Our Products

Photoresists & Developers
Removers & Ancillaries
Solvents & Etchants
Plating Solutions
Si, Glass and Quartz Wafers

2014
Dear Reader,

This brochure is intended to give you an up-to-date overview of our enhanced product portfolio.
Our aim is to offer you a comprehensive product range of resists, ancillaries, solvents, etchants, wafers and yellow light accessories for your litho-processes.
Moreover, technical support related to the application of our products has the same importance for us. Two technical booklets developed to assist you in the clean room:
Our **Photolithography 2012** provides a well-balanced mixture of theoretical background-knowledge and comprehensive application-oriented explanations and tips.
Our **Lithography Trouble Shooter 2012** answers the most frequently asked questions and provides solutions to potential problems.
If you would like one or more complimentary copies of our brochures, please contact us as at [brochure@microchemicals.net](mailto:brochure@microchemicals.net) - thank you for your interest!

Wishing you much success,

**Your MicroChemicals Team**
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Selective Criteria for Resists

Resist Film Thickness
Generally, the last two digits of the resist name (e.g. AZ® 6632) indicate the film thickness attained by spin coating (without gyrset) at 4000 rpm in 100 nm units. The thickness approximately decreases with the (increasing) square-root of the spin speed, so a given resist allows a certain range in the attainable resist film thickness. If the desired resist film thickness can/should not be realized by varying the spin speed, the usage of a different available viscosity of the given resist is recommended. Otherwise, the following has to be considered:

Dilution of high-viscosity resists with PGMEA (= AZ® EBR Solvent) allows to perform several applications with different film thicknesses using only one resist. However, diluted resists are sensitive to particle formation with a reduced shelf life depending on the resist, the dilution ratio and the storage temperature for the diluted resist.

Realizing thick films with low-viscosity resists is problematic for two main reasons: i) The required low spin speeds increase the edge bead, and ii) in case of positive or image reversal resists, the rather high concentration of the photo active compound (low optical transparency) in typical ‘thin resists’ requires high exposure doses for a sufficient exposure, which makes steep resist profiles hard to realize and may cause popping and foaming by N₂-bubbles formed during exposure.

Fields of Application

Wet chemical etching requires an optimized adhesion to the substrate. For this purpose, we recommend the AZ® 1500 series for resist film thicknesses of 500 nm to 3 µm, the AZ® ECI 3000 series for 1-4 µm resist film thickness, or the AZ® 4500 series for films of several 10 µm thickness. HF-containing etchants sometimes cause large-scale resist peeling as a consequence of HF-diffusion through the resist towards the substrate underneath. In this case, it’s generally beneficial to increase the resist film thickness using resists such as the AZ® 4562, the AZ® 9260, or the AZ® 40 XT.

Dry etching requires an elevated softening point of the resist as well as steep sidewalls. The AZ® 6600 series for resist film thicknesses of 1-4 µm, or the high-resolution AZ® 701 MiR, are optimized for both requirements and reveal an excellent thermal stability during dry etching.

If resist film thicknesses exceeding 5 µm are required, the thick positive resists AZ® 4562 or AZ® 9260, or the negative AZ® 15 nXT or AZ® 125 nXT are recommended. The two nXT resists crosslink and therefore reveal an excellent thermal stability during dry etching.

Lift-off processes require an undercut resist profile which can be attained with image reversal resists such as the AZ® 5214E (resist film thickness 1-2 µm), the TI 35ES (3-5 µm), or the AZ® nLOF 2000 (2-20 µm) negative resists. Additionally, these resists are thermally stable and therefore help to prevent a rounding of the resist structures during coating.

If the mask design requires positive resists for lift-off application, the resist sidewalls should be as steep as possible in order to prevent a coating of these sidewalls. For this purpose, we recommend the thermally stable AZ® 6600 resists, or the high-resolution AZ® 701 MiR.

Electroplating requires an improved adhesion of the resist to the substrate as well as an enhanced stability of the resist in the electrolyte. The negative resists AZ® 15 nXT (resist film thickness 5-30 µm) and AZ® 125 nXT (up to > 150 µm) are optimized for these requirements. Both resists can be developed in TMAH-based developers, wet-chemically stripped in common removers, and are compatible with all common substrate materials and electrolytes for Cu-, Au-, and NiFe plating.

If positive resists have to be used for electroplating, the AZ® 4500 series, the AZ® 9260, and the AZ® 40 XT allow steep sidewalls and a good adhesion.

Lateral Resolution and Aspect Ratio
The photoresist itself as well as the resist film thickness limit the theoretical resolution. Under
optimum conditions, high-resolution thin resists such as the AZ® 701 MiR allow feature sizes of approx. 300 nm using i-line exposure.

Beside a high absolute resolution, some processes require a high aspect ratio (ratio of the feature height to its width). Modern thick resists such as the AZ® 9260 allow an aspect ratio of 6-10, and even higher values under optimized process conditions.

### Selective Criteria for Developers

First of all, it has to be checked whether the developer has to be metal ion free (MIF), or alternatively metal ion containing (MIC) developers can be used. Most MIF developers are ready-to-use solutions, while typical MIC developers are supplied as a concentrate which has to be diluted before use.

- **AZ® 326 MIF** is 2.38 % TMAH (*TetraMethylAmmoniumHydroxide*) in H₂O.
- **AZ® 726 MIF** is 2.38 % TMAH in H₂O with surfactants added for fast and homogeneous substrate wetting.
- **AZ® 826 MIF** is 2.38 % TMAH in H₂O with surfactants added for fast and homogeneous substrate wetting, and further additives for removal of resist residuals occasionally remaining after development. These additives, however, slightly increase the dark erosion.
- **AZ® Developer** (MIC) is optimized for minimum Al attack. It is typically applied 1 : 1 diluted in DI-H₂O for high contrast, or undiluted for a high development rate. The dark erosion of AZ® Developer is slightly higher as compared to other developers.
- **AZ® 351B** (MIC) is based on buffered NaOH and typically used in a 1 : 4 dilution.
- **AZ® 400K** (MIC) is based on buffered KOH and typically used in a 1 : 4 dilution.
- **AZ® 303** (MIC) is based on KOH and NaOH and designed for the resist AZ® 111 XFS.

The next selection characteristic is the compatibility of the developer to a certain photoresist or/and a certain substrate material (see table overleaf).

### Selective Criteria for Removers

- **Acetone** is not well-suited as stripper for photoresists: The high vapour pressure of acetone causes a fast drying and thus re-deposition of stripped photoresist onto the substrate forming striations. If nevertheless acetone shall be used for this purpose, a subsequent rinse with isopropyl alcohol - immediately after the acetone step - is recommended in order to remove the resist-contaminated acetone residual-free.

- **NMP (1-Methyl-2-pyrrolidon)** is a powerful stripper due to its physical properties: NMP yields a low vapour pressure (no striation formation), strongly solves organic impurities as well as resists, keeps the removed resist in solution, and can be heated to 80°C due to its high boiling point. However, since NMP is classified as toxic and teratogenic, a recommended alternative is ...

- **DMSO (Dimethyl sulfoxide)** has a performance as photoresist stripper comparable to the performance of NMP, and is a kind of “safer-solvent” substitute for NMP.

- **AZ® 100 Remover** is an amine-solvent mixture, and a ready-to-use standard remover for AZ® and TI photoresists. In order to improve its performance, AZ® 100 Remover can be heated to 60-80°C. Since AZ® 100 Remover is strongly alkaline, aluminium containing substrates might be attacked as well as copper- or GaAs alloys/compounds. In this case, AZ® 100 Remover should be used as concentrate, any dilution or contamination of AZ® 100 Remover with water (even in traces!) has to be avoided.
High Performance Removers

TechniStrip® P1316

TechniStrip® P1316 is a powerful NMP-free remover for

- Novolak-based positive resists such as all positive AZ® resists.
- Epoxy-based resists
- Polyimides, bonding glues
- Dry films

At 75°C, TechniStrip® P1316 is able to dissolve – not only peel – even heavily cross-linked resists (e. g. by dry etching or ion implantation) from the substrate in few minutes. TechniStrip® P1316 can be used in batch immersion and batch spray equipment, as well as in single wafers cleaning tools due to its high stripping efficiency.

TechniStrip® NI555

TechniStrip® NI555 is a powerful remover for Novolak-based negative resists and ultrathick positive resists such as

- AZ® nLOF 2000
- AZ® 15 nXT
- AZ® 40 XT

TechniStrip® NI555 was developed to address fast and complete photoresist film dissolution thus avoiding filter clogging and subsequent insoluble resin debris deposition encountered with most of standard stripping solutions.

A crosslinked AZ® 15 nXT film peels from the substrate in DMSO-, NMP- or TMAH-based strippers (left), while TechniStrip® NI555 completely dissolves the resist film after 20 minutes. Image taken from the technical documentation of TECHNIC INC.
### Which Photoresist for which Purpose/Thickness?

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**Standard resist film thickness**

**Resist film thickness attainable via dilution or multiple coating**

### Which Developer for which Photoresist?

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**Recommended**  **Possible**  **NOT recommended**
AZ® 1500-Series: Positive Thin Resists for Wet Etching

**Thickness Range and Exposure**

**Film thickness**: 0.5 ... 2.5 µm  
**UV-sensitivity**: i-, h-, g-line (310 - 440 nm), broadband or monochromatic  
**Sales volumes**: 250 ml, 500 ml, 1000 ml, 2.5 L, and 5 L

**General Information**

The AZ® 1500 photoresist series yields an improved adhesion to the substrates making them a good choice for wet chemical etching. Beyond this application, the AZ® 1500 series is well-suited for almost all standard lithographic purposes. The lateral resolution – depending on the resist film thickness – reaches down to sub-µm.

AZ® 1505 and AZ® 1518 standard thin resists cover the thickness range from 0.5 to 2.5 µm. If only one resist is desired for various film thicknesses, this thickness range can be realized by dilution AZ® 1518 (PGMEA = AZ® EBR Solvent):

- **AZ® 1515** (nominal 1.5 µm at 4000 rpm): 100 g AZ® 1518 + 5.16 g PGMEA  
- **AZ® 1512** (nominal 1.2 µm at 4000 rpm): 100 g AZ® 1518 + 14.67 g PGMEA  
- **AZ® 1505** (nominal 0.5 µm at 4000 rpm): 100 g AZ® 1518 + 70.3 g PGMEA  

AZ® 1514 H covers the thickness range from 1.0 to 2.0 µm.

AZ® 1512 HS covers the thickness range from 1.0 to 2.0 µm. Besides an improved adhesion on many substrate materials, AZ® 1512 HS has a significantly improved photospeed and contrast due to its high photoactive compound concentration.

**Development**

AZ® 351B 1 : 4 or AZ® 726 MIF recommended; AZ® 400K 1 : 4 or AZ® 326 MIF possible

AZ® 6600-Series: Thermally Stable Positive Resists

**Thickness Range and Exposure**

**Film thickness**: 1.0 ... 4.5 µm  
**UV-sensitivity**: i-, h-, g-line (310 - 440 nm), broadband or monochromatic  
**Sales volumes**: 250 ml, 500 ml, 1000 ml, 2.5 L, and 5 L

**General Information**

The AZ® 6600 photoresist series yields an improved thermal stability for a better performance for dry etching, or – if required – a hardbake. The softening point of approx. 130°C makes the AZ® 6600 resists more stable against rounding during baking steps. The lateral resolution depends on the resist film thickness and reaches down to sub-µm.

AZ® 6612 and AZ® 6632 standard thin resists cover the thickness range from 1.0 to 4.5 µm. If only one resist is desired for various film thicknesses, this thickness range can be realized by dilution AZ® 6632 (PGMEA = AZ® EBR Solvent):

- **AZ® 6624** (nominal 2.4 µm at 4000 rpm): 100 g AZ® 6632 + 5.74 g PGMEA  
- **AZ® 6618** (nominal 1.8 µm at 4000 rpm): 100 g AZ® 6632 + 14.7 g PGMEA  
- **AZ® 6615** (nominal 1.5 µm at 4000 rpm): 100 g AZ® 6632 + 20.0 g PGMEA  
- **AZ® 6612** (nominal 1.2 µm at 4000 rpm): 100 g AZ® 6632 + 29.6 g PGMEA  

At higher dilution ratios, the AZ® 6600 photoresists are subject to particle formation due to the comparably high PAC concentration.

**Development**

AZ® 351B 1 : 4 or AZ® 726 MIF recommended; AZ® 400K 1 : 4 or AZ® 326 MIF possible
AZ® 4500-Series: Thick Resists for Medium Resolution

**Thickness Range and Exposure**

- **Film thickness:** 2.5 ... 10 µm, up to 100 µm by multiple coating
- **UV-sensitivity:** i-, h-, g-line (310 - 440 nm), broadband or monochromatic
- **Sales volumes:** 250 ml, 500 ml, 1000 ml, 2.5 L, and 5 L

**General Information**

Compared to many thin resists, AZ® 4533 and AZ® 4562 have a lower concentration of the photo active compound. The higher transparency allows the exposure of films with 10 µm or more. If a high illumination intensity, a higher film thickness, or rough substrates cause bubbling during exposure despite optimized processing, or a higher aspect ratio is required, the thick resist AZ® 9260 (following chapter) is a recommended alternative.

**Development**

AZ® 400K 1 : 4 or AZ® 826 MIF recommended

AZ® 9200-Series: Thick Resists for High Resolution

**Thickness Range and Exposure**

- **Film thickness:** 3 ... 20 µm, up to 150 µm by multiple coating (with restrictions)
- **UV-sensitivity:** i- and h-line (310 - 410 nm), broadband or monochromatic
- **Sales volumes:** 250 ml, 500 ml, 1000 ml, 2.5 L, and 3.78 L

**General Information**

Compared to the AZ® 4500 series, the AZ® 9200 resists have a lower optical absorption. This simplifies the exposure of (also very) thick resist films. Therefore – in combination with the missing g-line sensitivity – the AZ® 9200 series needs a higher exposure time under broadband condition, and reveals a lower development rate as compared to AZ® 4500 films processed under the same conditions.

For lower resist film thicknesses we recommend a dilution with PGMEA = ‘AZ® EBR Solvent’.

The following resist film thicknesses refer to 4000 rpm under standard conditions:

- **4.0 µm:**
  - 100 g AZ® 9260 + 13 g PGMEA
- **3.0 µm:**
  - 100 g AZ® 9260 + 23 g PGMEA
- **2.0 µm:**
  - 100 g AZ® 9260 + 42 g PGMEA
- **1.5 µm:**
  - 100 g AZ® 9260 + 55 g PGMEA
- **1.0 µm:**
  - 100 g AZ® 9260 + 88 g PGMEA

**Development**

AZ® 400K 1 : 4 or AZ® 726 MIF recommended. In case of very thick resist films, a rather strong developer concentration such as AZ® 400K 1 : 3.5 ... 1 : 3.0 might be reasonable for required short development times.
AZ® 701 MiR - High Resolution and Temperature Stability

**Thickness Range and Exposure**
- **Film thickness:** 900 nm at 4.000 rpm, few 100 nm by dilution
- **UV-sensitivity:** i-, h-, g-line (310 - 440 nm), broadband or monochromatic
- **Sales volumes:** 250 ml, 500 ml, 1000 ml, 2.5 L, and 3.78 L

**General Information**
AZ® 701 MiR is a thermally stable (softening point >130°C), high resolution photo resist optimized for dry etching of sub-µm structures.

For even higher resolutions applying e. g. laser interference lithography, AZ® 701 MiR can be further diluted to 500 nm and below.

**Development**
AZ® 726 MIF or AZ® 351B 1 : 4 recommended; AZ® 400K 1 : 4 or AZ® 326 MIF possible

AZ® ECI 3000 - High Resolution with Broad Process Window

**Thickness Range and Exposure**
- **Film thickness:** 1 ... 4 µm
- **UV-sensitivity:** i-, h-, g-line (310 - 440 nm), broadband or monochromatic
- **Sales volumes:** 250 ml, 500 ml, 1000 ml, 2.5 L, and 5 L

**General Information**
AZ® ECI 3000 reveals an improved adhesion as well as a high thermal stability. Therefore, this resist series is well suited for wet- as well as dry chemical processes.

The AZ® ECI 3000 series comes in three viscosity grades for film thicknesses of 2.7, 1.2, and 0.7 µm at 4000 rpm.

The very high resolution potential allows feature sizes of 300 nm, and yields a larger and very stable process parameter windows towards lower resolution requirements.

**Development**
AZ® 726 MIF or AZ® 351B 1 : 4 recommended; AZ® 400K 1 : 4 or AZ® 326 MIF possible
AZ® 5214 E: Image Reversal Resist for High Resolution

**Thickness Range and Exposure**

*Film thickness:* 1.0 ... 2.0 µm  
*UV-sensitivity:* i-, h-line (310 - 420 nm), NOT g-line sensitive  
*Sales volumes:* 250 ml, 500 ml, 1000 ml, 2.5 L, and 5 L

**General Information**

This special photoresist is intended for lift-off techniques which call for a negative side wall profile. The reversal bake moderately cross-links the exposed resist making the developed structures thermally stable up to approx. 130°C. Due to the comparably low resist film thickness, the process parameter window for an undercut is rather small thus requiring some optimizations in the exposure dose and the reversal bake parameters. Therefore, if the resolution required is not in the sub-µm range, a thicker resist such as the TI 35ES (next section), or the AZ® nLOF 2000 negative resists might be a good alternative.

**Development**

AZ® 726 MIF or AZ® 351B 1 : 4 recommended, AZ® 326 MIF or AZ® 400K 1 : 4 possible

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TI 35ES: Image Reversal Resist for Lift-off

**Thickness Range and Exposure**

*Film thickness:* 2.5 ... 5 µm  
*UV-sensitivity:* i-, h-, g-line (310 - 440 nm), broadband or monochromatic  
*Sales volumes:* 250 ml, 500 ml, 1000 ml, 2.5 L, and 5 L

**General Information**

A comparably large process window for a resist profile with undercut as well as a high thermal stability (softening point > 130°C, dependant on process parameters) allows reproducible lift-off of also thick evaporated or sputtered films. If the coated material should have a thickness of several 100 nm or more, evaporation instead of sputtering is strongly recommended in order to prevent coated resist sidewalls. This allows a fast and clean lift-off.

**Development**

AZ® 400K 1 : 4, AZ® 726 MIF or AZ® 826 MIF recommended
AZ® nLOF 2000 - Thermally Stable Negative Resists

**Thickness Range and Exposure**
- **Film thickness:** 1.5 ... 15 µm (> 20 µm via multiple coating possible)
- **UV-sensitivity:** i-line (365 nm), NOT g- or h-line sensitive
- **Sales volumes:** 100 ml, 250 ml, 500 ml, 1000 ml, 2.5 L, 3.78 L (gallon)

**General Information**
AZ® nLOF 2000 is a series of negative resists, whereby the exposed resist remains after development with an adjustable undercut. The negative profile in combination with its high softening point makes AZ® nLOF 2000 a well-suited resist for lift-off as well as for any other processes requiring resist structures with high to very high thermal stability.

**Outstanding Properties**
- **Very high thermal stability:** Almost no rounding of cross-linked resist patterns up to temperatures of 250°C and more.
- **High chemical stability:** Dependant on process parameters, AZ® nLOF 2000 is stable against many organic solvents as well as strong alkaline media (however, not stable against KOH Si-etches!).
- **The e-beam sensitivity of the AZ® nLOF 2000 resists allows the combination of fast UV and high-resolution e-beam lithography. Please contact us for further information!**

**Development**
The recommended developers are AZ® MIF developers such as AZ® 726MIF or AZ® 826 MIF. Using other developers may prevent development (start) due to an (accidentally) thermally or optically induced partially crosslinked resist surface.

**Stripper/Solubility**
- **NMP** (N-Methyl-2-pyrrolidone), **DMSO**, as well as **KOH** (> 3 %) are suitable for removal. Even completely cross-linked AZ® nLOF 2000 is lifted (not dissolved) from the substrate after a certain time (depending on resist film thickness and applied temperatures such as during post exposure bake, or hardbake).
- Strongly crosslinked resist films require elevated (60-80°C) temperatures or/and ultrasonic treatment for resist removal.
- **Acetone** dissolves unexposed AZ® nLOF 2000 as long as no temperatures > 170°C have been applied before. At higher temperatures, thermal crosslinking strongly reduces acetone solubility. Exposed and cross-linked (PEB > 90°C) AZ® nLOF is insoluble in acetone. However, if – in case of thick resist films – the substrate-near resist is not cross-linked due to the limited i-line penetration depth, acetone will diffuse through the cross-linked resist on top of it and lift the entire resist film from the substrate.

Left: 700 nm resist lines attained with the 2.0 µm thick AZ® nLOF 2020. Centre: 700 nm resist lines attained with the 3.5 µm thick AZ® nLOF 2035 (Source: AZ® nLOF™ 2000 product Data Sheet by AZ-EM). Right: A pronounced undercut attained with the AZ® nLOF 2070 in a thickness of 22 µm.
**AZ® 40 XT - Ultra-Thick Chemically Amplified Positive Resist**

**Thickness Range and Exposure**

**Film thickness:** 30 ... 100 µm (> 100 µm via multiple coating possible)  
**UV-sensitivity:** i-line (365 nm), NOT g- or h-line sensitive  
**Sales volumes:** 100 ml, 250 ml, 500 ml, 1000 ml, 2.5 L, 3.78 L (gallon)

10 µm (left), 20 µm (centre), and 30 µm (right) holes at 40 µm resist film thickness

30 µm (left), 20 µm (centre), and 10 µm (right) lines at 40 µm resist film thickness

Reflow of AZ® 40 XT cubes at different temperatures and for different time. All images taken from: AZ® 40 XT Product Data Sheet and the AZ 40XT-11D Thermal Flow data sheet of AZ-EM.

**General Information**

AZ® 40 XT is a chemically amplified positive resist for resist film thicknesses of approx. 30 - 100 µm. Its high viscosity allows high resist film thicknesses via single coating. Compared with standard positive thick resists, the chemical amplification and special chemistry makes the processing significantly faster and easier.
**Outstanding Properties**
- Chemically amplified platform
- Vertical profiles on aligners
- Excellent photospeed; good develop time; TMAH developer compatible
- Superior overall throughput
- Superior adhesion on substrates
- Superior DRIE performance, ideal for MEMS
- Copper substrate compatible
- Good plating compatibility
- Standard wet strip process for removal

**Developer**
We recommend the TMAH-based, ready-to-use AZ® 326/726/826 MIF.

**Removal**
NMP or DMSO are suited removers. In case of very thick resist films, heating the removers up to 60-80°C, or/and ultrasonic treatment, might be beneficial to fasten the resist removal.

**AZ® 15 nXT - Thick Negative Resist for Plating**

**Thickness Range and Exposure**
- **Film thickness:** 5 ... 30 µm
- **UV-sensitivity:** i-line (365 nm), NOT g- or h-line sensitive
- **Sales volumes:** 100 ml, 250 ml, 500 ml, 1000 ml, 2.5 L, 3.78 L (gallon)

5 µm lines at 10 µm resist film thickness

5 µm holes at 10 µm resist film thickness

5 µm plated CuNi image

3.6 µm plated CuNi image
General Information
AZ® 15 nXT is a cross-linking negative resist for resist film thicknesses up to approx. 30 µm. The high stability and superior adhesion make the AZ® 15 nXT well suited for most electroplating applications. The resist sidewalls are very steep up to a film thickness of approx. 10 µm, towards higher resist film thicknesses the resist profile becomes more and more negative allowing the electro-deposition of structures which narrow from bottom to top.

Outstanding Properties
- 5 ... 20 µm resist film thickness via single-coating
- Aqueous alkaline developers
- Excellent adhesion, no underplating
- Wide substrate compatibility: Cu, Au, Ti, NiFe, ...
- Wide plating compatibility: Cu, Ni, Au, ...
- Standard wet stripping processes

Developer
We recommend the TMAH-based, ready-to-use AZ® 326/726/826 MIF.

Removal
NMP or DMSO are suited removers, while the recommended stripper is the NMP-free, unotoxic TechniStrip NI555. In case of very thick resist films, heating the removers up to 60-80°C, or/and ultrasonic treatment, might be beneficial to fasten the resist removal.

AZ® 125 nXT - Ultra-Thick Negative Resist for Plating

Thickness Range and Exposure
- Film thickness: 30 ... 150 µm (> 500 µm can also be realized)
- UV-sensitivity: i-line (365 nm), NOT g- or h-line sensitive
- Sales volumes: 100 ml, 250 ml, 500 ml, 1000 ml, 2.5 L, 3.78 L (gallon)

General Information
AZ® 125 nXT is a cross-linking negative resist for resist film thicknesses up to 100 µm and even more with very steep sidewalls.
The high stability and superior adhesion make the AZ® 125 nXT well suited for most electroplating applications where very thick films are required. This resist requires neither a post exposure bake nor any delays between the process steps.

Outstanding Properties
- 30 ... 100 µm resist film thickness via single-coating
- Aqueous alkaline developers
- Excellent adhesion, no underplating
- No post exposure bake, no delays between process steps required
- Wide substrate compatibility: Cu, Au, Ti, NiFe, GaAs, ...
- Wide plating compatibility: Cu, Ni, Au, solder ...
- Standard wet stripping processes

Developer
We recommend the TMAH-based, ready-to-use AZ® 326/726/826 MIF.
Removal

NMP or DMSO are suited removers, while the recommended stripper is the NMP-free, nontoxic TechniStrip P1316. In case of very thick resist films, heating the removers up to 60-80°C, or/and ultrasonic treatment, might be required to fasten the resist removal.

All images taken from: AZ® 15 nXT and 125 nXT Product Data Sheet of AZ-EM.

AZ® TX 1311 - DUV Resist for Very High Aspect Ratios

**Thickness Range and Exposure**

- **Film thickness:** approx. 2 ... 4 µm (55 cP version)
- **UV-sensitivity:** 248 nm
- **Sales volumes:** 100 ml, 250 ml, 500 ml, 1000 ml, 2.5 L, 3.78 L (gallon)

**General Information**

AZ® TX 1311 is a chemically amplified positive deep-UV (DUV) resist for very high aspect ratios at resist film thicknesses of several µm. AZ® TX 1311 is optimized for high energy implant applications, and – due to its high thermal stability – also well suited for dry etching.

The AZ® TX 1311 makes, as other chemically amplified DUV resists, high demands on the purity of the cleanroom air as well as constant process conditions. The post exposure bake (PEB) conditions are rather critical, as well as the time span between softbake and PEB and between PEB and development.
**Outstanding Properties**

- 400 nm lines or spaces at a resist film thickness of up to 4 µm.
- High sensitivity (approx. 20 - 30 mJ/cm² at 4 µm resist film thickness)
- Aqueous alkaline developers (e.g. AZ® 326/726/826 MIF)
- Standard wet stripping processes

**Developer**

We recommend the TMAH-based, ready-to-use AZ® 326/726/826 MIF.

**Removal**

NMP or DMSO are suited removers.

**Results**

The figures below show cross sections of 400 nm trenches (top) and lines (bottom) at 3.8 µm resist film thickness as a function of the depth of focus and the exposure dose.
MicroChemicals® – Our Products

Our Etchants

**Acids, Bases and HMDS**

*Ammonia Solution (28-30 %)*
Available from 2.5 L sales volumes on in ULSI quality

*Acetic Acid (99.8 %)*
Available from 2.5 L sales volumes on in VLSI quality

*Hydrofluoric Acid (1, 10, 50 %)*
Available from 2.5 L sales volumes on in VLSI quality

*BOE 7 : 1 (Buffered Hydrofluoric Acid)*
Available from 2.5 L sales volumes on in VLSI quality

*HMDS*
Available in 1.0 L sales volumes on VLSI quality

*KOH Solution (44 %)*
Available from 2.5 L sales volumes on in VLSI quality

*Phosphoric Acid (85 %)*
Available from 2.5 L sales volumes on in VLSI quality

*Nitric Acid (69.5 %)*
Available from 2.5 L sales volumes on in VLSI quality

*Hydrochloric Acid (37 %)*
Available from 2.5 L sales volumes on in VLSI quality

*Sulphuric Acid (96 %)*
Available from 2.5 L sales volumes on in VLSI quality

*Hydrogen Peroxide (30.5 %)*
Available from 2.5 L sales volumes on in VLSI quality

*TMAH (25 %)*
Available from 2.5 L sales volumes on in ULSI quality

**Ready-to-Use Etching Mixtures**

*Aluminium Etch ANPE 80/5/5/10 (H₃PO₄ / HNO₃ / CH₃COOH)*
Available in 2.5 L sales units in MOS quality

*Chromium Etch No. 1 ((NH₄)₂[Ce(NO₃)₆] / HClO₄)*
Available in 2.5 L sales units in VLSI quality

*Silicon Etch NFE 70-3.6-26 (HF / HNO₃ / CH₃COOH)*
Available from 2.5 L sales volumes on in VLSI quality

*Gold Etch ACI₂ (KI / I₂)*
Available from 5 L sales volumes on in VLSI quality

Other sales volumes and purity grades on request!

phone: +49 (0)731/977343 0
fax: +49 (0)731/977343 29
**Physical Properties**

The bar graph below shows the physical properties flash point, boiling point and vapour pressure of selected solvents.

![Bar graph showing physical properties of solvents](image)

**Fields of Application**

**Acetone (VLSI - 2.5 L, 5 L, and drums)**

Acetone removes organic impurities from substrates and is well-suited for greasy/oily contaminations. Its high evaporation rate, however, requires a subsequent cleaning step in e.g. isopropyl alcohol in order to avoid striations on the substrate. Acetone is not well-suited as a lift-off medium due to its high flammability when heated and the trend of particles to be lifted to resorb onto the substrate.

**Cyclopentanone (ULSI - 2.5 L and drums)**

Cyclopentanone is a developer for e-beam resists.

**DMSO = Dimethyl sulfoxide (ULSI - 2.5 L and drums)**

DMSO as a nontoxic alternative to NMP is a powerful lift-off medium due to its physical properties: NMP yields a low vapour pressure (no striation formation), strongly dissolves organic impurities as well as resists, keeps dissolved particles in solution, and can be heated up to 80°C due to its high boiling point.

**Ethyl Acetate (VLSI - 2.5 L and drums)**

Ethyl acetate is a compound of many adhesives.

**Ethyl Lactate (VLSI - 2.5 L and drums)**

Ethyl lactate is besides PGMEA – a suitable thinner for AZ® and TI photoresists due to its high boiling point.
Isopropyl Alcohol (VLSI - 2.5 L, 5 L, and drums)
Isopropyl alcohol is well-suited for rinsing contaminated acetone off as well as removing particles from surfaces. This solvent is often used in the second substrate cleaning step after acetone. Isopropyl alcohol is also used as additive for anisotropic Si-etching.

MEK (VLSI - 2.5 L and drums)
MEK (methyl ethyl ketone) with its low boiling point can be used as an additional thinner for spray coating resists, which require a fast resist film drying on the substrate.

Methanol (VLSI - 2.5 L and drums)
Methanol can be used as a powerful solvent for contaminated acetone in a three-step (substrate) cleaning process (acetone → methanol → isopropyl alcohol). However, due to its toxicity, its application should be carefully considered.

MIBK = Methylisobutylketon (VLSI - 2.5 L and drums)
MIBK is a solvent with a boiling point of 116°C. In the microelectronics it is sometimes used as a developer for e-beam resists.

NMP = 1-methyl-2-pyrrolidone (ULSI - 2.5 L and drums)
NMP is a powerful lift-off medium due to its physical properties: NMP yields a low vapour pressure (no striation formation), strongly dissolves organic impurities as well as resists, keeps dissolved particles in solution, and can be heated due to its high boiling point. For the same reasons, NMP (pure or diluted in H₂O) is a well-suited stripper for photoresists processed under harsh conditions.

PGMEA = 1-methoxy-2-propyl-acetate (VLSI - 5 L and drums)
PGMEA is the solvent/thinner of almost all AZ® and TI photoresists due to its low vapour pressure and its suppression of particle formation in the (further diluted) resist. Additionally, PGMEA is often used for edge bead removal, since its low vapour pressure prevents further thinning of the coated resist film. The trade name of PGMEA is AZ® EBR Solvent.
Our Electroplating Solutions

**NBT SEMIPLATE CU 100 (Copper Electroplating Process)**

The NBT SEMIPLATE CU 100 process is an acid copper plating formulation engineered for wafer plating applications including copper bump plating, interconnects for VLSI/ULSI or MEMS.

The NBT SEMIPLATE CU 100 process provides excellent throwing power, improved levelling characteristics, ductile low stress deposits and offers unique flexibility in its operation.

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**NB SEMIPLATE AU 100 (Gold Electroplating Process)**

NB SEMIPLATE AU 100 is an alkaline, non-cyanide electroplating formulation which produces a bright, ductile deposit.

In comparison with other gold plating processes, the NB SEMIPLATE AU 100 electrolyte demonstrates exceptional throwing power that results in good coverage of recesses, holes and hollows of parts of complex geometry.

Deposits from the NB SEMIPLATE AU 100 process also exhibit the unique ability to build brightness with increasing thickness. Specific gravity measurements of the deposit consistently show values of 19.1 which indicate freedom of codeposited polymers generally found in deposits from other systems of similar purity. NB SEMIPLATE AU 100 deposits have main applications in MEMS processing.

**Physical Properties of the Deposit**

- **Purity**: 99.9%
- **Hardness**: 130 to 190 mHV$_{0.020}$
- **Contact Resistance**: 0.3 mΩ (measured by cross-wire method with 200 gram load)
- **Deposit weight for 2.5 microns**: 31.6 mg/in$^2$ (4.9 mg/cm$^2$) (100 micro inches)

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**NBT SEMIPLATE NI 100 (Ni-Sulfamate Electroplating Process)**

NBT SEMIPLATE NI 100 is a nickelsulfamate electroplating process that produces a pure, ductile, finegrained, semi-bright low stress nickel deposit required to meet the needs of the semiconductor industry for quality assured chemistry.

NBT SEMIPLATE NI 100 is manufactured to meet the requirements associated with the electroforming of microstructured wafers (Micro System Technology).

The NBT SEMIPLATE NI 100 process contains an anode activating agent in controlled amounts to enhance anode corrosion and prevent anode passivation.

Deposit properties are easy to control and maintain.
Feature / Benefits

- Pure nickel depositions
- High ductile plating
- Fine grained, satin dull deposition
- Controllable inner stress of the deposition up to 7000 µm
- No anode passivation
- High hardness, controllable
- Good throwing power

NBT SEMIPLATE SN 100 (Pure Tin Plating Process)

NBT SEMIPLATE SN 100 is a high-purity electroplating process which produces fine-grained, matte, pure tin deposits. It is especially formulated for use in the fabrication of circuit patterns and bumps on semiconductor wafers.

The process contains no fluoborates or formaldehyde and can be used with either soluble or insoluble anodes.
Silicon Wafers

From Quartz Sand to Silicon Wafers

Silicon in the Universe and on Earth

The visible matter of the universe is dominated by hydrogen and helium, and the mass fraction of silicon is less than 0.1%. The entire planet contains approx. 17% silicon. In the approx. 40 km thick earth crust, silicon (in the form of silicates and SiO$_2$) with a mass fraction of 26% is the second most abundant element after oxygen.

Production of Metallurgical-grade Silicon

Quartz sand (SiO$_2$) is reduced with carbon in an electric arc furnace at > 1900°C to metallurgical-grade silicon (> 98% pure). The majority produced in the world (2008: approx. 6 million tons) is used for manufacturing alloys with aluminium and steel.

Purification of Silicon

The metallurgical-grade silicon is converted into trichlorosilane gas (HSiCl$_3$) using hydrochloric acid. Multiple distillation of HSiCl$_3$ improves the purity to 99,9999999%. After the thermal decomposition of HSiCl$_3$ to polycrystalline silicon, monocrystalline silicon is formed via two alternative techniques, as described in the following section.

Silicon Ingot Production

Czochralski-Technique

With this technique, a small monocrystalline seed crystal pulls a monocrystal with the same crystallographic orientation out of the melted poly-Si.

- The pull velocity (some mm...cm per hour) determines the crystal diameter, additives in the melted silicon allow crystal doping.
- The advantages of the Czochralski-Technique are: Large crystal diameters; comparably low-cost technique. Disadvantages: Impurities from the crucible; inhomogeneous doping.

Float-Zone Technique

Hereby, a monocrystalline seed crystal is brought into contact with a polycrystalline Si ingot. Starting from here, an RF coil melts the poly-Si which, after cooling down, forms monocrystalline Si with the crystallographic orientation of the seed crystal. Doping is realized.
during crystal growth from the gaseous phase. The advantages of the float-zone technique are: no impurities from the crucible, homogeneous doping. Disadvantages: high cost; small crystal diameter.

**From the Ingot to Finished Silicon Wafers**

The ingot is cut and ground to the required length and diameter. An orientation flat is added to indicate the crystal orientation. The edge of the sliced wafers is ground to attain the specified diameter. Then the wafers are etched to remove the damaged surface resulting from the previous lapping. Finally, it is polished to a mirror surface by a combined mechanical-chemical action, and cleaned.

**Our Silicon-, Quartz-, Fused Silica- and Glass-Wafers**

Since 2010, a network of wafer manufacturers and distributors have allowed us to supply various semiconductor wafers, such as

- Si wafer with different diameter, doping, surfaces and orientation
- Si wafers with SiO₂ and Si₃N₄ coating
- Quartz and Fused Silica Wafers
- Borosilicate-glass Wafers
- GaAs wafers
- From single wafers (for certain types) up to entire lots

Please contact us for a quote!!

Our revised wafer stock list ready for shipment:

[www.microchemicals.com/products/si_wafers/our_wafer_stock_list.html](http://www.microchemicals.com/products/si_wafers/our_wafer_stock_list.html)
Purification Grades

**MOS, VLSI, ULSI and SLSI Quality**

**MOS** (metal oxide semiconductor): Impurity metal ion concentration (per element) approx. 100 ppb, particle concentration < 1000/ml

**VLSI** (very large scale integration): Impurity metal ion concentration (per element) approx. 10-50 ppb, particle concentration < 250/ml

**ULSI** (ultra large scale integration): Impurity metal ion concentration (per element) approx. 10 ppb, particle concentration < 30 ... 100/ml

**SLSI** (super large scale integration): Impurity metal ion concentration (per element) approx. 1 ppb, particle concentration < 30 ... 100/ml

**PPM, PPB and PPT**

1 ppm (parts per million, \(10^{-6}\)) approximately corresponds to a drop (approx. 30 µl) in a rather large bucket.

1 ppb (parts per billion, \(10^{-9}\)) corresponds to a drop in a comparably small swimming-pool.

1 ppt (parts per trillion, \(10^{-12}\)) would be a drop in a small lake, or a 5 µm particle dissolved in a cup of coffee, or approx. 100,000 atoms in a drop!

**How ‘Clean’ is Reasonable?**

The reasonable purity degree of process chemicals depends – among many other parameters – on the minimum feature size to be realized, the required yield, the cleanroom class, and subsequent process steps.

It is almost impossible to definitely correlate suboptimum process results with a purity degree of the chemicals applied being too low. Therefore, one cannot give a certain statement on the required purity grade.

With VLSI and ULSI quality, we fulfil almost all requirements in research and development as well as in production.

**Disclaimer of Warranty**

All information, process guides, recipes etc. given in this brochure have been added to the best of our knowledge. However, we cannot issue any guarantee concerning the accuracy of the information.

We assume no liability for any injuries/damage to staff and equipment which might stem from the information given in this brochure.

Generally speaking, it is in the responsibility of every staff member to inform herself/himself about the processes to be performed in the appropriate (technical) literature, in order to minimize any risk to man or machine.
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