s	
							< 30 min		< 30 min	6 h	< 30 min	
AR-P 5300 Example 5350	1.5	95 - 150	600-71 300-73 300-76	< 20 s	< 20 s	< 20 s		< 20 s		< 20 s		
				< 60 s	< 60 s	< 60 s		< 60 s		< 60 s		
							1 h		1 h		< 30 min	
AR-U 4000 Example 4040	1.5	95	600-71 300-76 (300-72)	< 20 s	< 20 s	< 20 s		< 20 s		< 20 s		
				< 20 s	< 20 s	< 20 s		< 20 s		< 60 s		
							< 5 min		< 5 min		3 h	
							< 30 min		< 30 min			
AR-PC 500 Example 504	2.0	150	600-71 300-76 (300-72)	< 5 min	< 5 min	< 1 h	< 5 min	< 1 h	< 5 min		< 5 min	
				< 30 min	< 30 min	1 h	< 5 min	1 h	< 5 min		4 h	
AR-P 5900 Example 5910	5.0	85 - 120	300-76 300-73 (300-72)	< 20 s	< 20 s	< 20 s		< 20 s		< 5 min		
							< 2 h	< 30 min	< 2 h	< 30 min	< 2 h	< 5 min
											< 2 h	
AR-N 4200 Example 4240	1.5	85 - 150	600-71 300-76 300-73	< 20 s	< 20 s	< 20 s		< 20 s		< 20 s		
				< 20 s	< 20 s	< 60 s		< 60 s		< 5 min		
							< 1 h		< 1 h		< 1 h	

## Remover for AR Resists

Remover recommendations				< 20/60 s	optimally suitable	< 5/30 min	suitable	< 1-6 h	limited suitability	≥ 6 h	unsuitable
Product AR	Film thickness (µm)	Tempering (°C)	Recom- mend.	600-70	600-71	300-76 new		300-70, 300-72		300-73	
				21 °C	21 °C	21 °C	80 °C	21 °C	80 °C	21 °C	50 °C
AR-N 4300 Example 4340	1.5	95	300-76 (300-72) 300-73	< 20 s	< 20 s	< 20 s		< 20 s		< 60 s	
		110				< 60 s		< 60 s	1 h	< 60 s	
		120				< 30 min	< 5 min	< 5 min		6 h	< 30 min
		150				1 h	< 30 min	< 30 min	< 5 min		< 30 min
		180				6 h	1 h	1 h	< 30 min		
		200						5 h	1 h		
AR-N 4400 Example 4400-50	50	95	600-71 600-70	< 20 s	< 20 s	< 5 min	< 5 min	< 5 min	< 60 s	< 60 s	
		120		< 5 min	< 5 min	6 h	< 60 s	5 h	< 60 s	6 h	< 30 min
		150		< 5 min	< 5 min		1 h		1 h		2 h
		180		< 30 min	< 30 min		2 h		2 h		
		200		5 h	4 h						
AR-P 617 Example 617.08	0.5	190	600-71 300-76 300-73	< 5 min	< 5 min	< 1 h	< 60 s	< 1 h	< 60 s		< 30 min
		210		< 30 min	< 5 min	6 h	< 5 min	6 h	< 5 min		< 30 min
AR-P 630-670 Example 671.05	0.5	150	600-71 300-76 (300-72)	< 20 s	< 20 s	< 30 min	< 20 s	< 30 min	< 20 s		< 30 min
		180		< 5 min	< 5 min	< 30 min	< 60 s	< 30 min	< 60 s		< 30 min
		200		< 5 min	< 5 min	< 1 h	< 60 s	< 1 h	< 60 s		
AR-P 6200 new Example 6200.09	0.4	150	600-71 300-76 300-73		< 20 s	< 30 min	< 5 min	< 30 min	< 5 min	< 30 min	< 5 min
		180			< 60 s	< 30 min	< 5 min	< 30 min	< 5 min	< 1 h	< 30 min
		200			< 60 s	< 30 min	< 60 s	< 30 min	< 60 s		< 30 min
AR-P 7400 Example 7400.23	1.5	105	600-71 300-76 (300-72)	< 20 s	< 20 s	< 20 s	< 20 s	< 20 s		< 20 s	
		120		< 20 s	< 20 s	< 20 s	< 20 s	< 20 s		< 20 s	
		150					< 5 min		< 5 min		3 h
		180					< 30 min		< 30 min		
AR-N 7500 Example 7500.18	0.4	85-150	600-71 300-76 300-73	< 20 s	< 20 s	< 20 s		< 20 s		< 20 s	
		180					6 h		4 h	3 h	< 10 min
AR-N 7520 new Example 7520.17	0.4	85	600-71 300-73 300-76	< 20 s	< 20 s	< 20 s		< 20 s	< 20 s	< 60 s	
		105		< 20 s	< 20 s	< 20 s		< 20 s	< 20 s	< 5 min	
		120					4 h		3 h	< 30 min	< 5 min
		150					6 h		4 h		< 1 h
AR-N 7700 Example 7700.18	0.4	105	300-76 300-73			< 1 h	< 30 s		< 1 h	< 1 h	< 60 s
		120								< 1 h	< 5 min
		150								3 h	< 30 min
AR-N 7720 Example 7720.18	1.4	105-120	600-71 300-76 (300-72)	< 60 s	< 60 s	< 20 s		< 20 s		< 20 s	
		150		< 5 min	< 5 min	3 h	< 5 min	2 h	< 5 min	< 60 s	
		180					< 30 min	< 30 min	< 30 min	< 30 min	< 5 min
		200					1 h		1 h		

The average times required for removal as listed under "properties" are divided into time clusters (< 20 s, < 60 s ...) for better orientation. In the column for remover recommendations, the first entry applies to low-baked and the second entry (or, if applicable, the third) to resist films baked at higher temperatures. The recommendation for remover AR 300-72 is indicated in brackets, since this remover is highly effective, but also classified as toxic for reproduction and thus not prioritized by Allresist. As replacement, we recommend the equivalent removers AR 300-76 and 600-71.



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## Adhesion Promoter for AR Resists

### AR 300-80 and HMDS adhesion promoter

For improving the adhesive strength of photo and e-beam resists

#### Characterisation

- improvement of the adhesive strength of photo and e-beam resist films
- especially for surfaces with low adhesion properties, e.g. metal, SiO<sub>2</sub>, GaAs
- AR 300-80: spin coating of a diphenylsilanediol solution = improved adhesion properties and simple, cheaper alternative to HMDS
- HMDS: evaporation of HMDS on the substrate surface (equipment required)

#### Properties

Parameter / AR	300-80	HMDS
Density at 20 °C (g/cm <sup>3</sup> )	0.971	0.774
Flash point (°C)	42	14
Filtration (µm)	0.2	0.2
Storage 6 month (°C)	10-22	

#### Processing information AR 300-80

AR 300-80 is applied by spin coating between 1000 and 6000 rpm. The film thickness can be adjusted by varying the spin speed to the optimum conditions of the respective process.

Higher spin speeds and thus thinner films are preferable, e.g. 4000 rpm with approx. 15 nm thickness. Too high concentrations (film thickness values) may reduce or neutralise the adhesion-promoting effect.

It is recommended to perform the subsequent tempering on a hot plate for 2 min or in a convection oven for 25 min at 180 °C. During tempering, a very uniform, extremely thin layer of adhesion promoter is generated on the substrate (approx. 15 nm).

After cooling of the substrate, the resist can be applied as usual.

An excess of adhesion promoter may be rinsed off with organic solvents like e.g. AR 600-70 or AR 600-71. The optimised surface properties are maintained without restriction.

#### Processing information HMDS

Appropriate equipment is required for the processing of HMDS.

The pre-treatment should be performed immediately prior to resist coating. Generally, hot plates with integrated HMDS-evaporation are used in the production. If this option is not available, the substrate is placed in a desiccator where HMDS evaporates at room temperature or at temperatures up to 160 °C max. HMDS is under these conditions deposited as monomolecular layer (approx. 5 nm) on the substrate surface.

The treated substrate can be coated with resist immediately after HMDS-deposition without subsequent tempering, or stored in a closed container for a couple of days.

The storage stability may be limited due to an uptake of water from the atmosphere. Storage in open containers should thus be avoided.





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## Product Portfolio Photoresists

We deliver our products within 1 week ex work, in-stock stock items are delivered immediately or on the desired date. Resists are available in package sizes of ¼ l, 0,5 l, 1 l, 2,5 l, 6 x 1 l, 4 x 2,5 l and corresponding process chemicals in package sizes of 1 l, 2,5 l, 5 l, 4 x 2,5 l, 4 x 5 l. Test samples/smallest quantities of 30 ml and 100 ml are possible. Please request our price lists.

Resist system	Product	Do/ µm 4000 rpm	Type	Characteristic Properties	Applica- tion	Resolution [µm]	Con- trast	Expo- sure	Thinner	Deve- loper	Remo- ver	
AR-P 1200	1210, 1220, 1230	[0.5 - 10]	positive resist	spray resist, var. applications	MEMS	1	3	i-line, g-line, BB-UV	-	300-44 300-35	300-76 300-73	
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	electro- plating, MST	4 ; 3 ; 1.2	2 ; 2.5 ; 2.0		300-12	300-26	600-71 300-76	
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	300-76 300-73	
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	300-76 300-72	
AR-P 3700, 3800	3740, 3840	1.4 ; 1.4		highest resolution, sub-µm, 3840 dyed	VLSIC	0.4 ; 0.4	6.0 ; 6.0		300-12	300-47 300-26	600-71 300-76	
AR-P 5300	5320, 5340	5.0 ; 1.0		undercut structures (single layer lift-off)	evapor- ation structures	2 ; 0.5	4 ; 5		300-12	300-26	600-71 300-73	
AR-U 4000	4030, 4040 4060	1.8 ; 1.6 ; 0.6	special application	optionally pos. or neg., lift off	ICs	0.8 ; 0.7; 0.5	3 ; 3 ; 3.5	-	300-12	300-35 300-26	300-76 300-72	
AR-PC 500	503 dyed 504	1.2 ; 2.2		protective coating, 40% KOH etch-stable	protecti- ve film	-	-		600-01	-	600-71 300-76	
AR-BR 5400	5460, 5480	1.0 ; 0.5		bottom resist for 2L lift-off	lift-off (pos/neg.)	3 ; 1.5	lift-off		-	-	300-73 300-76	
AR-P 5900	5910	5.0		complicated patten. up to 5 % HF / BOE	MEMS	2	2.0		i-line, g-line, BB-UV	300-12	300-26	300-76 300-73
AR-N 2200	2210, 2220, 2230	[0.5 - 10]	negative resist	spray resist, var. applications	MEMS	1	3	deep UV, i-line	-	300-44	600-71 300-73	
AR-N 4200	4240	1.4		highly sensitive, high resolution	ICs	0.6	2.8		300-12	300-26 300-47	600-71 300-76	
AR-N 4300	4340	1.4		highest sensitivity, high resolution, CAR	ICs	0.5	5		300-12	300-26 300-475	600-76 300-72	
AR-N 4400	4400-50, -25, -10, -05	1000 rpm: 50 ; 25 ; 10 ; 5		thick films up to 100, 50, 20, 10 µm, easy removal	electro- plating, MST, LIGA	5.0 ; 3.5 ; 2.0 ; 1.0	6 ; 5 ; 4 ; 4		X-ray, e-beam, i-line	300-12	300-44 bis -475	600-71 600-70
AR-N 4450	4450-10	1000 rpm: 10		thick films up to 20 µm, lift-off		2.0 3.5	10 lift-off			300-12	300-47	600-71 600-70

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



## Product Portfolio E-Beam Resists

We deliver our products within 1 week ex work, in-stock stock items are delivered immediately or on the desired date. Resists are available in package sizes of ¼ l, 0,5 l, 1 l, 2,5 l, 6 x 1 l, 4 x 2,5 l and corresponding process chemicals in package sizes of 1 l, 2,5 l, 5 l, 4 x 2,5 l, 4 x 5 l. Test samples/smallest quantities of 30 ml and 100 ml are possible. Please request our price lists.

Resist system	Product	Do/ µm 4000 rpm	Type	Characteristic Properties	Applica- tion	Resoluti- on [µm]*	Con- trast	Expo- sure	Thin- ner	Deve- loper	Remo- ver	
AR-P 617	copolymer PMMA/MA 33%	0.09-1.75	positive	highest resolution, pro- cess-stable, safer solvent methoxypropanole	ICs, masks	10 / 100	6.0	e-beam, deep UV	600-07	600-50 600-55	600-71 300-76	
AR-P 631- 671	PMMA 50K, 200K, 600K, 950K	0.02-1.70		highest resolution, process stable, sol- vent chlorobenzene	ICs, masks	6 / 100	7.0		600-01	600-55 600-56	600-71 300-76	
AR-P 632- 672	PMMA 50K, 200K, 600K, 950K	0.01-1.87		highest resolution, process stable, safer solvent anisole	ICs, masks	6 / 100	7.0		600-02	600-55 600-56	600-71 300-76	
AR-P 639- 679	PMMA 50K, 200K, 600K, 950K	0.02-0.74		highest resolution, process stable, safer solvent ethyl lactate	ICs, masks	6 / 100	7.0		600-09	300-55 300-56	600-71 300-76	
AR-P 6200 <sup>new</sup> CSAR 62	6200.04, .09, 6200.13 styrene acrylate	0.08 ; 0.4 ; 0.2		highest resolution, high sensitivity, plas- ma etching-resistant	ICs, sensors, masks	6	14		600-02	600-546 600-548 600-549	600-71 300-76	
AR-P 6500	6510.17, .18, 6510.19 PMMA	350 rpm: 45. 80. 150		thick films up to 250 µm; synchrotron	micro compo- nents	1 µm (x-ray)	10 (x-ray)		x-ray, e-beam, deep UV	300-12	600-51 600-56	600-71 300-76
AR-P 7400	7400.23 novolac	0.6		mix&match, high resolution, short writing times	ICs, masks	40 / 150	10		e-beam, deep UV, g-line	300-12	300-47	300-76 600-71
AR-N 7500	7500.08, 7500.18 novolac	0.1 ; 0.4	negative	mix&match, high resolution, plasma etching resistant	ICs, masks	40 / 100	5.0	e-beam, deep UV, g-line, i-line	300-12	300-47	600-71 300-73	
AR-N 7520 new	7520.07, .11, 7520.17 novolac	0.1 ; 0.2; 0.4		mix&match, high resolu- tion, plasma etching resistant	ICs, masks	30	8.0		300-12	300-47	600-71 300-73	
AR-N 7700	7700.08, 7700.18 novolac	0.1 ; 0.4		CAR, high resoluti- on, steep gradation	ICs, masks	80 / 100	5.0	e-beam, deep UV	300-12	300-46 300-47	300-76 300-73	
AR-N 7720	7720.13, 7720.30 novolac	0.25 ; 1.4		CAR, high resolu- tion, low contrast, flat gradation	diffract. optics	80 / 200	< 1.0		300-12	300-46 300-47	300-76 300-72	

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

Note: If the stopper AR 600-60 is used for developer AR-P 631-679, higher contrast values of up to 10 can be achieved.

Resists AR-P 617, 631-679, 6200 require brief stopping in stopper AR 600-60 after development.

Resists of the AR-P 6500 series require brief stopping in stopper AR 600-61 after development.

\* best value / industrial application



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## Product Portfolio Experimental Samples

We deliver our products within 1 week ex work, in-stock stock items are delivered immediately or on the desired date. Resists are available in package sizes of ¼ l, 0,5 l, 1 l, 2,5 l, 6 x 1 l, 4 x 2,5 l and corresponding process chemicals in package sizes of 1 l, 2,5 l, 5 l, 4 x 2,5 l, 4 x 5 l. Test samples/smallest quantities of 30 ml and 100 ml are possible. Please request our price lists.

Special product	Do/µm 4000 rpm	Type	Characteristic properties / Application	Resoluti- on [µm]*	Con- trast	Exposure	Thinner	Deve- loper	Re- mover
<b>Market-ready experimental samples</b>									
X AR-P 3220/7	6.0	positive	temperature-/ plasma et- ching stable thick resist	2	2	i-line, g- line, BB-UV	300-12	300-26	300-76 300-72
X AR-P 5800/7	0.6		plasma etching positive resist for deep UV	0.6	3	deep UV, i-line	300-12	300-35 300-47	600-70
X AR-P 5900/4	1.4		positive photoresist, alkali- stable up to pH 14	1	2	i-line, g-line	300-12	300-26	600-70
X AR-N 7700/30	0.4	neg.	highly sensitive, highest- resolution CA negative e-beam resist	0.2	5	e-beam, deep UV	300-12	300-475	600-70 300-76
<b>Special designs / Experimental samples</b>									
SX AR-P 3500/6	2.0	positive	positive photoresist for holography (488 nm)	1	3	i-line, g- line, BB-UV	300-12	300-47	600-70 300-76
SX AR-P 3740/4	1.4		positive photoresist, highly process-stable, high contrast	0.6	5	i-line, g- line, BB-UV	300-12	300-475	600-70 300-76
SX AR-N 4340/7	1.4	neg.	temperature-stable nega- tive resist up to 300 °C (2L-system)	0.5	5	i-line, g-line	300-12	300-47	300-76 600-71
SX AR-PC 5000/22.2	0.02	-	protective coating for spray application, smooth surface	-	-	-	600-09	-	600-70 300-76
SX AR-PC 5000/40	5.0	-	protective coating 40% KOH- and 50% HF-resistant	- 2L: 10	- 2L: 1	- 2 L: i-line	300-74/1	300-26	300-74/1
SX AR-PC 5000/80.2	0.4	-	polyimide photoresist, protective coating for 2 L-patterning	- 2L: 2	- 2L: 1	- 2 L: i-line	300-12/3	-	600-70 300-76
SX AR-P 5000/82.7	0.8	-	polyimide photoresist, structurable and tempera- ture-stable	1.5	2	i-line	300-12/3	300-26 300-47	300-76 300-72
SX AR-PC 5000/90.1	0.1	-	conductive protective coating for PMMA-e-beam resists	-	-	-	-	-	DI water
SX AR-N 7530 new	0.2	neg.	white light e-beam resist like AR-N 7520	0.03	8	e-beam, deep UV	300-12	300-47 300-47	600-71 300-76
SX AR-N 7730 new	0.2		white light e-beam resist like AR-N 7720	0.08	< 1.0				

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

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Authors: Matthias and Brigitte Schirmer  
assisted by Dr. Christian Kaiser  
Layout: Ulrike Dorothea Schirmer  
Translation: S.K. Hemschemeier

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**ALLRESIST**



Allresist GmbH  
Am Biotop 14  
15344 Strausberg  
Germany

Phone +49 (0) 3341 35 93 - 0  
Fax +49 (0) 3341 35 93 - 29

info@allresist.de  
www.allresist.de



Technologie  
Stiftung  
Brandenburg



Zukunftspreis  
Brandenburg

