

ZEONREX® Electronic Chemicals
High Resolution Positive Electron Beam Resist

ZEP520A

Technical Report

ZEON CORPORATION
Electronics Materials Division

CONTENTS

1. Characteristics
2. Properties
3. Spin Curve
4. Dependence on Prebake Temperature
5. Dependence on Development Temperature
6. Dependence on Development Time
7. Examples of Application
8. Dry Etching Resistance
9. Example of Process Conditions
10. Handling Precaution
11. Appendix

Any process conditions and data are examples.
Those will not guarantee the same data in customers' process.

1. Characteristics

ZEP520A is high performance positive EB resists which show high resolution and dry etch resistance.

They are suitable for various EB processes.

(1) Resolution

Shows high resolution and rectangle pattern profile.

(2) Resistance to dry etching

Shows high dry etch resistance and they are almost equivalent to that of positive photoresists generally used.

(3) Sensitivity

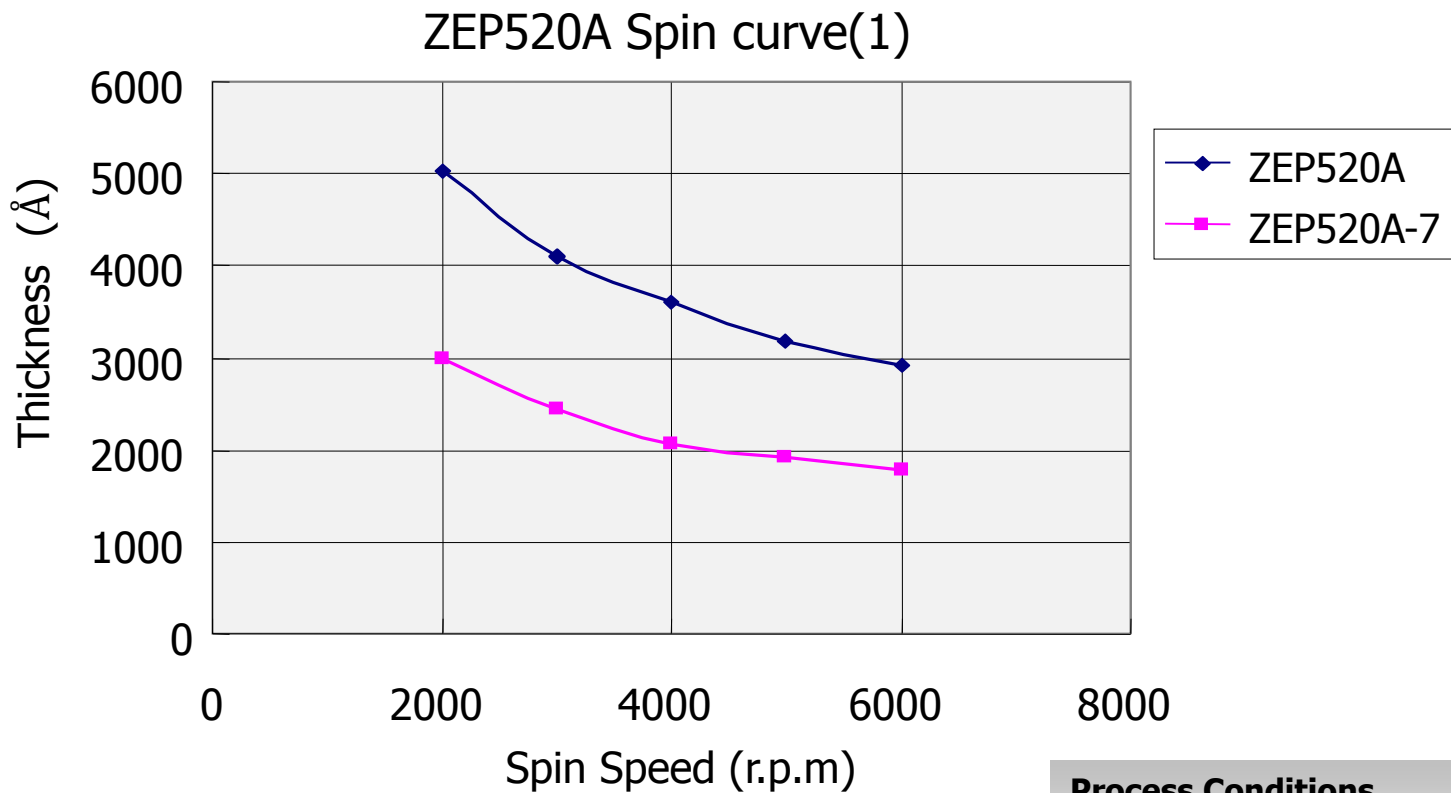
Shows high sensitivity.

2. Properties

Item		Mw	Viscosity (mPa · s)	Solvent	Form
EB resist	ZEP520A ZEP520A-7	57,000	$\frac{11}{7}$	Anisole	1QT bottle / 100ml bottle

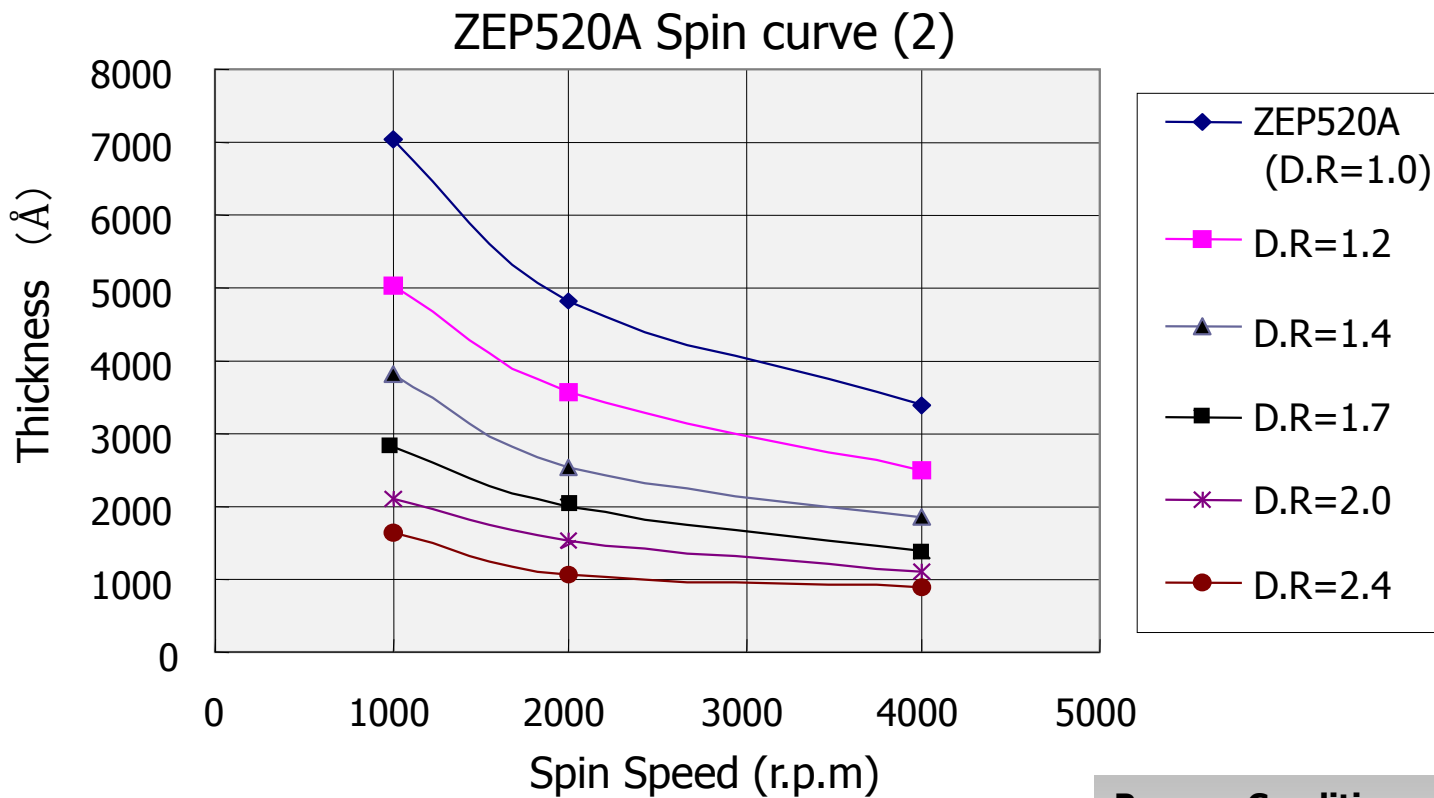
Item		Composition	Remarks	Form
Thinner	ZEP-A	Anisole	ZEP520A	1QT bottle
Developer	ZED-N50	n-Amyl acetate		1GL bottle
Rinse	ZMD-D	Methyl isobutyl ketone 100%		1GL bottle / 1QT bottle
Remover	ZDMAC	Dimethylacetamide		1GL bottle

3. Spin Curve



Process Conditions
 Substrate: 4inch Si wafer
 Resist: ZEP520A
 Spin : 300rpm,3sec.→Xrpm,120sec.
 PB temp.: 180°C
 PB time: 3min.

3. Spin Curve (Reference data for dilution)



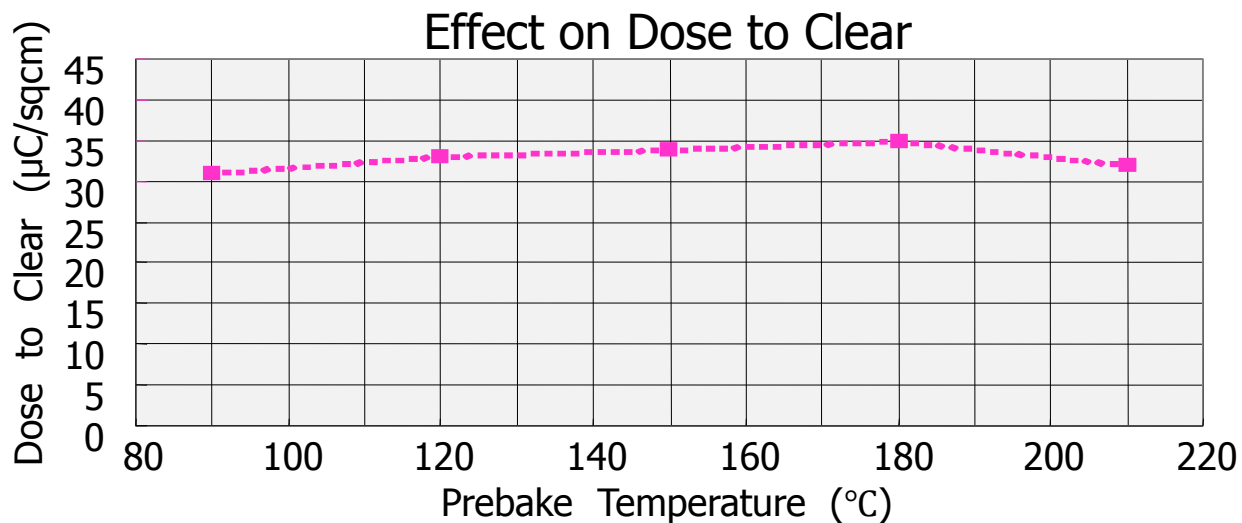
D.R (Dilution Rate)

$$= \frac{\text{Original Resist(g)} + \text{Solvent(g)}}{\text{original Resist(g)}}$$
(Weight Ratio)

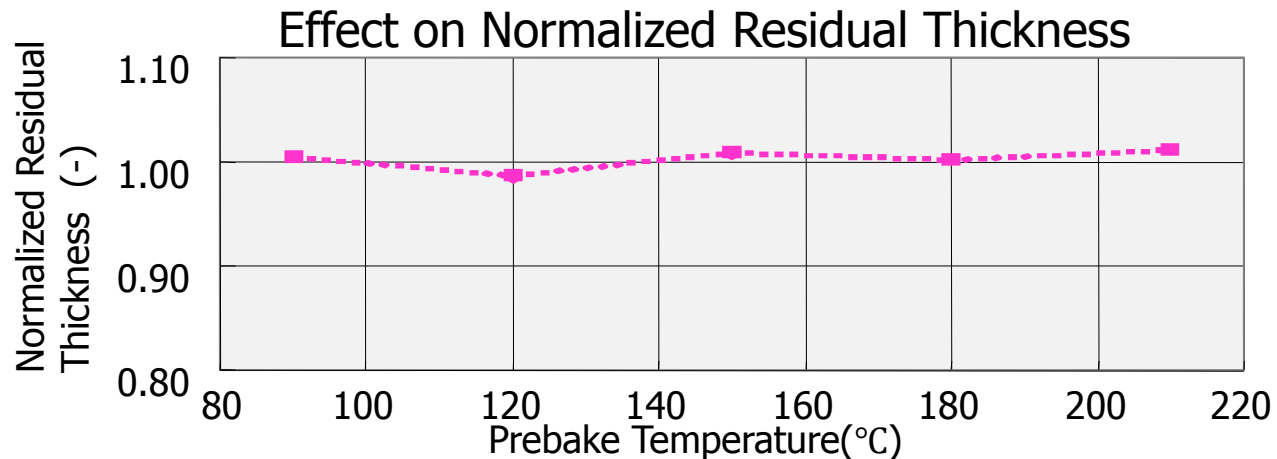
Process Conditions

Substrate: 4inch Si wafer
 Resist: ZEP520A
 Spin: 300rpm, 3sec. → Xrpm, 120sec.
 PB temp.: 180°C
 PB time: 3min.

4. Dependence on Prebake Temperature



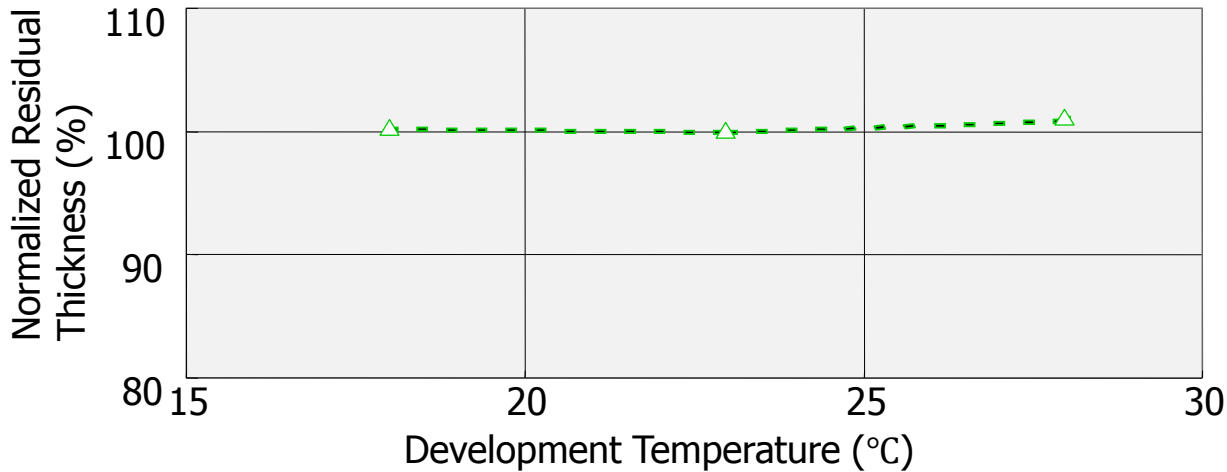
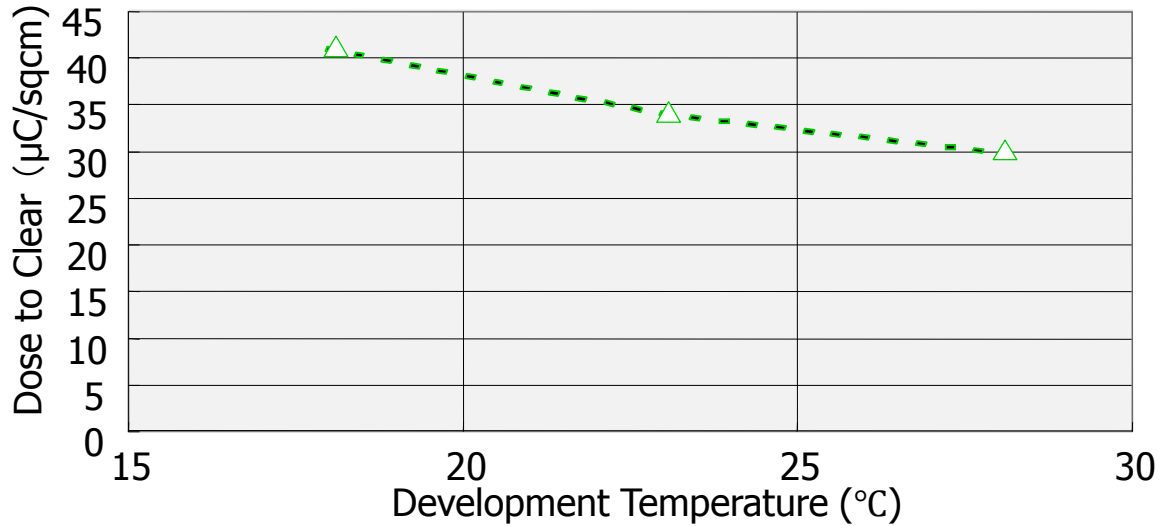
---■--- ZEP520A



Process conditions

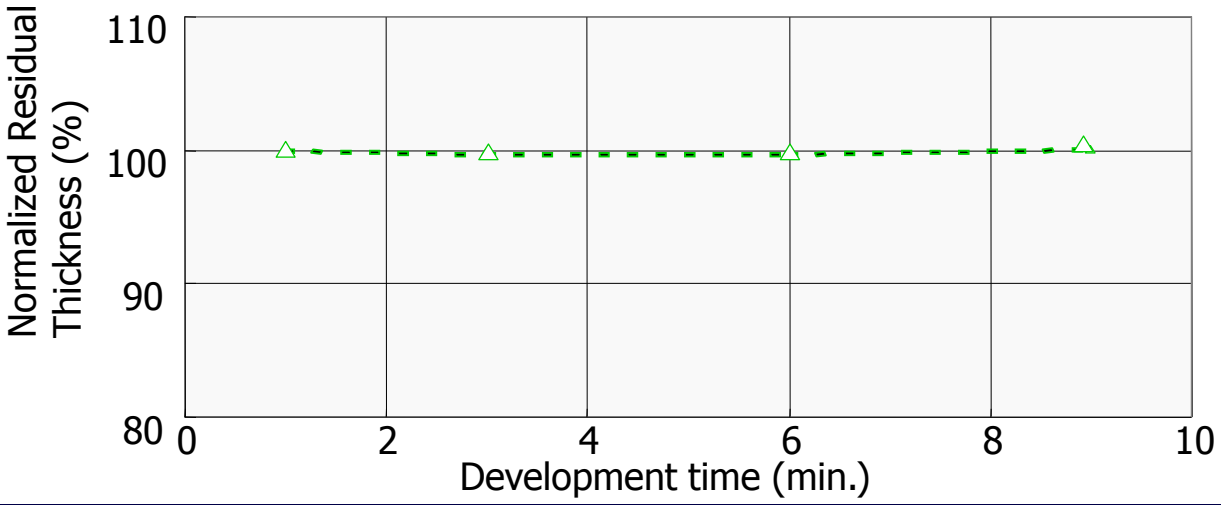
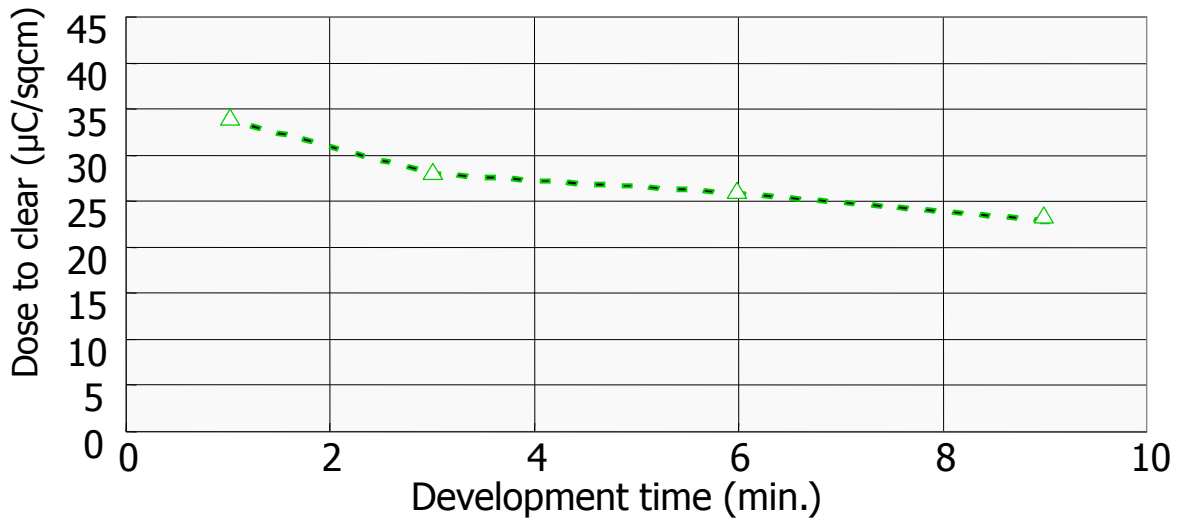
Substrate: Si wafer
 Resist: ZEP520A
 Film thickness: 5000Å
 PB time: 3 min.
 Exposure: ELS3300, 20kV
 Developer: ZED-N50, 23°C
 Dev.time: 1 min.
 Rinse: ZMD-D, 23°C, 10sec.

5. Dependence on Development Temperature



Process conditions
 Substrate: Si wafer
 Resist: ZEP520A
 Film thickness: 5000Å
 PB temp. : 180°C
 PB time: 3 min.
 Exposure: ELS3300, 20kV
 Developer: ZED-N50, 23°C
 Dev.time: 1 min.
 Rinse: ZMD-D, 23°C, 10sec.

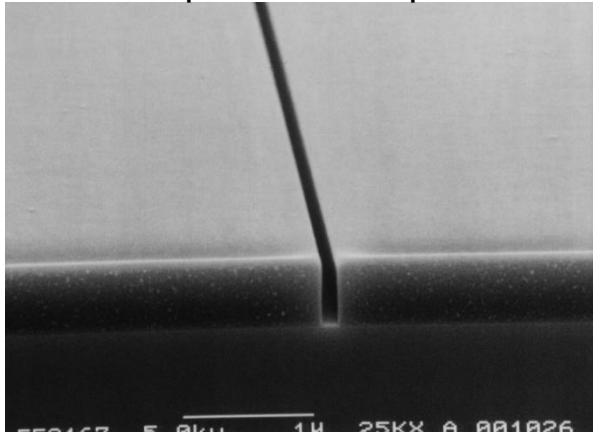
6. Dependence on Development Time



Process conditions
 Substrate: Si wafer
 Resist: ZEP520A
 Film thickness: 5000Å
 PB temp. : 180°C
 PB time: 3 min.
 Exposure: ELS3300, 20kV
 Developer: ZED-N50, 23°C
 Dev.time: 1 min.
 Rinse: ZMD-D, 23°C, 10sec.

7. Examples of application

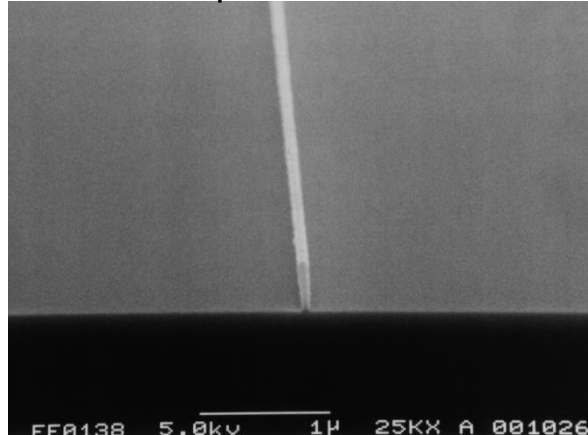
0.15 μ m Isolated space



Process Conditions

Resist : ZEP520
 Film thickness : 5000 \AA
 PB temp. : 180 $^{\circ}\text{C}$
 PB time : 2min.
 Exposure : 30kV, $5 \times 10^{-11}\text{A}$, 1 line exp.
 $50 \times 10^{-5}\mu\text{C}/\text{cm}$
 Dev. temp. : ZED-WN(end of sale),
 23 $^{\circ}\text{C}$, 30sec.
 Rinse : IPA, 23 $^{\circ}\text{C}$, 20sec.

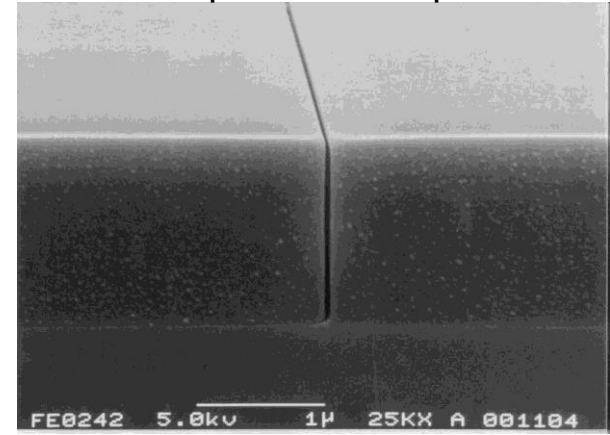
0.1 μ m Isolated line



Process Conditions

Resist : ZEP520
 Film thickness : 5000 \AA
 PB temp. : 180 $^{\circ}\text{C}$
 PB time : 2min.
 Exposure area : 100 μm^2 (20000 \times 20000dot)
 Exposure : 30kV, $5 \times 10^{-11}\text{A}$, 1 line exp.
 0.7 $\mu\text{sec./dot}$
 Dev. temp. : ZED-WN(end of sale),
 23 $^{\circ}\text{C}$, 60sec.
 Rinse : IPA, 23 $^{\circ}\text{C}$, 20sec.

0.05 μ m Isolated space



Process Conditions

Resist : ZEP520
 Film thickness : 15000 \AA
 Exposure : 75kV

These data were presented by ELIONIX INC.

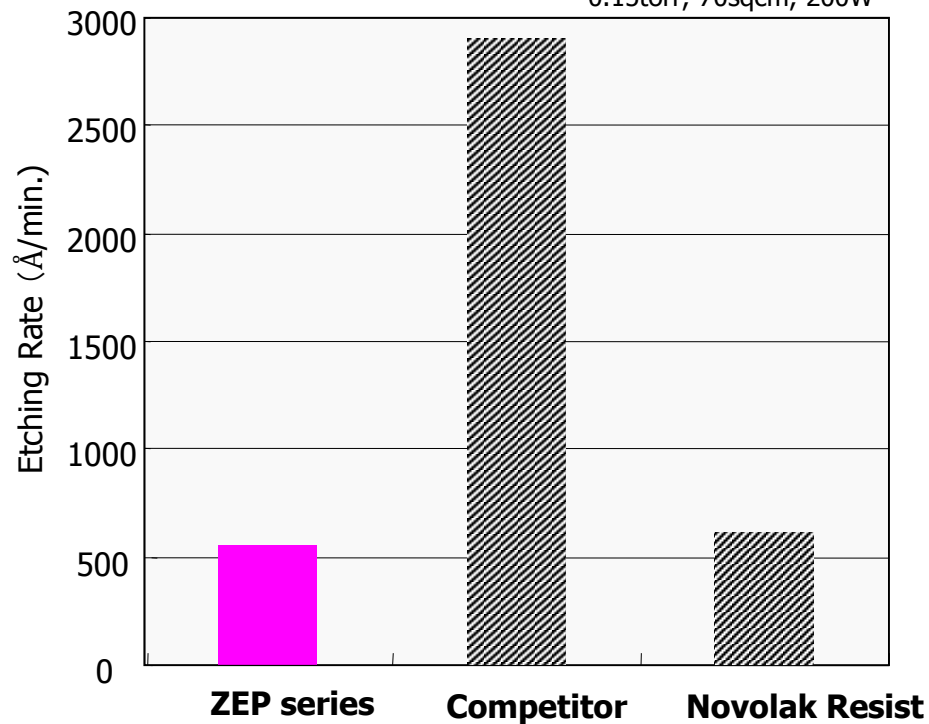


* These SEM photographs & Data are offers of ELIONIX INC. Although ZEP520 is not sold from consideration of environment now. We think that the same pattern formations are possible also in ZEP520A.

8. Dry Etching Resistance

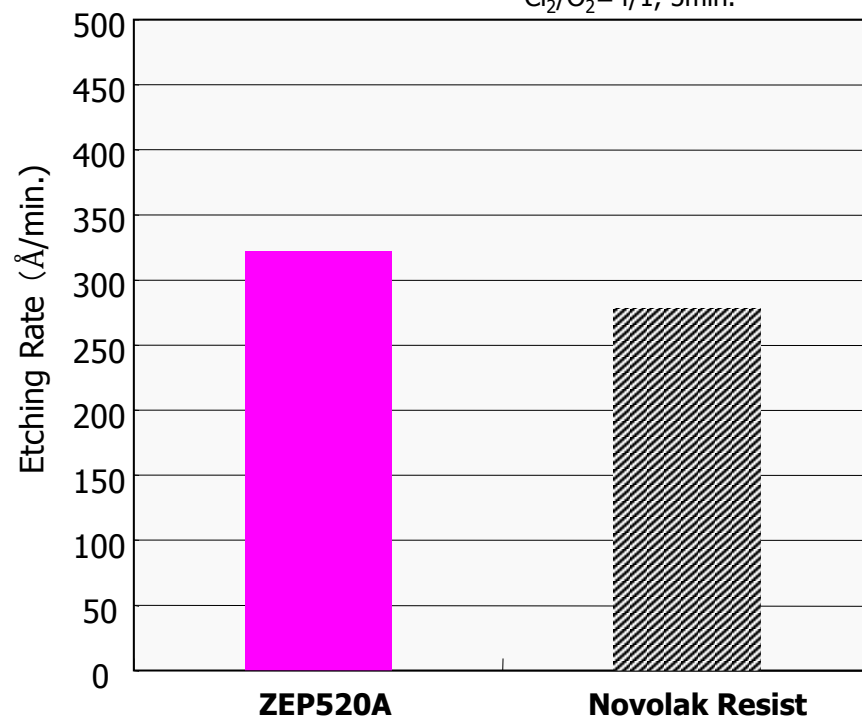
(1) CF₄ Dry Etching Rate

CF₄ Dry Etching Condition
0.15torr, 70sqcm, 200W



(2) Cl₂+O₂ Dry Etching Rate

Cl₂+O₂ Dry Etching Condition
Cl₂/O₂=4/1, 5min.



9. Example of Process Conditions

(1) Coating

ZEP520A 2000rpm × 60sec → 5000Å
 ZEP520A-7 2000rpm × 60sec → 3000Å

(2) Prebake

170~200°C × 20~30min. (Oven)
 170~200°C × 2~5min. (Hot Plate)

(3) Exposure

20~50μC/cm² at 20kV

(4) Development

20~25°C × 60~360sec. (Dipping)
 ZED-N50

(5) Rinse

20~25°C × 10~60sec. (Dipping)
 ZMD-D

(6) Post bake

in case of wet etching
 100~140°C × 20~30min. (Oven)
 100~140°C × 2~3min. (Hot Plate)

(7) De-scum

O₂-plasma (if need be)

(8) Etching

Dry process and wet process can be used.

(9) Resist removing

<organic solvent >

Dimethylacetamide(DMAC) (30~35°C)
 N-methyl-2-pyrrolidone(NMP) (30~35°C)

< deep-UV + organic solvent >

1st step: 185nm+254nm, 10mW/cm², 3min.-irradiation
 2nd step: Dimethylacetamide(DMAC) or
 N-methyl-2-pyrrolidone (NMP), 23°C × 1min.

*As the polymer of ZEP520A is decomposed by
 deep-UV irradiation, it can be easily removed.

10. Handling Precaution

- (1) Flammable Liquid.**
- (2) Harmful by inhalation.**
- (3) Avoid contact with skin and eyes.**

CAUTION: Open carefully. Use in well ventilated area. In case of contact with skin and eyes, rinse immediately with plenty of water for 15 minutes and get medical attention. In case of fire use Alcohol form CO₂ or dry chemical, never use water.

STORAGE: Keep capped and away from oxidants, sparks and open flame. Store at cool[32° F(0° C)~77° F(25° C)] and dark place. Use in clean room.

11. Appendix

(1) Refractive index of ZEP520A film

Cauchy coefficient

$$n = n_0 + n_1/\lambda^2 + n_2/\lambda^4$$

$$n_0 = 1.541093$$

$$n_1 = 4.113002 \times 10^5$$

$$n_2 = 4.070357 \times 10^{12}$$

absorption coefficient = 0

unit of λ : Å

measured by UV-1250/SE(KLA Tencor)

(2) Glass transition temperature of ZEP520A polymer

T_g : 105°C measured by DSC