AZ ELECTRONIC MATERIALS PRESENTS

THE AZ® P4000-SERIES RESISTS FOR PLATING AND RECORDING HEAD APPLICATIONS

INTRODUCING THE P4000-SERIES RESISTS

- CHARACTERISTICS
- APPLICATIONS
- FEATURES AND BENEFITS
- TYPICAL PROCESSES
- PERFORMANCE

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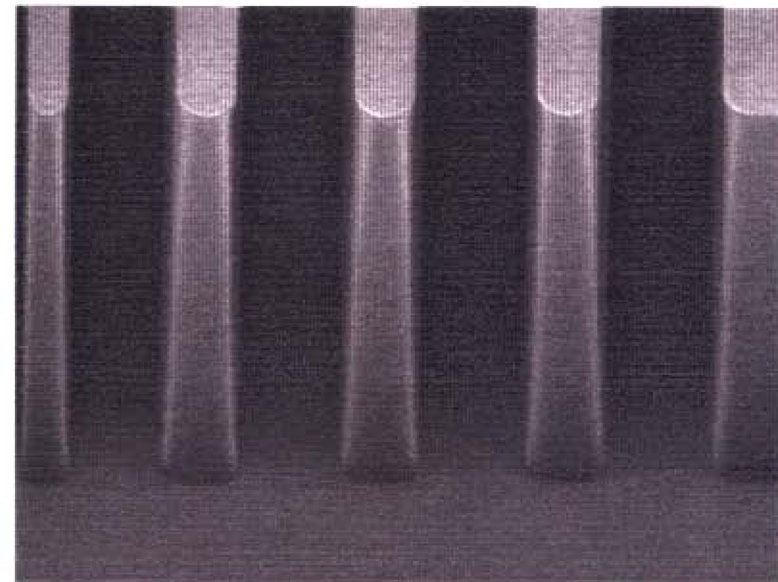
INTRODUCING THE P4000-SERIES RESISTS

- PRODUCTION-PROVEN FOR
  - MAGNETORESISTIVE (MR) AND INDUCTIVE THIN FILM RECORDING HEAD PLATING
  - AIR BEARING/SLIDER FABRICATION
  - TAPE-AUTOMATED BONDING AND C4 “FLIP CHIP” BUMPING PROCESSES
- VISCOSITY GRADES FOR FILM THICKNESS OF 1 TO 50 µm
- SPIN, SPRAY AND ROLLER COAT VERSIONS AVAILABLE FOR VARIETY OF SUBSTRATES



AZ® P4620 PHOTORESIST @ 6.5 µm : 1.5 µm L/S ON Si

AZ PHOTORESIST : THE BEST IN THICK FILM

AZ P4000-SERIES PHOTORESIST OFFERS ....

Features	Benefits
Steep wall profiles and excellent adhesion on a wide variety of substrates	• Ideal profile for up-plating • Reduced rework • No underplating even in thick films
Sensitive to g-, h- and i-line wavelengths	• Fast photospeed on all popular exposure tools
Available in viscosities that allow coating thicknesses up to 50 μm	• Single resist series that applies to wide range of applications
Excellent ion milling properties	• High yields • No cracking, peeling, or bubbling
Exceptionally stable cured films	• Provides an excellent, easy to use permanent insulator layer for critical high-reliability applications in thin film recording heads
Cast in PGMEA "safer" solvent with no co-solvent	• Toxicity hazard extremely low • Provides excellent coating properties

SEVERAL GRADES AVAILABLE

Film Thickness (u

35
30
25
20
15
10
5
0

1000 2000 3000 4000 5000 6000

Spin Speed (RPM)

EXAMPLE OF 6.5 µm PROCESS

Coat: Target 6.5 µm Film Thickness

Event	Operation	Time	Speed	Accel	Comment
1	SpinLS	2 sec	300 rpm	50 krpm/sec	Alert
2	spin LS	10 sec	0 rpm		dispense
3	SpinLS	3 sec	300 rpm	50 krpm/sec	disperse
4	SpinHS	60 sec	3900 rpm *	50 krpm/sec	coat
5	EBR	10 sec	500 rpm	50 krpm/sec	EBR
6	SpinHS	10 sec	1000 rpm	50 krpm/sec	Dry

* Estimated rpm

Softbake: 110°C

Event	Operation	Time	Gap
1	Gap *	10 sec	0.001
2	Bake	120 sec	Full Contact

* Gap used to imitate slow heating of substrate
Use 120 sec Bake if Gap function not available

Develop Program:
Constant Spray at 27.0°C

Event	Operation	Time	Speed	Accel
1	Spray *	180 sec	250 rpm	50 krpm/sec
2	Rinse	20 sec	300 rpm	50 krpm/sec
3	Dry	15 sec	4000 rpm	50 krpm/sec

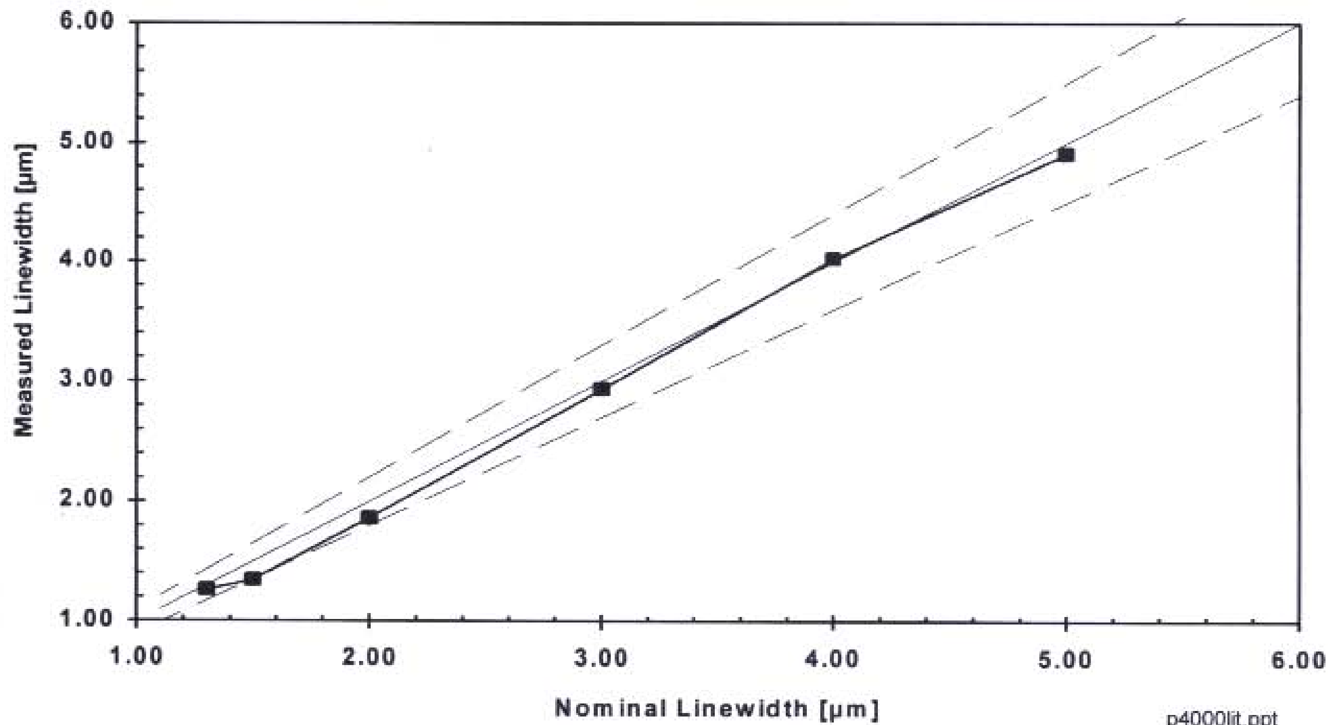
* 140 ml of Developer per min

Delay times required of 30-45 minutes after softbake, and 30 min. after exposure

PERFORMANCE OF THE AZ® P4000 PHOTORESIST

AZ® P4620 PHOTORESIST

Linearity on Silicon at 350 mJ/cm², 6.5 micron film thickness

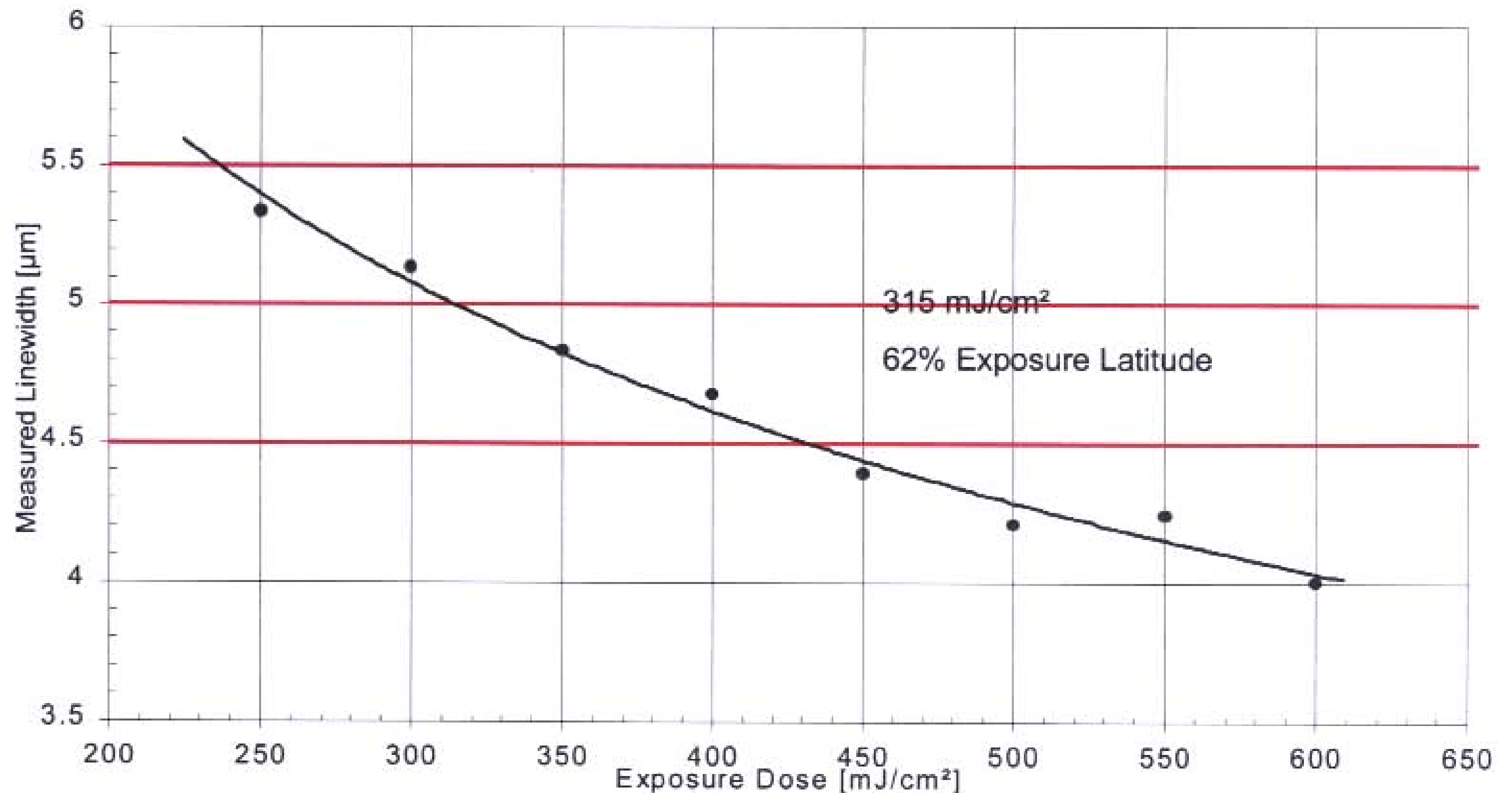


Dense Lines
SB: 110°C/120 sec
Ultratech 1500
AZ® 400K Developer 1:4/180 sec spray

PERFORMANCE OF THE AZ® P4000 PHOTORESIST

AZ® P4620 PHOTORESIST

5.0 µm L/S Exposure Latitude on Silicon, 6.5 micron film thickness



Dense Lines
SB: 110°C/120 sec; Ultratech 1500
AZ® 400KDeveloper 1:4/180 sec spray

PERFORMANCE OF THE AZ® P4000 PHOTORESIST

BOSSUNG PLOT, AZ® P4620 PHOTORESIST

4.0 µm L/S on Silicon, 6.5 micron film thickness

MEASURED LINEWIDTH (UM)

5
4
3

-11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1

FOCUS

300 mJ/cm²
350 mJ/cm²
400mJ/cm²
450 mJ/cm²
500 mJ/cm²

Dense Lines
SB: 110°C/120 sec
Ultratech 1500
AZ® 400K Developer 1:4/180 sec

AZ® P4620 Photoresist Focus/Exposure Array

4.0 µm Dense L/S, 6.5 µm thick., 110°C SB/120 sec, AZ 400K(1:4)/180 sec spray
Ultratech 1500

300 mJ/cm² 350 mJ/cm² 400 mJ/cm² 450 mJ/cm² 500 mJ/cm²

-10 µm
-9 µm
-8 µm
-7 µm
-6 µm
-5 µm
-4 µm
-3 µm
-2 µm
-1 µm
0 µm

Bossung4.p65

AZ® P4620 Photoresist Focus/Exposure Array

5.0 µm Dense L/S, 6.5 µm thick., 110°C SB/120 sec, AZ 400K(1:4)/180 sec spray
Ultratech 1500

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EXAMPLE OF 24 μm PROCESS

Coating Process:

First Coat: Target 10 μm Film Thickness

Event	Operatio	Time	Speed	Accel
1	SpinLS	2 sec	300 rpm	50 krpm/sec
2	spin LS	10 sec	0 rpm	
3	SpinLS	3 sec	300 rpm	50 krpm/sec
4	SpinHS	60 sec	2100 rpm *	50 krpm/sec
5	EBR	10 sec	500 rpm	50 krpm/sec
6	SpinHS	10 sec	1000 rpm	50 krpm/sec

* Estimated rpm

First Softbake: 110°C

Event	Operatio	Time	Gap
1	Gap *	10 sec	0.001
2	Bake	80 sec	Full Contact

* Gap used to imitate slow heating of substrate
Use 85 sec Bake if Gap function not available

Second Coat: Target 24.0 μm Total Film Thickness

Event	Operatio	Time	Speed	Accel
1	SpinLS	2 sec	300 rpm	50 krpm/sec
2	spin LS	10 sec	0 rpm	
3	SpinLS	3 sec	300 rpm	50 krpm/sec
4	SpinHS	60 sec	900 rpm *	50 krpm/sec
5	EBR	10 sec	500 rpm	50 krpm/sec
6	SpinHS	10 sec	1000 rpm	50 krpm/sec

* Estimated rpm

Second Softbake: 110°C

Event	Operatio	Time	Gap
1	Gap *	10 sec	0.001
2	Bake	160 sec	Full Contact

* Gap used to imitate slow heating of substrate
Use 165 sec Bake if Gap function not available

Develop Program:

Constant Spray at 27.0°C

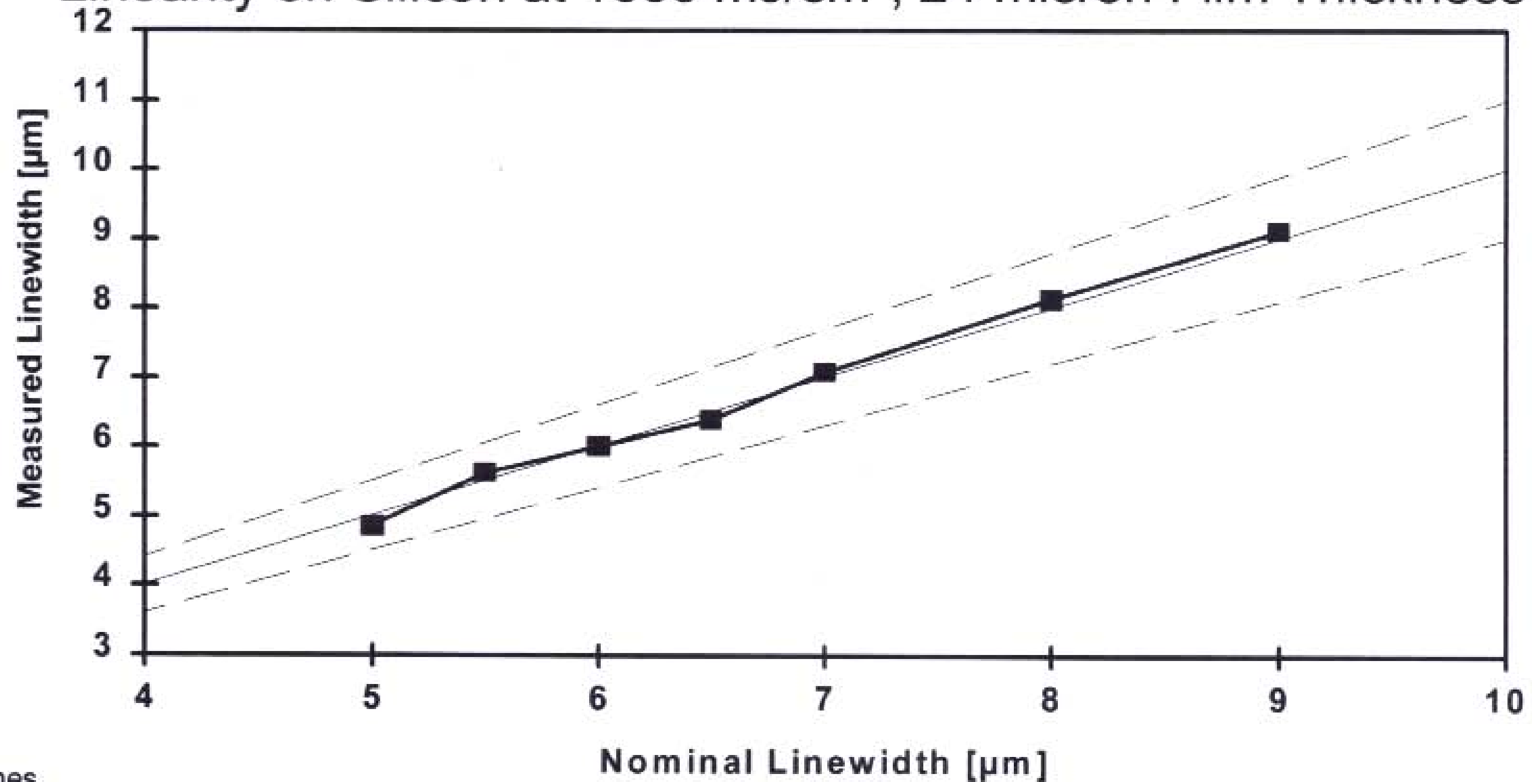
Event	Operatio	Time	Speed	Accel
1	Spray *	260 sec	250 rpm	50 krpm/sec
2	Rinse	20 sec	300 rpm	50 krpm/sec
3	Dry	15 sec	4000 rpm	50 krpm/sec

* 140 ml of Developer per min

Delay times required of 60 min. after last bake, and 30 min. after exposure

NOTE : RECOMMENDATIONS FOR SINGLE-COAT PROCESSES ALSO AVAILABLE

PERFORMANCE OF THE AZ® P4000 PHOTORESIST



Dense Lines
Double Coat/SB: 110°C
Ultratech 1500
AZ® 400K Developer 1:4/260 sec spray

PERFORMANCE OF THE AZ® P4000 PHOTORESIST

AZ® P4620 PHOTORESIST

9.0 µm L/S Exposure Latitude on Silicon, 24 micron Film Thickness

Dense Lines
Double Coat/SB: 110°C; Ultratech 1500
AZ® 400KDeveloper 1:4/260 sec spray

PERFORMANCE OF THE AZ® P4000 PHOTORESIST

BOSSUNG PLOT, AZ® P4620 PHOTORESIST

9.0 µm L/S on Silicon, 24 micron film thickness

Measured Linewidth (um)

13
12
11
10
9
8
7
6

-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2

Focus

1400 mJ/cm²
1500mJ/cm²
1600 mJ/cm²
1700 mJ/cm²
1800 mJ/cm²

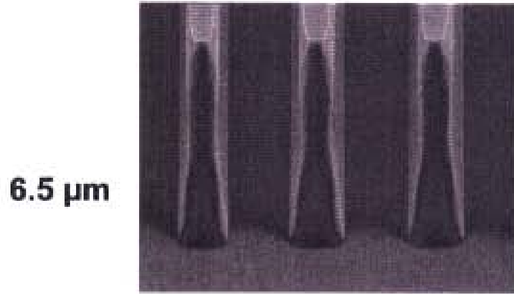
Dense Lines
Double Coat/SB: 110°C
Ultratech 1500
AZ® 400K Developer 1:4/260 sec

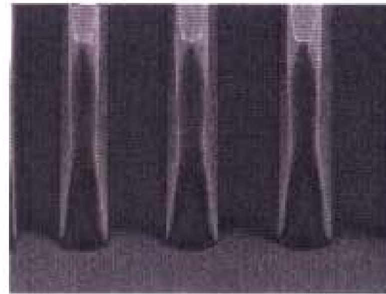
AZ®P4620 Photoresist

Linearity
1600 mJ/cm²

24 µm resist on Silicon
Ultratech 1500
Double Coat/Bake at 110°C
AZ 400K(1:4) /260 sec spray

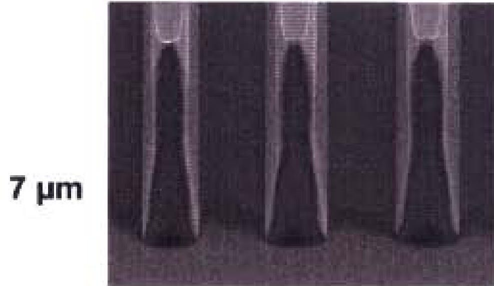
6.5 µm

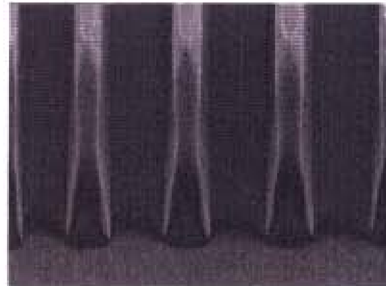




6 µm

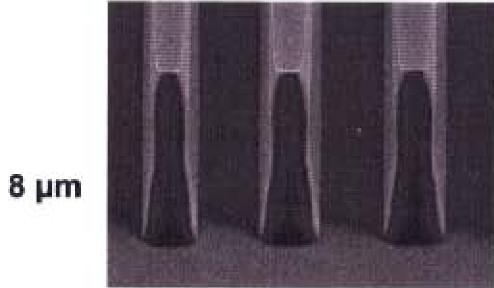
7 µm

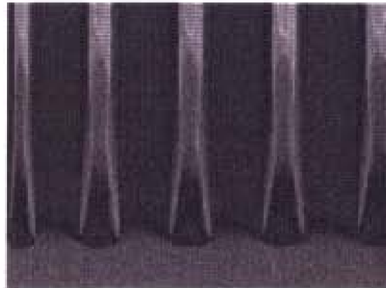




5.5 µm

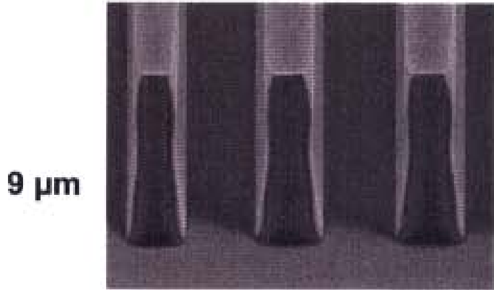
8 µm

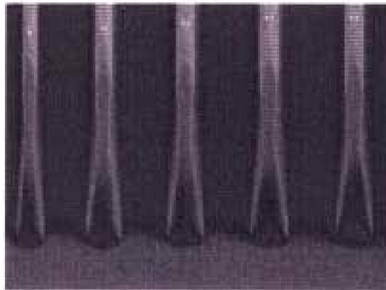




5 µm

9 µm



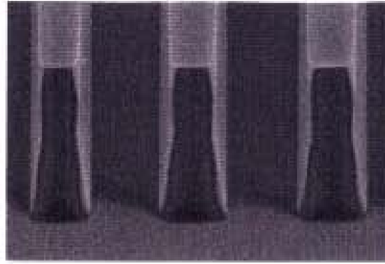


4.5 µm

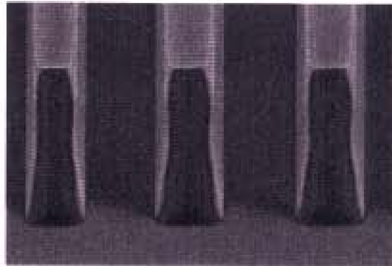
AZ®P4620 Photoresist

24 µm resist on Silicon
Ultratech 1500
Double Coat/Bake at 110°C
AZ 400K(1:4)/260 sec spray

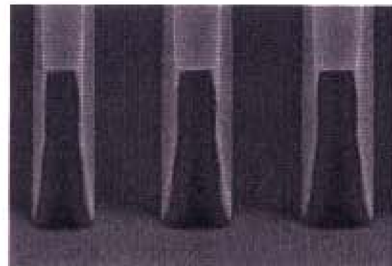
Focus Latitude
1600 mJ/cm²



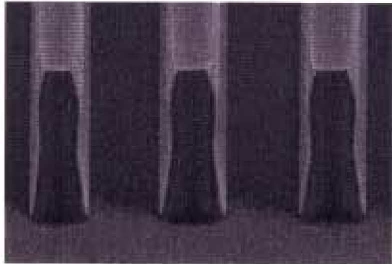
-4 µm



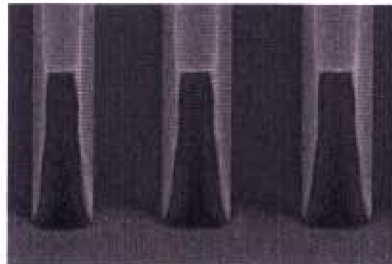
-5 µm



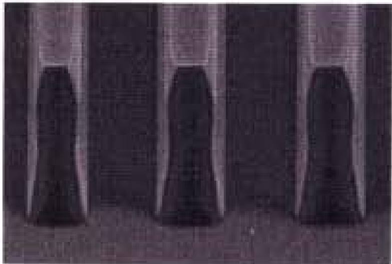
-3 µm



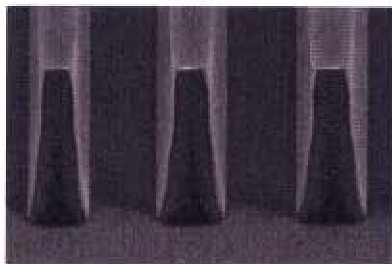
-6 µm



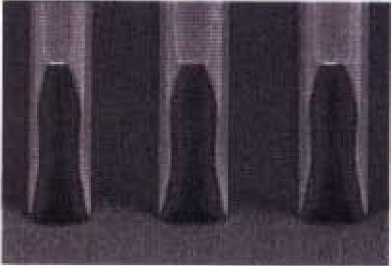
-2 µm



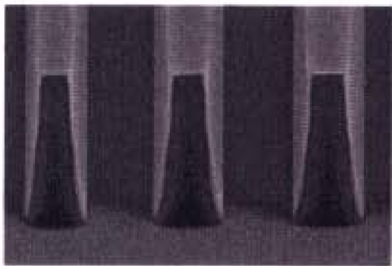
-7 µm



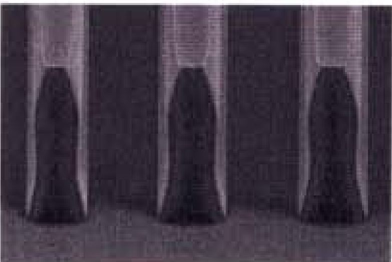
-1 µm



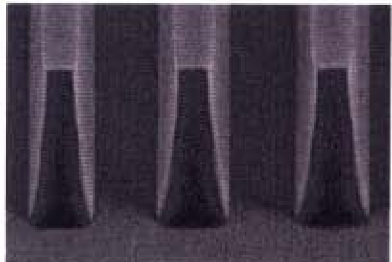
-8 µm



0 µm



-9 µm



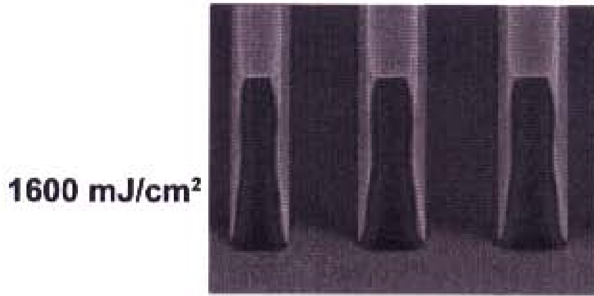
1 µm

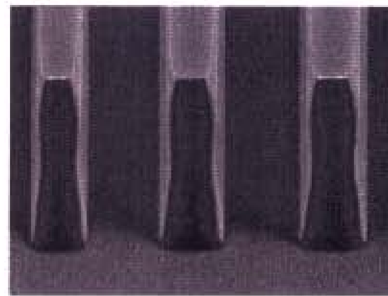
AZ®P4620 Photoresist

Exposure Latitude
9.0 µm L/S

24 µm resist on Silicon
Ultratech 1500
Double Coat/Bake at 110°C
AZ 400K(1:4) /260 sec spray

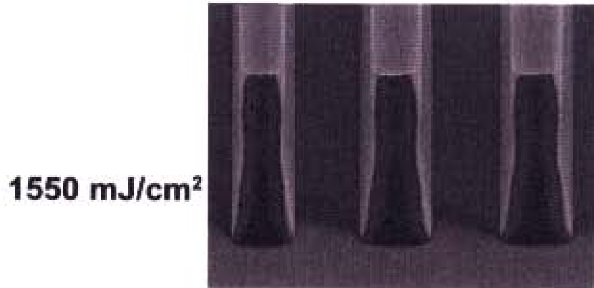
1600 mJ/cm²

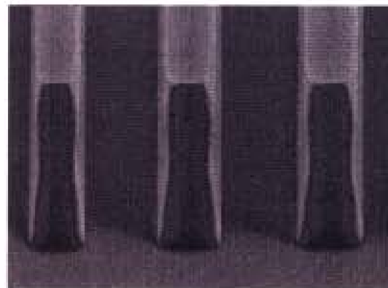




1650 mJ/cm²

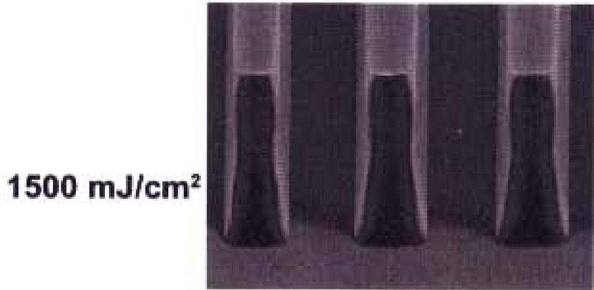
1550 mJ/cm²

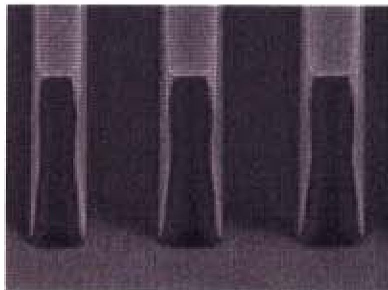




1700 mJ/cm²

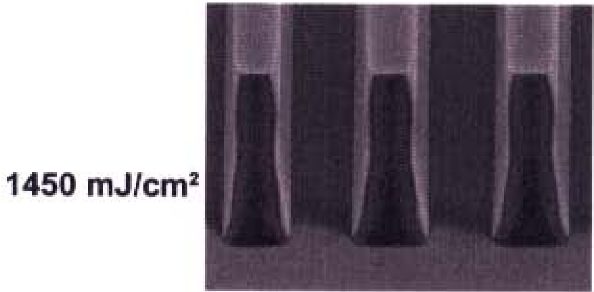
1500 mJ/cm²

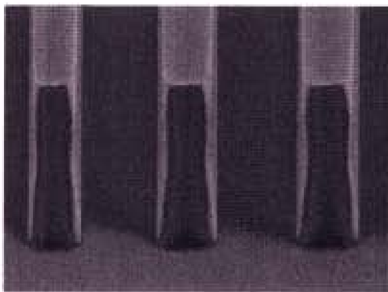




1750 mJ/cm²

1450 mJ/cm²





1800 mJ/cm²

AZ® P4620 Photoresist Focus/Exposure Array

9.0 µm Dense L/S, 24 µm thick., Double Coat/Bake at110°C , AZ 400K(1:4)/260 sec spray
Ultratech 1500

1400 mJ/cm² 1500 mJ/cm² 1600 mJ/cm² 1700 mJ/cm² 1800 mJ/cm²

-9 µm

-8 µm

-7 µm

-6µm

-5 µm

-4 µm

-3 µm

-2 µm

-1 µm

0 µm

1 µm

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Thermal Comparison of Thick Film Photoresists

24 μm F.T. using Two Coat Process on Silicon Wafer; Results after 2 min at temperature on a vacuum chuck hot plate

AZ® 9260
SB: 110°C, 240 sec

AZ® P4620
SB: 110°C, 240 sec

No Bake

110°C

115°C

120°C

125°C

thktherm.p65

PERFORMANCE OF THE AZ® P4000 PHOTORESISTS

- PERFORMANCE COMPARISON OF AZ® P4620 PHOTORESIST USING SPRAY AND IMMERSION DEVELOPMENT AT 22°C AND 27°C.

Develop Conditions	DTP mJ/cm2	Exposure Latitude	Resolution (µm)	DOF (µm)
27°C, Spray	1263	11%	5	14
27°C, Immer.	1284	26%	4.5	14
22°C, Spray	1221	6%	4	16
22°C, Immer.	1456	21%	4	14

24 µm RESIST ON SILICON
ULTRATECH 1500
SOFTBAKE 110 ° C, 240 SEC.
260 SEC. SPRAY OR IMMERSION USING AZ® 400K DEVELOPER 1:4

PERFORMANCE OF THE AZ® P4000 PHOTORESISTS

Refractive Index					
	Bleached	365	405	435	
	n	1.7173	1.6902	1.6796	
	k	0.0020	0.0014	0.0100	
	Unbleached	365	405	435	
	n	1.7150	1.7017	1.6963	
	k	0.0203	0.0207	0.0150	
Cauchy Constants					
		A	B	C	Thk. (nm)
	Bleached	1.6207	0.0029136	2.78E-03	2010.3
	Unbleached	1.6154	0.010349	8.16E-04	2018.5
Dill Parameters		365	405	435	
	A (µm-1)	0.6117	0.5901	0.3697	
	B (µm-1)	0.0427	0.0318	0.0243	
	C (cm²/mJ)	0.0270	0.0285	0.0203	
Bake Conditions					
		Temp (°C)	Time (sec)		
	Soft Bake:	110	60		
	PEB Bake:	110	60		

AZ® P4000 Bleached Absorbance Curve

AZ® P4000 Unbleached Absorbance Curve

AZ P4000 Series resist(s)
Ellipsometrc Absorbance
Normalized to 1/µm

'k' ellipsometric: P4000

Absorbance ('k')

3.00
2.50
2.00
1.50
1.00
0.50
0.00

175 200 225 250 275 300 325 350 375 400 425 450 475 500

Wavelength (nm)

AZ® P4000 PHOTORESIST ELECTRICAL PROPERTY DATA

CURE TEMP.	DIELECTRIC CONSTANT	BREAKDOWN VOLTAGE (volts/um)
	AZ P4620	AZ P4620
200 °C	4.02	629
225 °C	4.09	693
250 °C	4.58	674

AZ® P4000 PHOTORESIST AGING DATA

AZ®P4620 Resist Lot # J7651 Aging Study

% PS Vs. Ref

30
25
20
15
10
5
0
-5

May-96
Jun-96
Jul-96
Aug-96
Sep-96
Oct-96
Nov-96
Dec-96
Jan-97
Feb-97
Mar-97
Apr-97
May-97
Jun-97
Jul-97

Time

Room Temp.

Normal Storage Cond.(refer)

LET THE AZ TEAM SERVE YOUR THICK RESIST REQUIREMENTS

- GLOBAL INFRASTRUCTURE TO SUPPORT YOUR WORLDWIDE BUSINESS WITH EXPANDING LOCAL SUPPORT NETWORKS
- EXPERIENCED PHOTORESIST SUPPLIER TO THE THIN FILM RECORDING HEAD INDUSTRY
  - IMAGING IN THICK FILMS, RESIST PLATING (CU, AU), ADHESION, CURING
- EXCELLENT <u>PERFORMANCE AND VALUE</u> IN ALL OUR PRODUCTS AND SERVICES
- WIDE SELECTION OF SOLUTIONS TO YOUR PROBLEMS