

## AZ 4500 Series

Thick Film  
Photoresists

### GENERAL INFORMATION

This series of positive photoresists is intended for applications where coating thicknesses above 3  $\mu\text{m}$  are required. When using a standard photoresist at film thicknesses above 3  $\mu\text{m}$ , the necessary exposure energy drastically increases. This is due to the absorption of the photoactive compound (PAC) in the actinic range of the spectrum. So with increasing film thickness exposure dose has to be adjusted to provide sufficient energy also at the bottom of the photoresist, otherwise the pattern cannot be cleared. In extreme cases it becomes almost impossible to expose the resist properly and exposure doses above 1000  $\text{mJ}/\text{cm}^2$  have to be applied. Under these conditions unwanted side effects also appear: the dose at the surface of the photoresist becomes too high and induces crosslinking of the resist. This effect is similar to the well known deep-UV hardening used to preserve the resist profiles at postbake temperatures up to 200°C. Standard resist would also generate too much nitrogen during exposure which, trapped in the thick layer, cannot diffuse fast enough and may lead to lifting of the resist.

For AZ 4500-series photoresists we have chosen a special photoactive compound with low absorption and reduced nitrogen content which enables these resists to be used at thicknesses up to 50  $\mu\text{m}$ . The highest viscosity product AZ 4562 allows to spin coat 10  $\mu\text{m}$  in a single step (2000 rpm). For even higher thicknesses special coating techniques have to be applied:

1. The common spin time of about 30 - 40 seconds is reduced down to only 3 seconds. By this 20  $\mu\text{m}$  are obtained, however the substrate has to be left on the spinner in a horizontal position for another minute to allow for drying.
2. AZ 4562 may be multiple coated with a bake cycle in-between. Due to the high solids content of this resist, which is close to the dissolution limit, the underlying coating will only be dissolved minor. The bake temperatures in-between should not exceed 90°C or the final prebake temperature.

When using high film thicknesses some special guidelines have to be observed: after coating the resist should be kept at room temperature for at least 15 minutes to allow most of the solvent to evaporate before it is put into an oven for prebake. Otherwise the resist surface will dry quite fast and trapped solvent remaining in the bulk may form bubbles and lift the resist film. Adhesion failure is the result. Using a hotplate instead of an oven is the better choice, especially when the temperature is ramped to the final value.

# Technical data sheet

## Technisches Datenblatt

The development process also has to be adopted to the high film thickness: Background for this is the fact that even heavily overexposed positive photoresists only have limited dissolution rates. There is a saturation at values in the order of 100 nm/s. For this it is recommended to operate at development rates of about 2  $\mu\text{m}/\text{min}$ . and adjust the exposure dose for proper clearing and feature size.

This resist series is designed for use with any common sodium and potassium based developer. AZ 340, 1:5 diluted with water is a good choice, AZ 400K may be used as well.

### PHYSICAL and CHEMICAL PROPERTIES

	<b>AZ 4533</b>	<b>AZ 4562</b>
<b>Solids content [%]</b>	34.5	39.5
<b>Viscosity [cSt at 25°C]</b>	125	440
<b>Absorptivity [l/g*cm] at 398nm</b>	0.86	1.01
<b>Solvent</b>	methoxy-propyl acetate (PGMEA)	
<b>Max. water content [%]</b>	0.50	
<b>Spectral sensitivity</b>	310 - 440 nm	
<b>Coating characteristic</b>	striation free	
<b>Filtration [<math>\mu\text{m}</math> absolute]</b>	0.2	

### FILM THICKNESS [ $\mu\text{m}$ ] as FUNCTION of SPIN SPEED (characteristically)

<b>spin speed [rpm]</b>	2000	3000	<b>4000</b>	5000	6000
<b>AZ 4533</b>	4.67	3.81	<b>3.30</b>	2.95	2.69
<b>AZ 4562</b>	8.77	7.16	<b>6.20</b>	5.55	5.06

### PROCESSING GUIDELINES

<b>Dilution and edge bead removal</b>	AZ EBR Solvent or AZ EBR 70/30
<b>Prebake</b>	100°C, 50", hotplate
<b>Exposure</b>	broadband and monochromatic
<b>PEB</b>	not required, optional with monochromatic exposure
<b>Development</b>	AZ 340, 1:5, 30"/ $\mu\text{m}$ film thickness
<b>Postbake</b>	115°C, 50s hotplate or 60 min. oven
<b>Removal</b>	AZ 100 Remover, conc.

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### HANDLING ADVISES

Consult the **Material Safety Data Sheets** provided by us or your local agent!

This AZ Photoresists are made up with our patented safer solvent PGMEA. They are **flammable liquids** and should be kept away from oxidants, sparks and open flames.

**Protect from light and heat and store** in sealed original containers between 0°C and 25°C, exceeding this range to +27°C for 10 hours, +32°C for 6 hours or +35°C for 5 hours does not adversely affect the properties.

**Shelf life** is 1 year at recommended storage conditions. The **expiration date** is printed on the label of every bottle.

AZ Photoresists are compatible with most commercially available wafer processing equipment. **Recommended materials** include PTFE, stainless steel and high-density polyethylene and -propylene.

We advise our customers regarding technical applications to the best of our knowledge within the scope of the possibilities open to us, but without obligation. Current laws and regulations must be observed at all times. This also applies in respect of any protected rights of third parties. Our suggestions do not relieve our customers of the necessity to test our products, on their own responsibility, for suitability for the purpose envisaged. Quotations from our literature are only permitted with our written authority, and the source must be stated.

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The logo for Merck, consisting of the word "MERCK" in a bold, blue, sans-serif font.