Negative E-Beam Resists AR-N 7720

AR-N 7720 e-beam resists with flat gradation

High-resolution e-beam resists for the production of diffractive optics

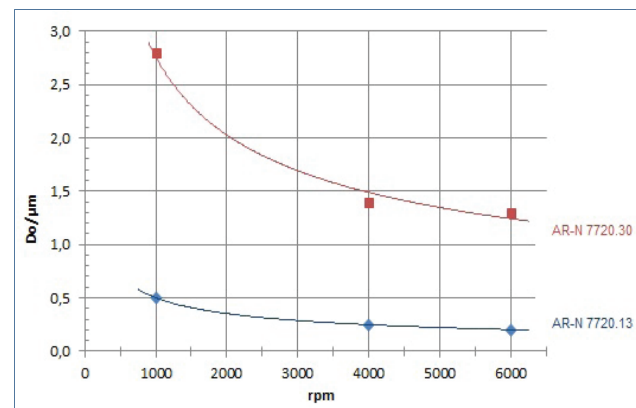
Characterisation

- e-beam, deep UV; chemically enhanced (CAR)
- flat gradation for three-dimensional resist profiles for diffractive optics and holograms
- negative-tone with high resolution in the UV-range 248-265 nm and 290-330 nm
- plasma etching resistant, temperature-stable up to 140 °C
- novolac, acid generator, crosslinking agent
- safer solvent PGMEA

Properties I

Parameter / AR-N	7720.30	7720.13
Solids content (%)	30	13
Viscosity 25 °C (mPas)	20	3
Film thickness/4000 rpm (µm)	1.4	0.25
Resolution best value (nm)	80	
Contrast	< 1	
Flash point (°C)	42	
Storage 6 month (°C)	8 - 12	

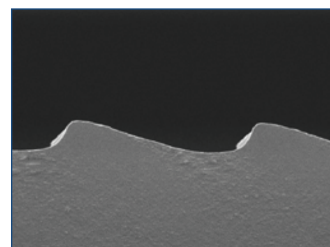
Spin curve



Properties II

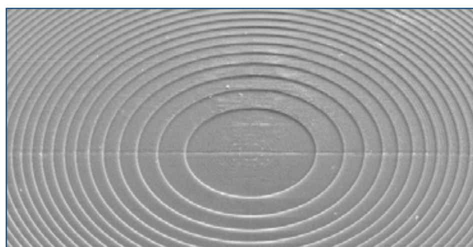
Glass trans. temperature (°C)	102	
Dielectric constant	3.1	
Cauchy coefficients not crosslinked / crosslinked	N_0	1.595 / 1.602
	N_1	69.9 / 85.3
	N_2	64.9 / 56.8
Plasma etching rates (nm/min) (5 Pa, 240-250 V bias)	Ar-sputtering	8
	O_2	168
	CF_4	38
	80 CF_4 + 16 O_2	89

Three-dimensional structure



AR-N 7720.13
Sinusoidal structures

Applications of AR-N 7720



Diffractive optic transferred with AR-N 7720.30 into silicone

Process parameters

Substrate	Si 4" wafer
Tempering	85 °C, 90 s, hot plate
Exposure	Vistec Lion, 12.5 kV
Development	AR 300-47, 4 : 1, 60 s, 22 °C

Process chemicals

Adhesion promoter	AR 300-80
Developer	AR 300-47, 300-26
Thinner	AR 300-12
Remover	AR 300-76, AR 300-72

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Process conditions

This diagram shows exemplary process steps for AR-N 7720 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".

Process step	AR-N 7720.30	AR-N 7720.13
Coating	4000 rpm, 60 s 1.4 µm	4000 rpm, 60 s 0.25 µm
Tempering (± 1 °C)	85 °C, 1 min hot plate or 85 °C 30 min convection oven	
E-beam exposure	Vistec Lion, acceleration voltage 12.5 kV E-beam exposure dose (E_0):	
	100 µC/cm²	35 µC/cm²
Crosslinking bake	105 °C, 1 min hot plate or 100 °C, 60 min convection oven	
Post-bake	70 °C, 20 min, hot plate or 70 °C, 120 min convection oven for preventive avoidance of roughnesses	
Development (21-23 °C ± 0,5 °C) puddle	AR 300-47 90 s	AR 300-47, 4 : 1 60 s
Rinse	DI-H_2O, 30 s	
Post-bake (optional)	120 °C, 1 min hot plate or 120 °C, 25 min convection oven for slightly enhanced plasma etching resistance	
Customer-specific technologies	Fabrication of holograms or diffractive optics	
Removal	AR 300-76 or O_2 plasma ashing	

Development recommendations

optimal / suitable

Developer	AR 300-26	AR 300-35	AR 300-40
AR-N 7720.30 ; 7720.13	1 : 2 ; 1 : 3	-	300-47 undil. ; 300-47, 4 : 1

ALLRESIST

Innovation
Creativity
Customer-specific solutions

Negative E-Beam Resists AR-N 7720

Processing instructions

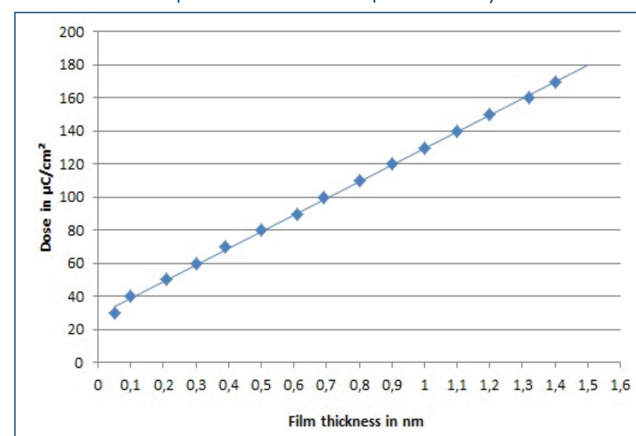
These resists are predestined for e-beam exposure, but also suitable for UV exposure. During e-beam exposure, the resist works in a negative mode. The exposure dose mainly depends on the acceleration voltage, the substrate and the film thickness. The resist also work in a negative mode after deep UV exposure if the image-wise exposure is performed at a wavelength of 248-265 and 290-330 nm. A bake step is mandatory after exposure (e-beam/UV) to induce the required crosslinking. Contrast and development rate strongly depend on the tempering. Recommended is a temperature of 105 °C (hot plate, 2 min), with possible variation in a range of ± 5°C. Higher crosslinking temperatures require stronger developers.

For resist AR-N 7720 it is recommended to add a further tempering step at 60 – 70 °C for 1-3 h in the oven prior to development to avoid possibly occurring roughnesses of the structures to be developed. Contrast and development rate can be influenced to a large degree if developer strength and tempering temperature are coordinated accordingly. The general rule is: the weaker the developer, the higher is the contrast and the lower the development rate. The development time ideally is about 60 s (30 … 120 s) at 21 – 23 °C. Shorter times for complete development will attack the crosslinked structures. Own tests with respect to the development process are required.

Three-dimensional, "analogous" structures

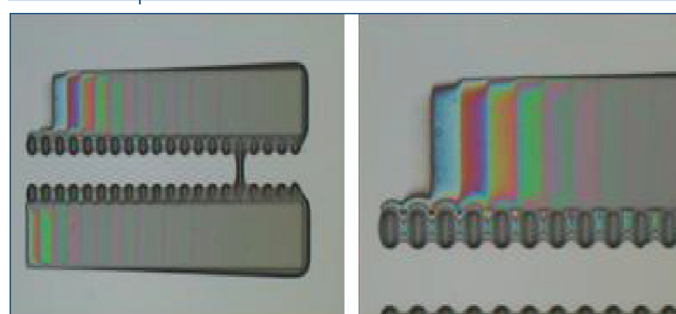
For most applications, a high contrast is desired to obtain a high resolution. For the production of holograms, diffractive optics or curved surfaces however, in particular resists with low contrast are predestined. Resist AR-N 7720 was specifically designed for these applications. The active components acid generator and crosslinking agent were both substantially reduced as compared to "digital" resists, which results in lower crosslinking efficiency. With increasing exposure dose, consequently a defined increase of the film thickness is obtained (see diagram below).

Film build-up and dose dependency



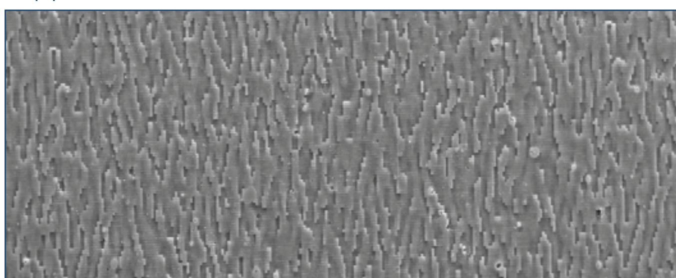
AR-N 7720.30: The build-up proceeds constantly across the entire dose range as indicated. Film thickness 1.4 µm, acceleration voltage 12.5 kV, crosslinking bake 100 °C, 3 min, postbake 70 °C, 4 h convection oven, developer AR 300-47 (4 : 1 dilution).

Dose sequence of AR-N 7720.30



Up to a film thickness of 1.4 µm, smooth and defined surfaces are obtained.

Application AR-N 7720



Fabrication of a topologically structured code with AR-N 7720.30