Technical datasheet

AZ® P4000 Series

Positive Tone Photoresists

APPLICATION

General purpose positive tone photoresists featuring a special PAC (Photo Active Compound) engineered to prevent poisoning of plating solutions and extend plating bath life. Excellent substrate adhesion for wet etch applications.

- Wide compatibility with electro-plating solutions
- Safe solvent
- Single coat thicknesses from 1.0 to >20µm
- May be cured as a permanent dielectric insulator

THICKNESS GRADES

Grade	Film Thickness Range
AZ P4110	1.0 – 3.0µm
AZ P4210	2.0 – 4.0µm
AZ P4330-RS	3.0 – 5.0µm
AZ P4400	4.0 – 6.0µm
AZ P4620	6.0 - >20µm*
AZ P4903	10.0 - >30µm*

* Contact your AZ product representative for more information and special spin programs for ultra thick films.

COMPANION PRODUCTS

Thinning/Edge Bead Removal

AZ® EBR Solvent or AZ® EBR 70/30

Developers

AZ® 400K 1:3 or 1:4, AZ® 421K, AZ Developer 1:1, AZ 340

Removers

AZ® 300T, AZ® 400T, AZ Kwik Strip

TYPICAL PROCESS

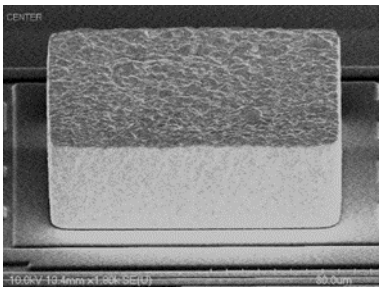
Soft Bake: 90-115C*
Rehydrate: for films > 4.0µm thick
Expose: 350-450nm sensitive
Develop: Spray or immersion
Developer type: Inorganic (IN)

* Use higher soft bake temp. for best adhesion to metals. Ramped temperature may be required for thicker films.

OPTICAL CONSTANTS*

Cauchy A	1.6154
Cauchy B (μm^2)	0.010349
Cauchy C (μm^4)	8.16E-04
n @ 633nm	1.63
k @ 633nm	0

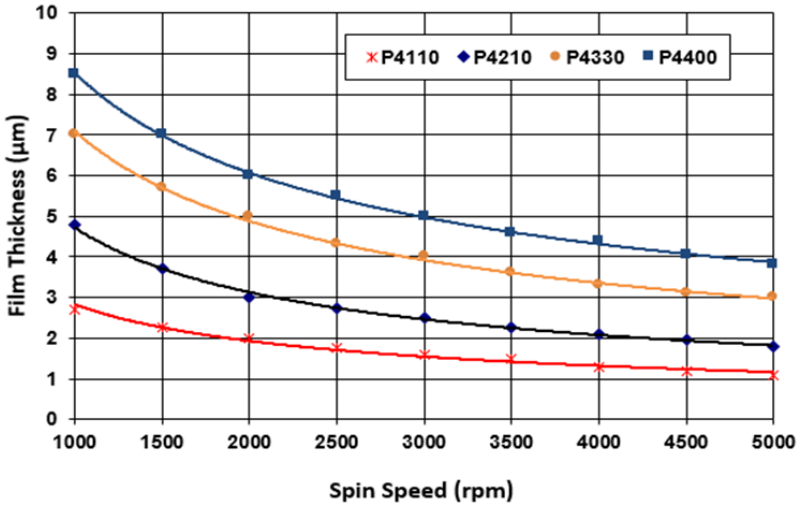
* Unexposed photoresist film



96µm gold bump plated in AZ P4620

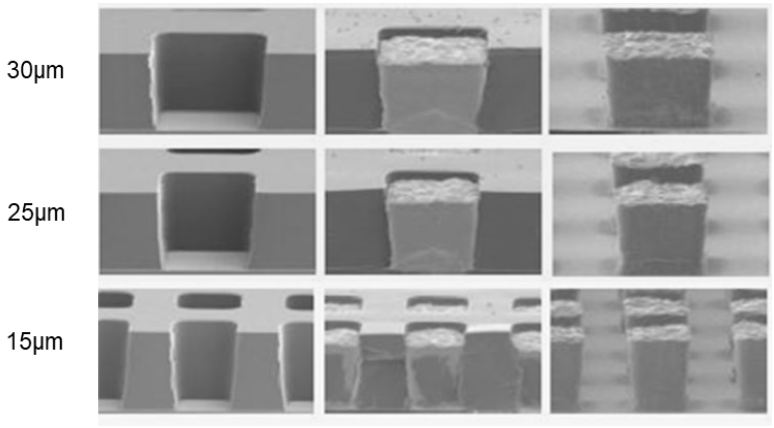
Cyanide electro-plating solution

TYPICAL SPIN CURVES (150MM SUBSTRATE)



Note: Thicker films will be coated by varying spin times and other dispense parameters (or via multiple coats). Single films above 7.0µm are not spun to equilibrium.

TYPICAL AU PLATING RESULTS (CYANIDE PLATING SOLUTION; PH = 5.5)

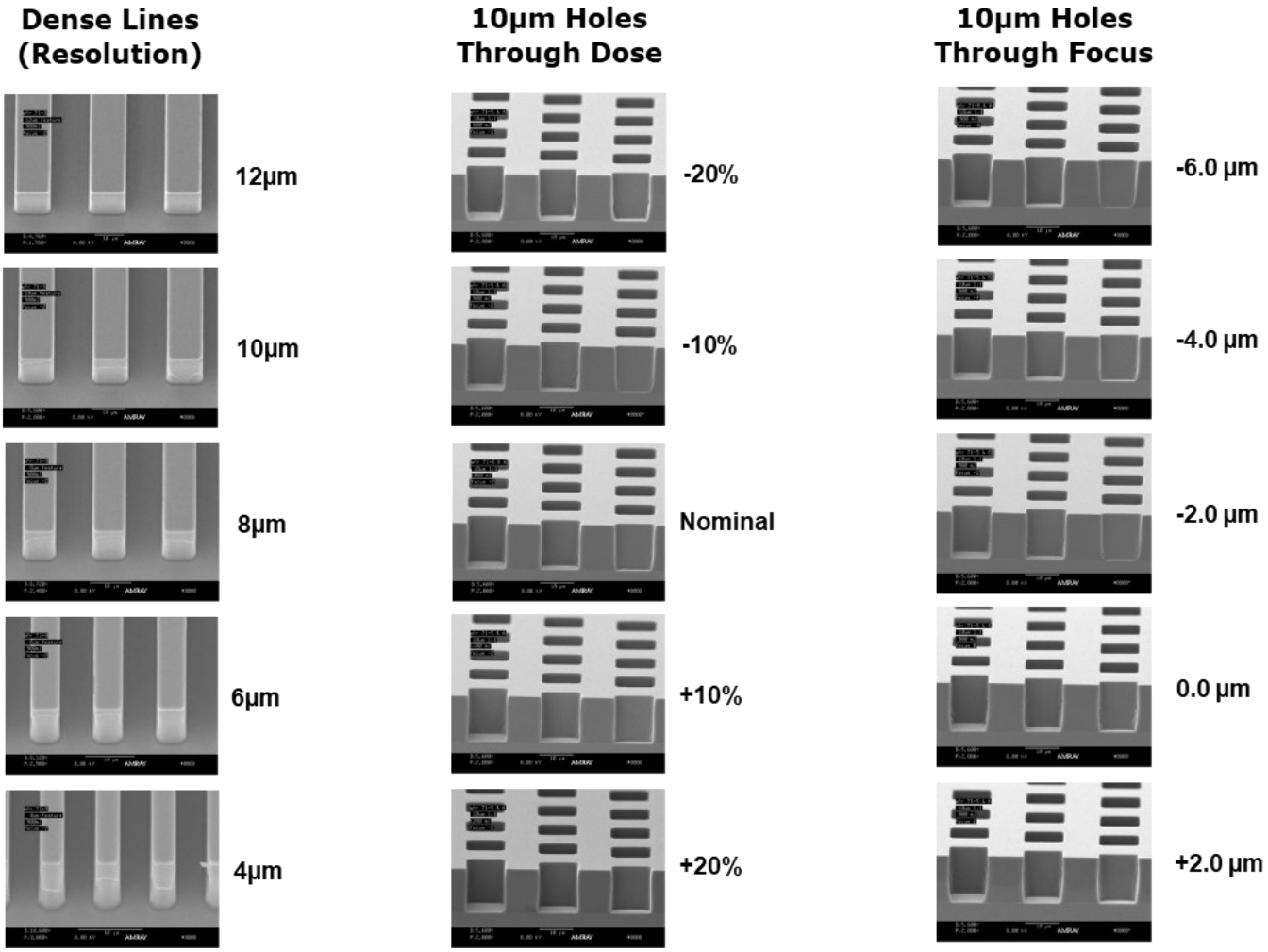


Resist: AZ P4620
Thickness: 24µm
Develop: AZ 400K 1:3
Plating Temp: 45C
Plating Time: 50 min.
Metal Thickness: 20µm
Strip: AZ 400T

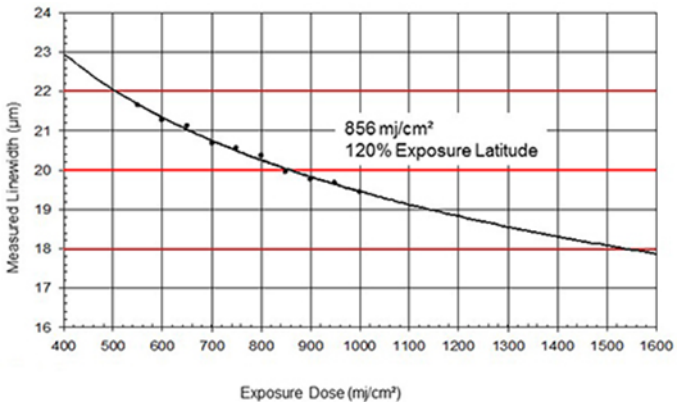
REFERENCE PROCESS (12µM THICK AZ P4620 FILM)

Process Step	Parameters
Coat	12µm thick film on Silicon
Soft Bake	110C, 80 seconds, direct contact hotplate*
Re-hydration Hold	30 min. @ Rh = 42%
Exposure	Suss MA-200 @ 600-850 mJ/cm^2
Develop	Spray @ 23º C

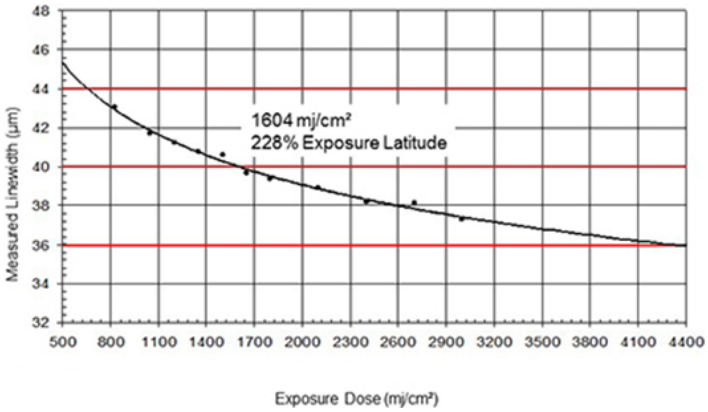
* Thicker films may require a ramped soft bake process to avoid bubble formation due to rapid outgassing of solvents. Contact your AZ product representative for ultra-thick coat and bake processing guidelines.



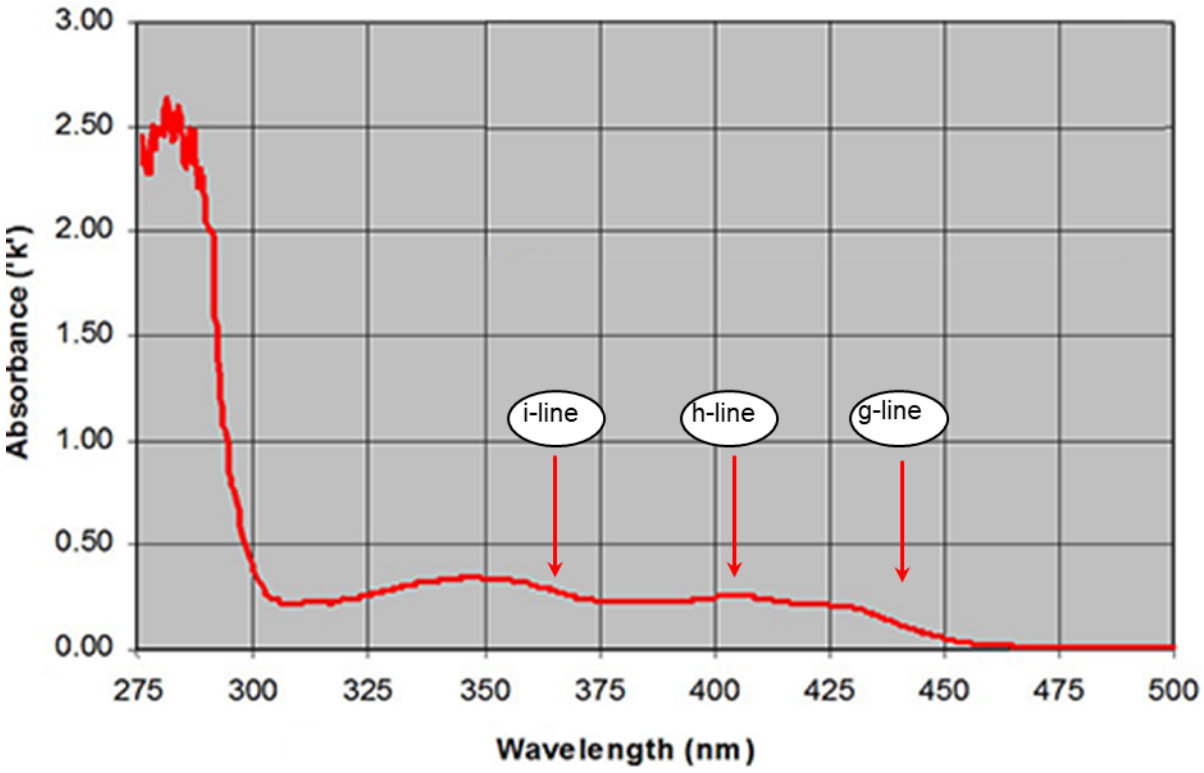
EXPOSURE LATITUDE FOR 20µM LINES AZ P4620 AT FT = 12µM



EXPOSURE LATITUDE FOR 40µM LINES AZ P4620 AT FT = 24µM



ABSORBANCE SPECTRA OF P4000 SERIES PHOTORESISTS (UNBLEACHED, NORMALIZED TO 1µM)



PROCESSING P4000 AS A DIELECTRIC INSULATOR

AZ P4000 Series photoresists may be thermally cured after develop to form stable dielectric isolators. The dielectric properties are cure temperature dependent as shown in the table below.

Cure Temperature	Dielectric Constant	Breakdown Voltage
200º C	4.02	629 V/µm
225º C	4.09	693 V/µm
250º C	4.58	674 V/µm

AZ P4000 SERIES FLUID VISCOSITIES

Grade	Viscosity @ 23º C (cSt)
AZ P4110	18
AZ P4210	54
AZ P4330-RS	127
AZ P4400	184
AZ P4620	536
AZ P4903	1650

DILL MODELLING PARAMETERS

Parameter	Value @ 435nm
A	$0.3697\mu m^{-1}$
B	$0.0243\mu m^{-1}$
C	$0.0203 cm^2/mJ$

APPROXIMATE EXPOSURE DOSE REQUIREMENT VS. FILM THICKNESS (SUSS MA-200)

FT (µm)	Approximate Dose
1.5	90 mJ/cm^2
3.5	135 mJ/cm^2
12	800 mJ/cm^2

EXAMPLE COATING SEQUENCE FOR 20+ µM THICK FILMS

Step	Time (s)	Spin Speed (rpm)	Acceleration (krpm/sec)
Low Speed Spin	4	500	20
Dispense Resist	5	0	0
Spread Resist	3-5	300	20
Cast Spin	*	* Time & rpm depend on FT	50
Edge Bead Removal	20	400	20
EBR Dry	10	400	20

PROCESS CONSIDERATIONS

SUBSTRATE PREPARATION

Substrates must be clean, dry, and free of organic residues. Oxide forming substrates (Si, etc.) should be HMDS primed prior to coating AZ P4000. Contact your AZ product representative for detailed information on pre-treating with HMDS.

COATING

Films up to 8.0µm thick (depending upon wafer size) may be set and spun to equilibrium using the spin curve graphs as a reference. Thicker films require special coat programs using carefully timed spread and spin cycles. Contact your AZ products representative for additional information.

SOFT BAKE

Soft bake times and temperatures may be application specific. Process optimization is recommended to ensure stable lithographic and adhesion performance. Soft bake temperatures for AZ P4000 should be in the 95-115C range. Temperatures towards the high end of this range will improve adhesion to most metals. Thick films may require gradual ramping of the soft bake temperature to prevent bubbling.

FILM REHYDRATION

P4000 photoresist films thicker than 4.0µm require a rehydration hold between soft bake and exposure. Hold times are typically 30-60 minutes (depending upon film thickness) @ relative humidity 40 - 45%.

EXPOSURE

AZ P4000 is sensitive to exposure wavelengths between 310 and 450nm. 365-436nm is recommended.

POST EXPOSE BAKE

A PEB is not generally required for P4000 but may be employed to maximize process latitudes and to mitigate standing wave effects caused by monochromatic exposure. PEB temperatures and times may be application specific. As a general rule, PEB temperatures should be in the 100 to 115C range.

DEVELOPING

Spray or immersion developing in AZ 400K series developers is recommended. AZ 400K 1:3 or AZ 421K (unbuffered) are recommended for resist film thicknesses above 12µm. AZ 400K 1:4 provides improved developer selectivity for thinner films. AZ Developer 1:1 may be used in applications requiring zero etch rate on Aluminum substrates.

HARD BAKE

Hard baking (post develop bake) improves adhesion in wet etch or plating applications and improves pattern stability in dry etch processes. Hard bake temperatures should be in the 100 to 110C range to ensure minimal thermal distortion of the pattern. Higher temperatures may be used to cure the pattern (cross link the resin) for use as a permanent insulator.

COMPATIBLE MATERIALS

AZ P4000 Series materials are compatible with all commercially available lithography processing equipment. Compatible materials of construction include glass, quartz, PTFE, PFA, stainless steel, HDPE, polypropylene, and ceramic.

HANDLING/DISPOSAL

AZ P4000 Series materials are flammable liquids containing PGMEA (1-Methoxy-2-propanol acetate). Refer to the current version of the MSDS and to local regulations for up to date information on safe handling and proper disposal. AZ P4000 is compatible with drain lines handling similar organic solvent based materials.

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Disclaimer

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