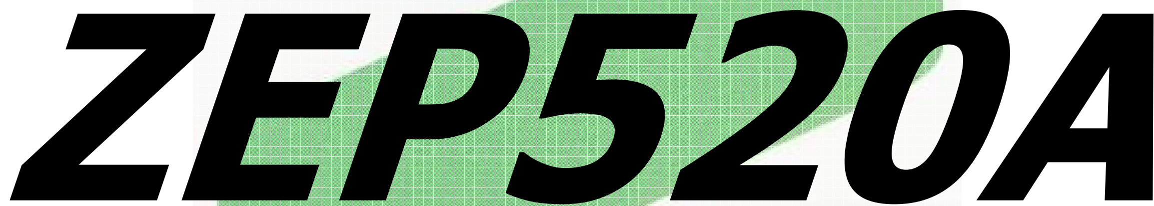
Technical Report

ZEP520A Ver.1.02 Apl.2003

ZEONREX Electronic Chemicals

ZEP520A

High Resolution Positive Electron Beam Resist



ZEON CORPORATION *Specialty Materials Division*

Headquarters
Furukawa Sogo Bldg., 2-6-1 Marunouchi,
Chiyoda-ku, Tokyo 100-8323 , JAPAN
Phone : 81-3-3216-0590
Fax : 81-3-3216-1827

R&D Center
1-2-1 Yako, Kawakaki-ku Kawasaki-shi
Kanagawa-ken 210-9507, JAPAN
Phone : 81-44-276-3741
Fax : 81-44-276-3957

http://www. zeon. co. jp/

CONTENTS

1. Characteristics
2. Properties
3. Thinner
4. Developer
5. Rinse
6. Remover
7. Spin Curve
8. Dependence on Prebake Temperature
9. Dependence on Developer
10. Examples of Application
11. Dry Etching Resistance
12. Example of Process Conditions
13. Handling Precaution
14. 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, high sensitivity 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
ZEP520A	57,000	11	Anisol	1QT bottle or 100ml bottle
ZEP520A-7		7		

3. Thinner

Item	Composition	Remarks	Form
ZEP-A	Anisol	ZEP520A	1QT bottle

4. Developer

Item	Composition	Remarks	Form
ZEP-RD	Xylene(o-,m-,p- mixed)	standard	1GL bottle
ZED-N50	n-Amyl acetate	high resolution	
ZED-N50 is recommended			

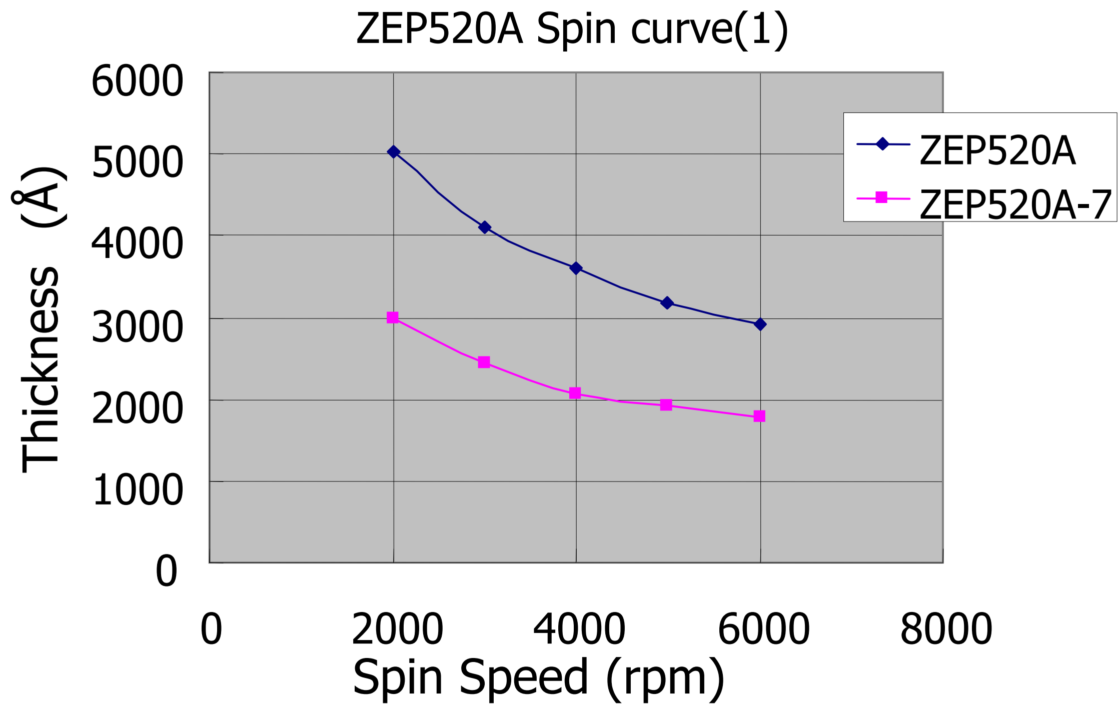
5. Rinse

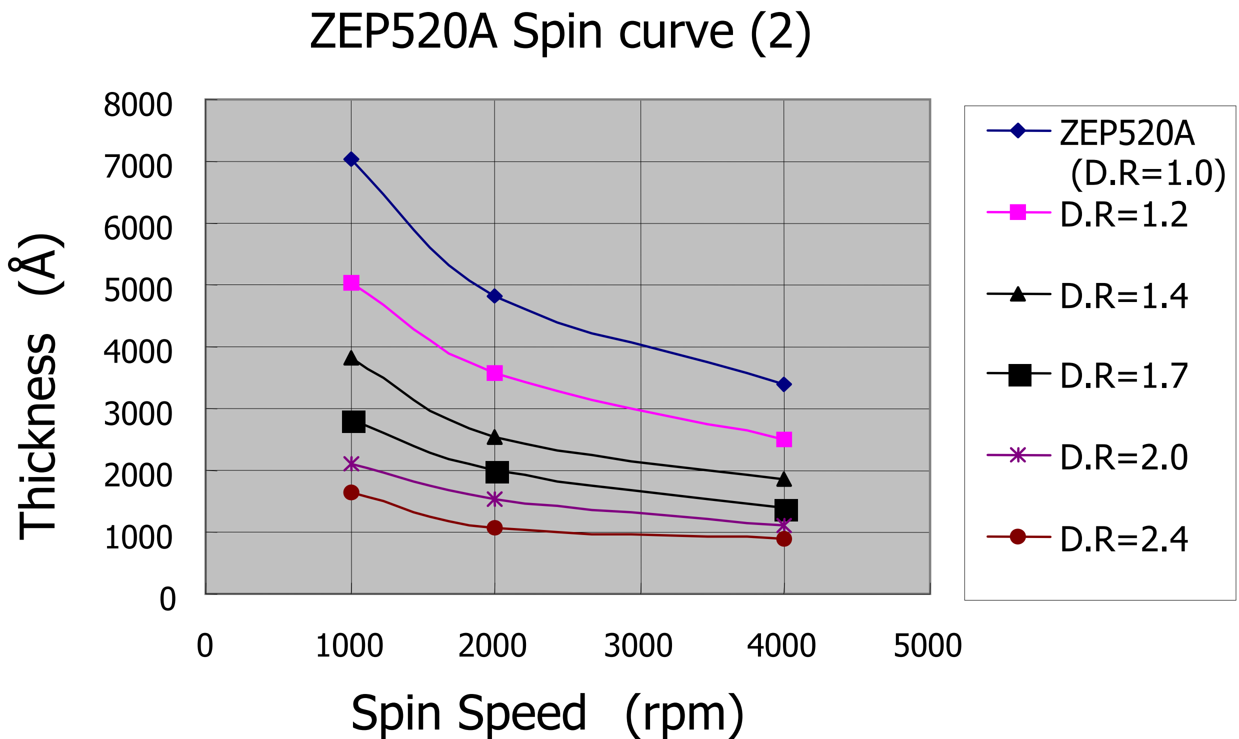
Item	Composition	Remarks	Form
ZMD-D	Methyl isobutyl ketone 100%		1GL bottle

6. Remover

Item	Composition	Remarks	Form
ZDMAC	Dimethylacetamide		1GL bottle

7. Spin Curve

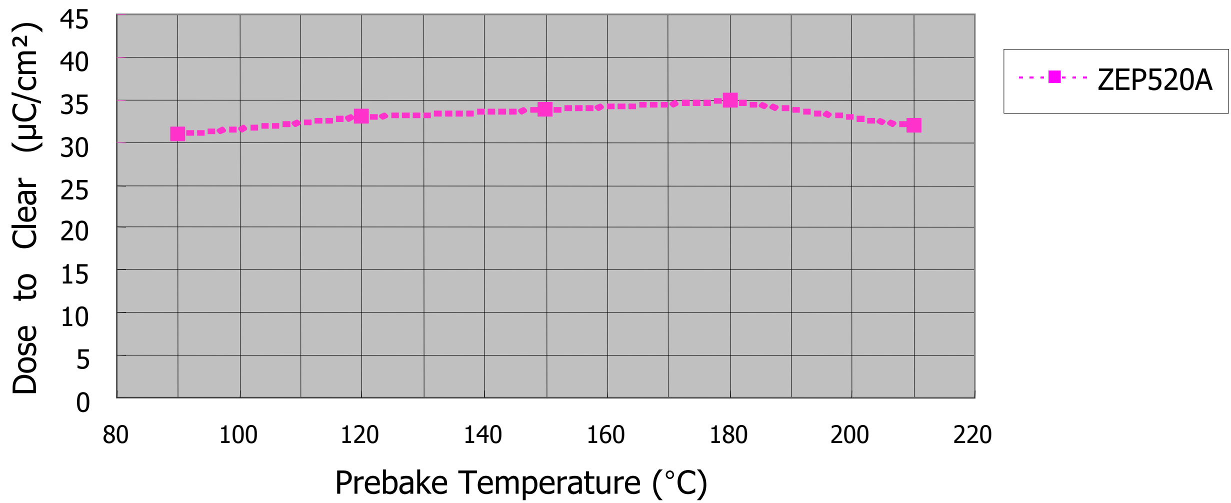


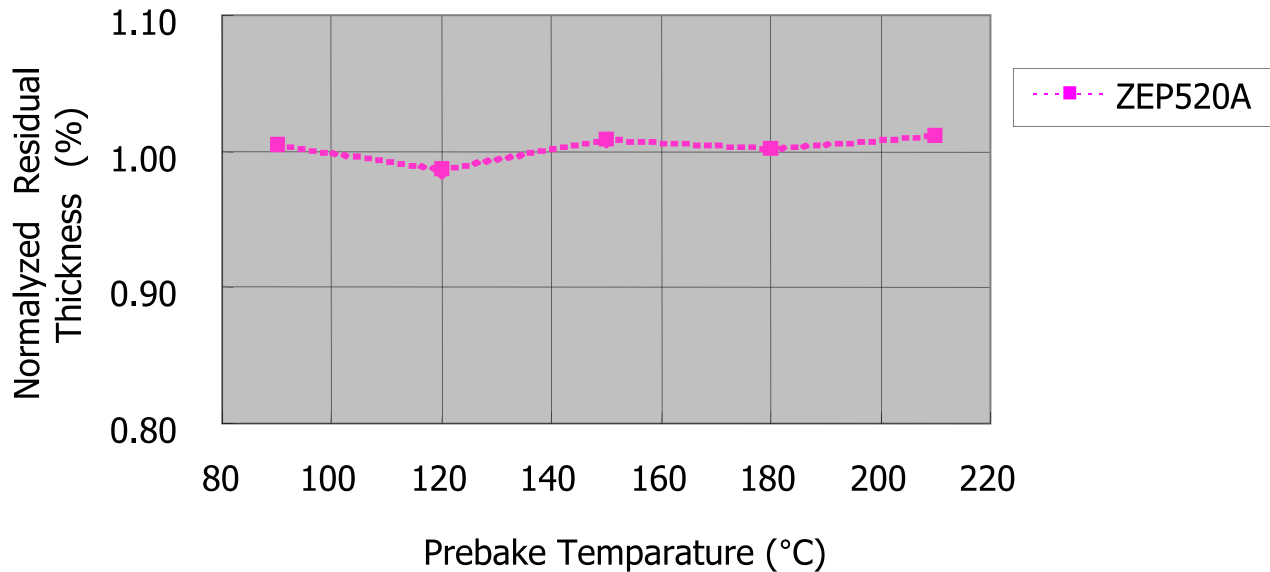


D.R.: Dilution Rate =
{Original Resist(g)+Solvent(g)}/original Resist(g)
(Weight Ratio)

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

8. Dependence on Prebake Temperature

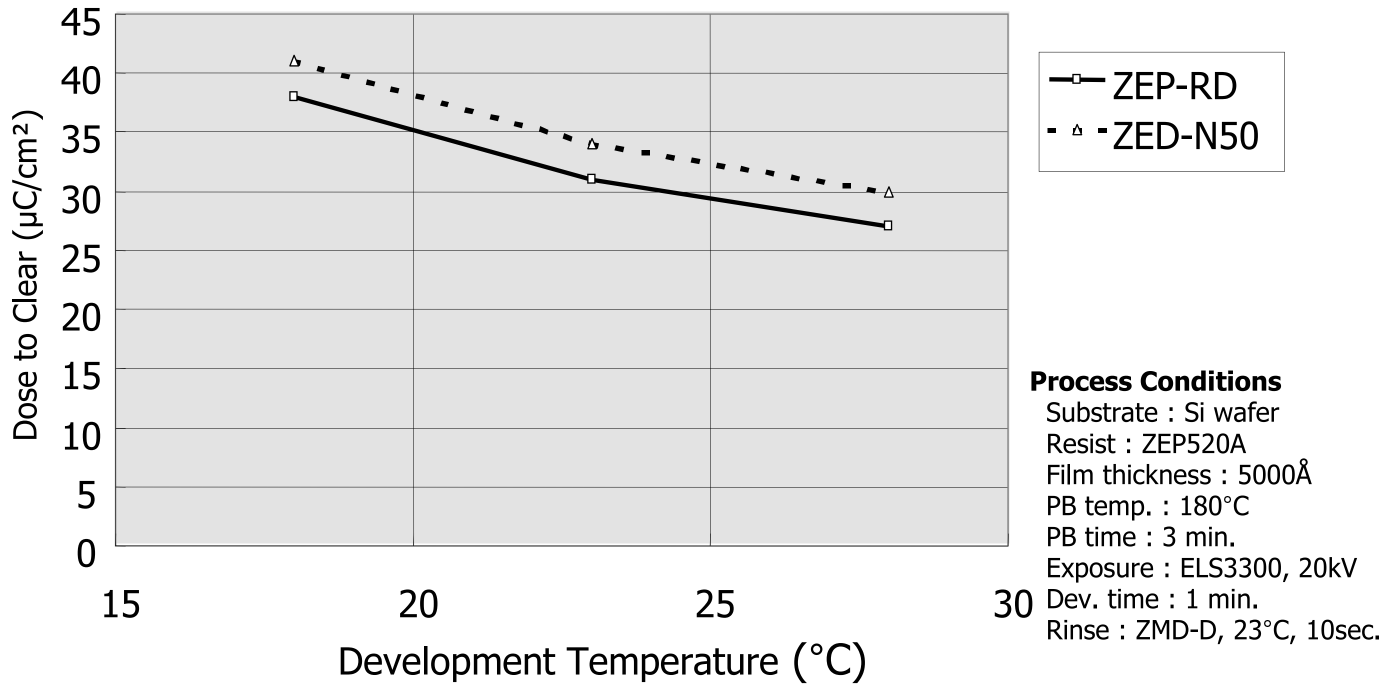


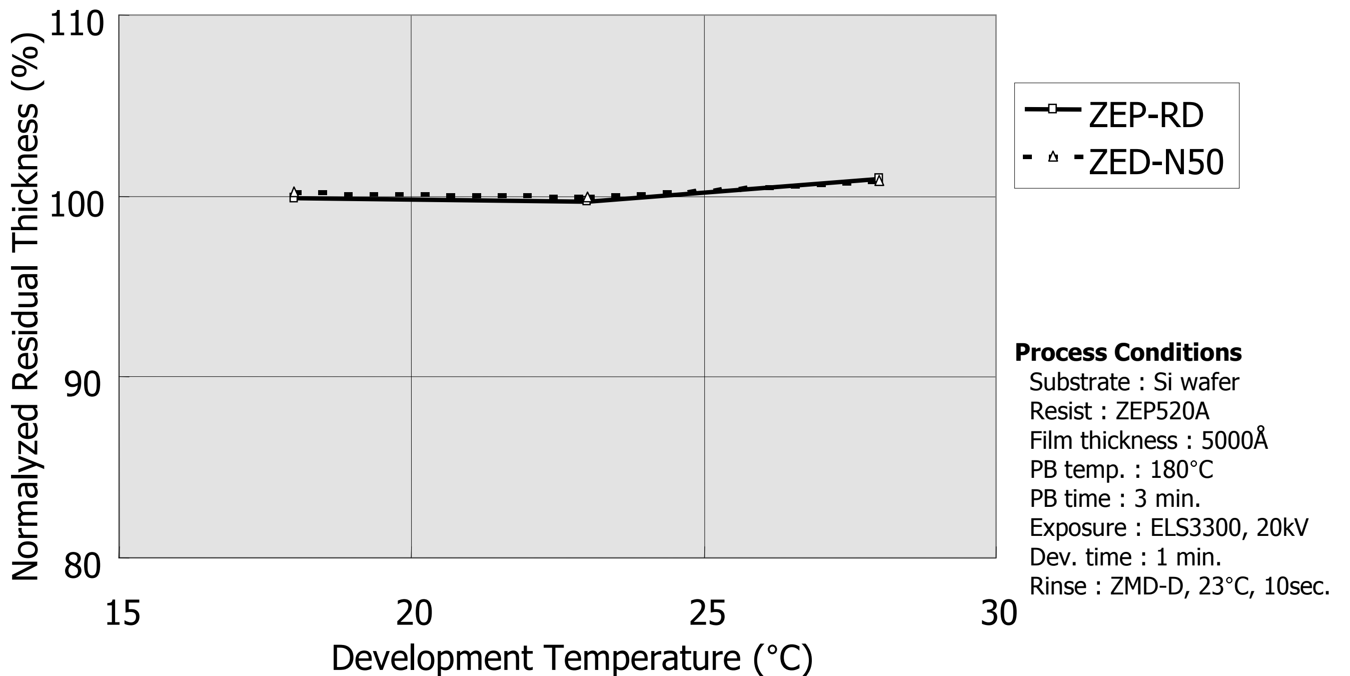


Process conditions

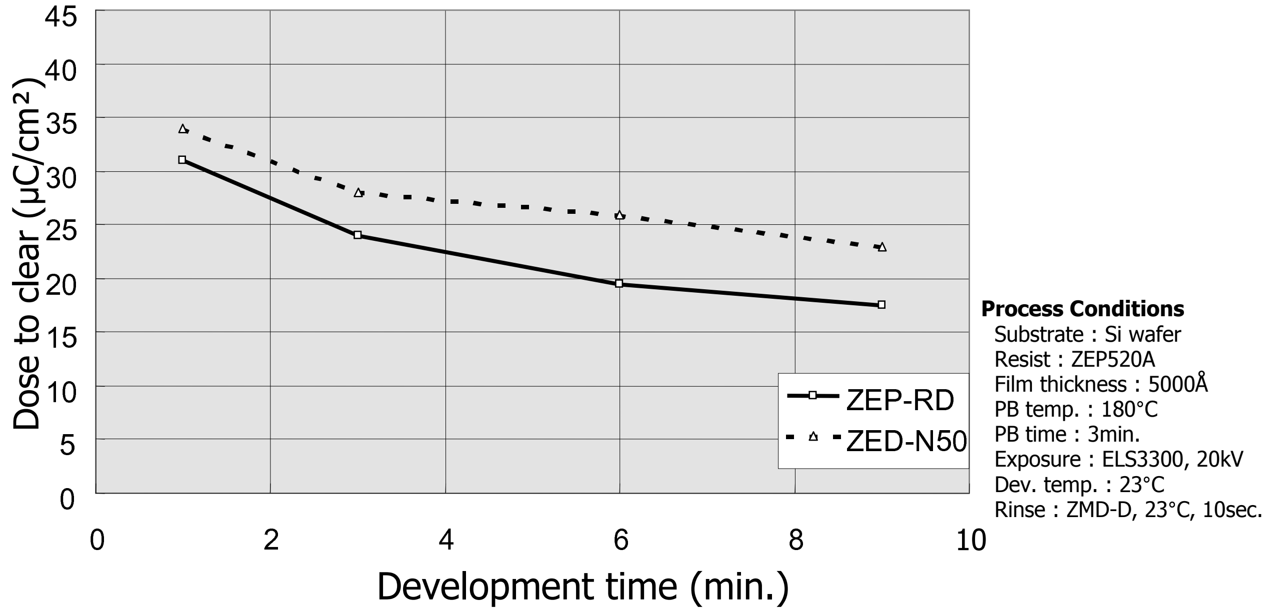
Substrate: Si wafer
Resist: ZEP520A
Film Thickness: 5000Å
PB Time: 3 min.
Exposure: ELS3300,20kV
Developer: ZED-N50, 23°C
Dev. Time: 1 min.
Rinse: ZMD-D, 23ºC, 10sec.

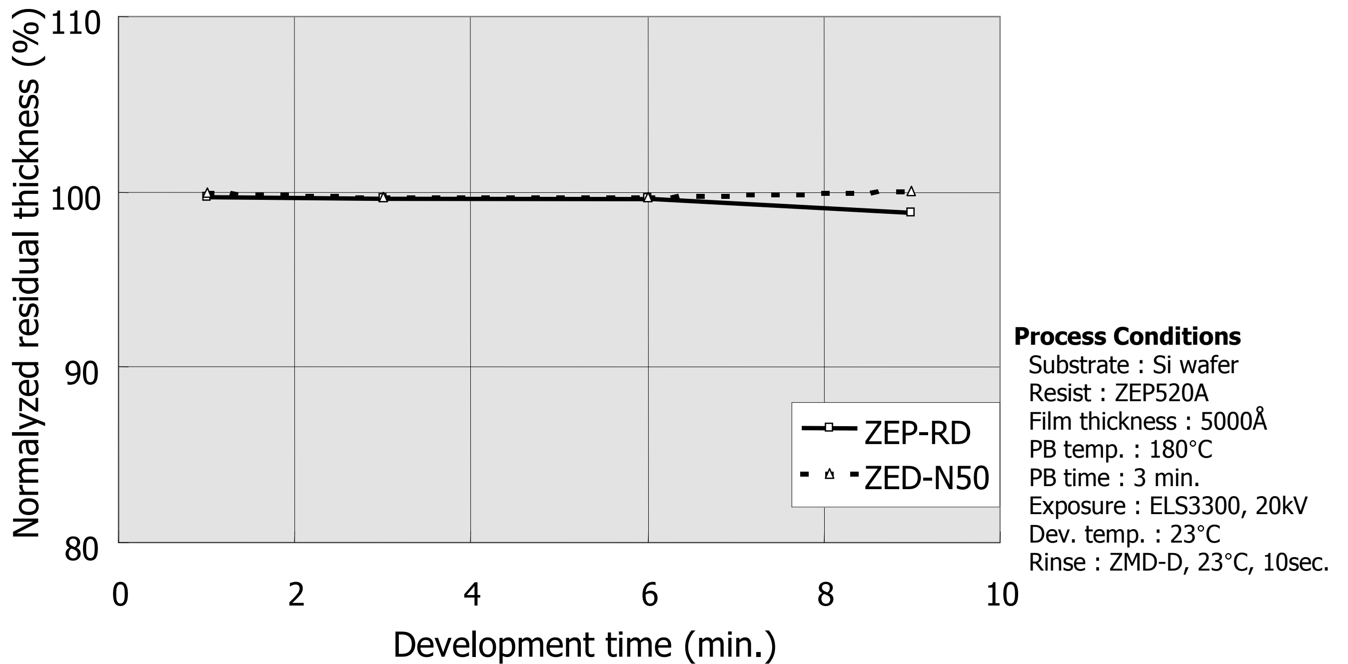
9. Dependence on Development Temperature



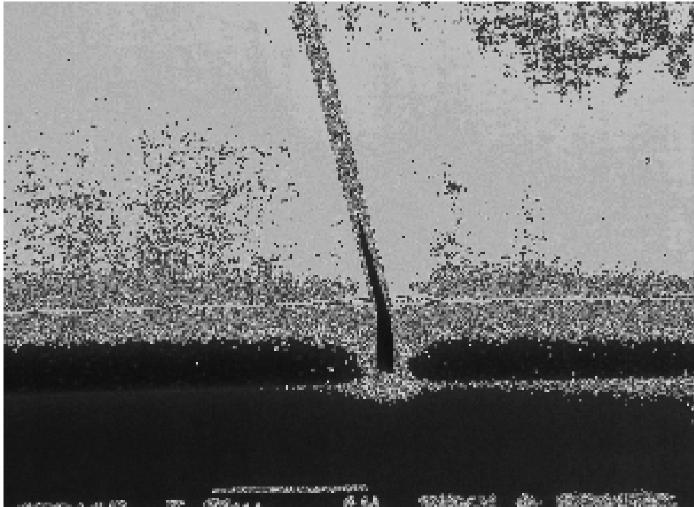


9. Dependence on Development Time





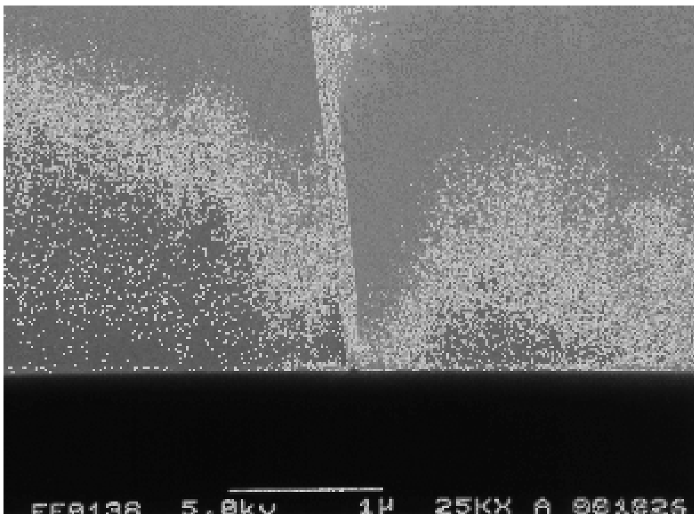
10. Examples of application



0.15μm Isolated space

Process Conditions

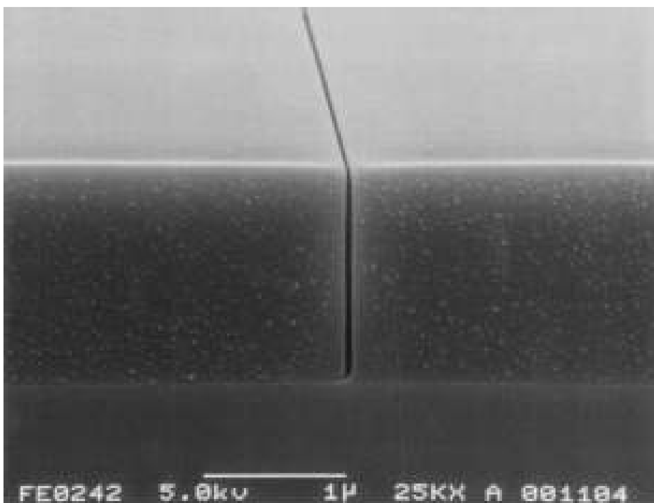
Resist : ZEP520
Film thickness : 5000Å
PB temp. : 180°C
PB time : 2 min.
Exposure : 30kV, 5×10^{-11}A, 1 line exp.
50×10^{-5}μC/cm
Dev. temp. : ZED-WN, 23°C, 30 sec.
Rinse : IPA, 23°C, 20 sec.



0.1μm Isolated line

Process Conditions

Resist : ZEP520
Film thickness : 5000Å
PB temp. : 180°C
PB time : 2 min.
Exposure area : 100μm (20000×20000dot)
Exposure : 30kV, 5×10^{-11}A, 1 line exp.
0.7μsec./dot
Dev. temp. : ZED-WN, 23°C, 60 sec.
Rinse : IPA, 23°C, 20 sec.



0.05μm Isolated space

Process Conditions

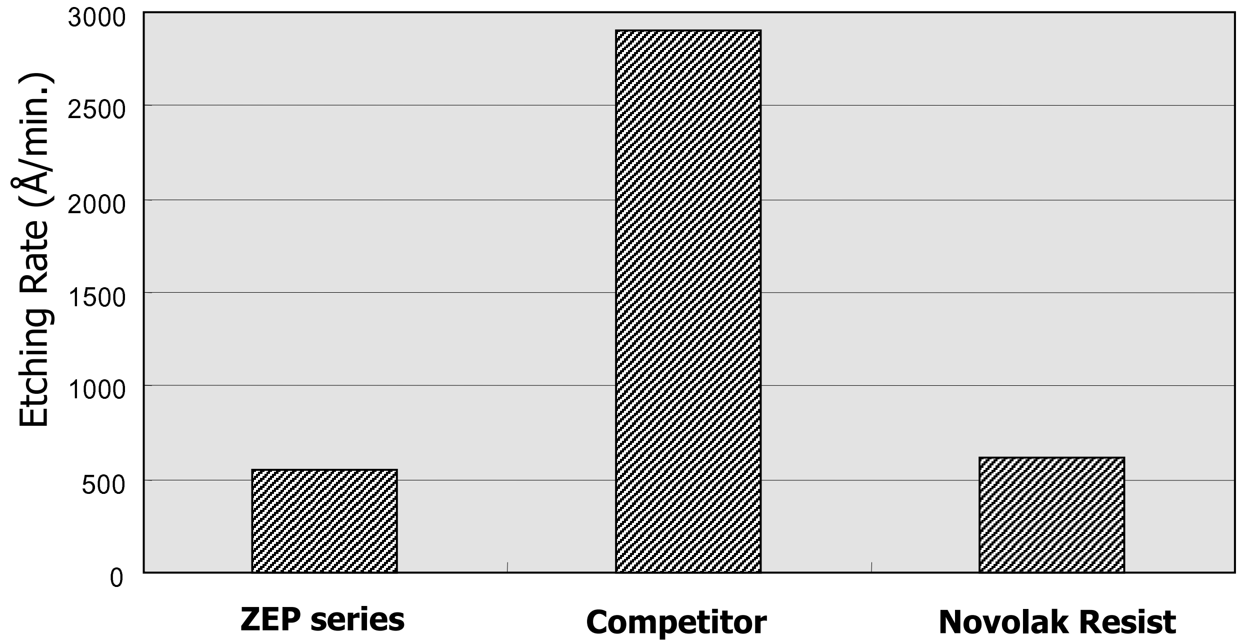
Resist : ZEP520
Film thickness : 15000Å
Exposure : 75kV

* 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.

11. Dry Etching Resistance

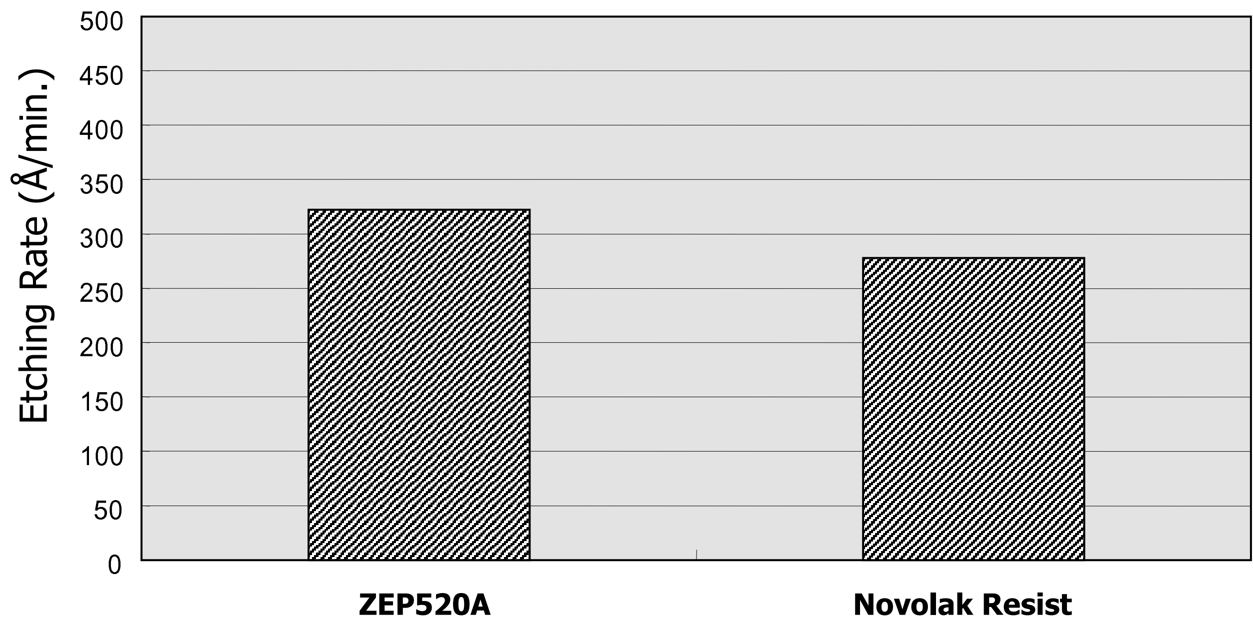
(1) CF_4 Dry Etching Rate

CF_4 Dry Etching Condition
0.15torr, 70sqcm, 200W



(2) Cl_2+O_2 Dry Etching Rate

Cl_2+O_2 Dry Etching Condition
Cl_2/O_2=4/1, 5min.



12. Example of Process Conditions

(1) Coating

ZEP520A 2000rpmx60sec ⟶ 5000Å
ZEP520A-7 2000rpmx60sec ⟶ 3000Å

(2) Prebake

170-200°Cx20-30min. (Oven)
170-200°Cx2-5min. (Hot Plate)

(3) Exposure

20-50 μC/cm² at 20kV

(4) Development

20-25°Cx60-360sec. (Dipping)
ZEP-RD, <u>ZED-N50</u>

(5) Rinse

20-25°Cx10-60sec. (Dipping)
ZMD-D

(6) Post bake

In case of <u>wet etching</u>
100-140°Cx20-30min. (Oven)
100-140°Cx2-3min. (Hot Plate)

(7) De-scum

O_2-plasma (if need be)

(8) Etching

Dry process and wet process can be used.

<u>Wet Etching solution for Cr</u>
Ammonium cerium(IV) nitrate $(NH_4)_2Ce(NO_3)_6$ 13-18wt%
Perchloric acid $HClO_4$ 3-8wt%
Pure water H_2O 77-84wt%

(9) Resist removing

< deep-UV + organic solvent >
1st step: 185nm+254nm,10mW/cm²,3min.-irradiation
2nd step:
Dimethylacetamide(DMAC) or N-methyl-2-pyroridone (NMP),
23°C×1min.
*As the polymer of ZEP520A is decomposed by deep-UV irradiation, it can be easily removed.

<organic solvent >
Dimethylacetamide (DMAC) (30-35°C)
N-methyl-2-pyroridone(NMP) (30-35°C)

13. Handling Precautions

(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 CO_2 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.

14. 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

Tg : 105°C measured by DSC

< U.S.A >
Zeon Chemicals L.P. (ZCLP)
4111 Bells Lane, Louisville, Kentucky 40211
(TEL) +1-502-775-2043
(FAX) +1-502-775-7675

< Europe >
Zeon Europe GmbH
Am Seestern 18 40547
Dusseldorf Germany
(TEL) +49-211-5267-113
(FAX) +49-211-5267-160