O C G   M I C R O E L E C T R O N I C   M A T E R I A L S   N V

HPR 500

SAFER SOLVENT
POSITIVE RESIST SERIES

HPR 500 Series resists are positive working resists for semiconductor application, having suitable properties for use as a mask for ion implant, wet and dry etching. HPR 500 Series resists perform in a wide range of developer conditions, MIF or MIC, using track or immersion systems. The HPR 500 Series resist range gives spin coatings ranging from 1.0 - 2.2µ

How you benefit

* The solvent used in HPR 500 Series resists is ethyl lactate (2-hydroxy ethyl propionate). It is a safer solvent compared to those previously used in resist products.
* HPR 500 Series resists have wide process latitude and are suitable for a wide range of process applications giving you a repeatable on-line process.
* As with all OCG's resist products, HPR 500 Series resists are supported by local offices with their adminstration and technical sales staff, together with a field force of product specialists who have access to our Technical Service Centre, providing you with the service and the back-up that you require.

Inside

How to use HPR 500 Series resists

Product specification

Contact address and phone numbers

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Spin Coating

A choice of viscosities / solids content

HPR 500 Series resists are available in several viscosities providing a range of film thicknesses as shown in figure1

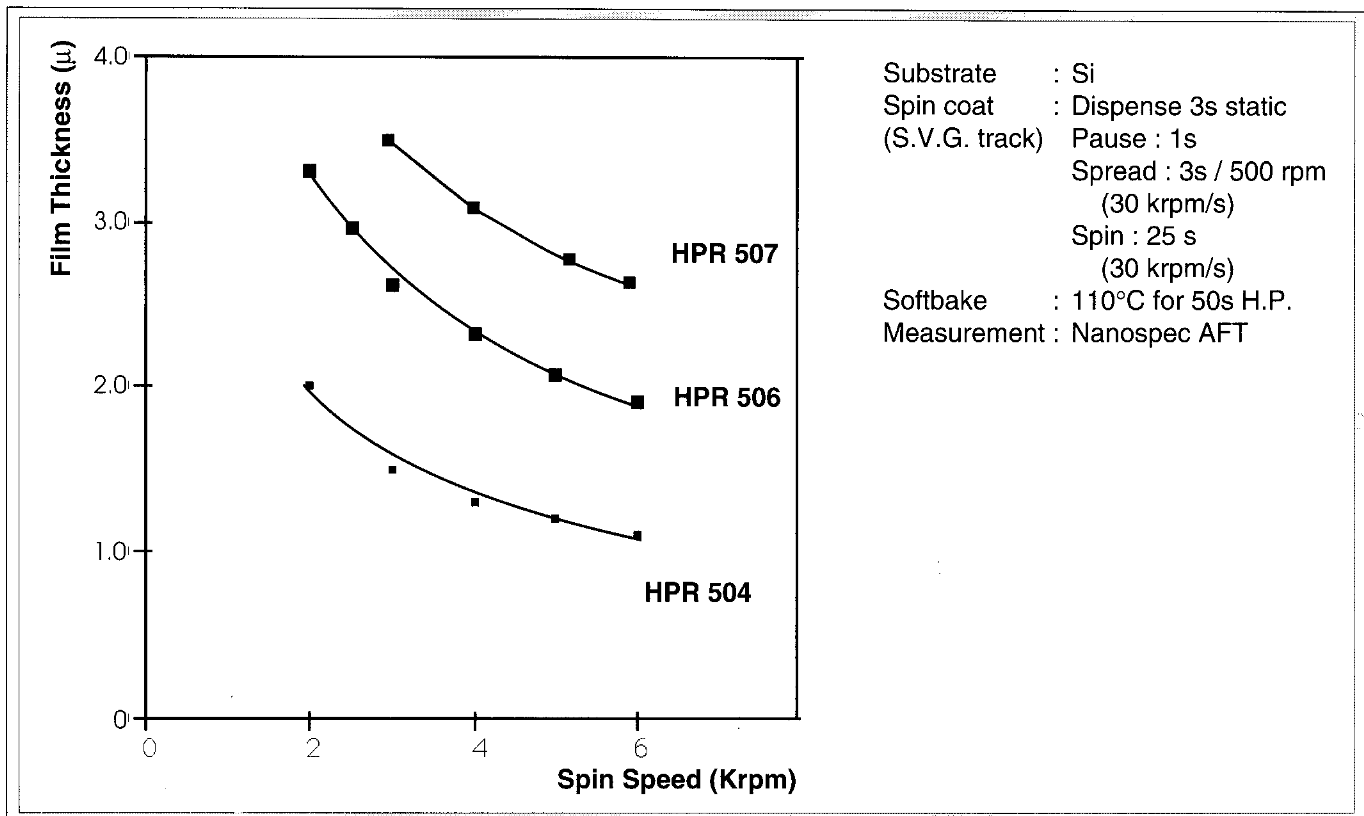

Figure 1 : Spin curves for HPR 500 Series resists

The substrate must be clean and dry to ensure coating quality, optimum adhesion, and process consistency.

Good adhesion

HPR 500 Series resists have good adhesion properties, and surface priming may not be necessary on all masking layers. HPR 500 Series resists are also compatible with silylating pretreatments, so adhesion promoters such as HMDS can be used on those substrates that require such treatment.

However, contact with any residual HMDS vapour or liquid, causes a noticeable decrease in photospeed.

Uniform spin coating

Various coating cycles can be employed with HPR 500 Series depending on your particular requirements. Using the following spin program with HPR 504 resulted in a coating uniformity sigma of 65 Å, on a 4" wafer.

Step	Time	rpm	Accl	Comment
Dispense	2 s	0*	0	2.5 ml
Pause	1 s	0	0	-
Spread	2 s	500	1 K rpm/s	-
Spin	20 s**		5 K rpm/s	

Comments for higher viscosities

* When using HPR 506, HPR 507 and HPR 508 it is recommended that a dynamic dispense method is used to gain optimum uniformity with the thicker coatings obtained.

** To ensure that the bulk of the solvent is removed prior to softbake, it is recommended that this final spin time is increased by 10 seconds for spin coatings thicker than 1.8μ.

Edge bead removal

Resist edge bead removal can be succesfully achieved using RER 500. An example of a typical process is given below using an SVG Model 8626 photoresist coater. The process removed 1.5 mm of edge bead from 4" wafers coated with 1.2μ of HPR 504 resist on SiO_2.

Step	Time (s)	Spinspeed (rpm)	Acceleration (rpm/s)
Spin Dispense	2	300	10,000
RER 500	10	300	10,000
Spin	2	300	10,000
Spin Dry	10	3000	2,000

Other settings

Exhaust	:	1.5 inches
Dispense nozzle size	:	0.064 inches
Nozzle placement	:	10mm from wafer edge
Metering valve setting	:	2.25
Dispense pressure	:	60 oz/inch (3.75 psi)

Softbake

The purpose of this bake is to remove residual solvent left over after coating, and to promote adhesion between resist and coated substrate.

Recommended Conditions

Resist	Hot plate bake time	Temp
HPR 504/5	40 - 60s	100 ± 10°C
HPR 506/7	60 - 90s	100 ± 10°C

HPR 500 Series resists can be softbaked using convection oven, track oven, or hotplate systems. Lower softbake temperatures give higher photospeed, while higher temperatures improve adhesion.

Figure 2 gives an indication of the soft bake latitude of HPR 500 Series resists, showing the critical dimension change with softbake temperature.

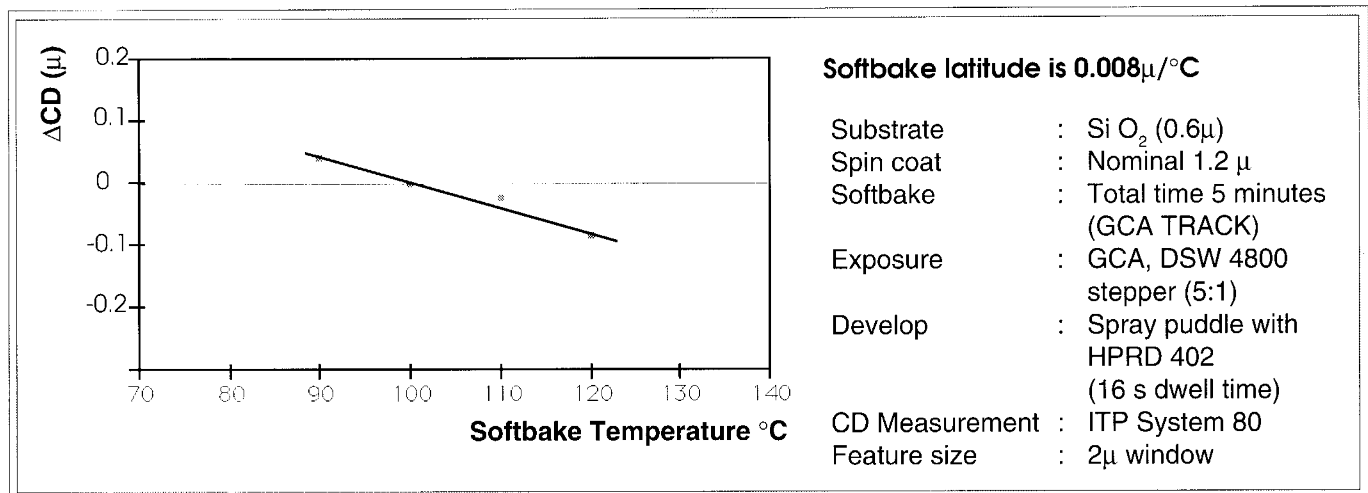

Figure 2 : ΔCD vs softbake temperature for 1.2μ thick HPR 504

g-line stepper exposure

HPR 500 Series resists may be used with contact, projection and stepper exposure equipment, using g- or h-line, or broadband sources.

HPR 500 Series offers good photospeed with HPRD developers maximizing throughput without reducing process latitude.

Figures 3 to 7 show g-line stepper data.

Figure 3 shows a sinusoidal exposure curve generated using a GCA DSW 4800 stepper and the HPR 504 / HPRD 428 system in a double puddle development mode. It is a guideline for the exposure energy required for different resist film thicknesses.

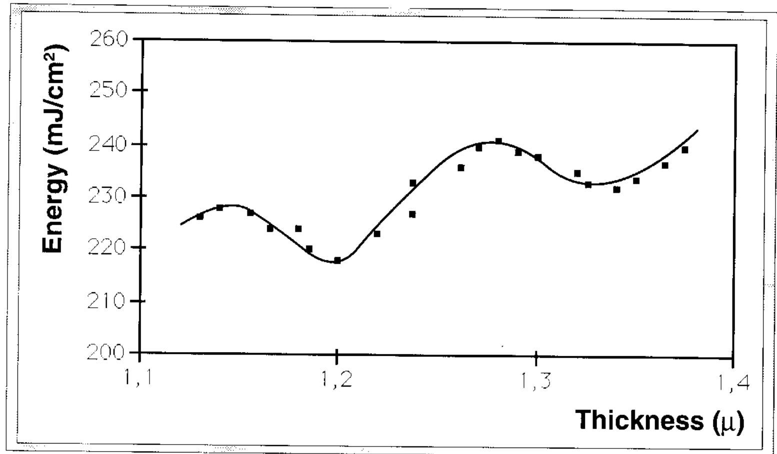

Figure 3

Figure 4 compares g-line stepper exposure latitude for different developer series.

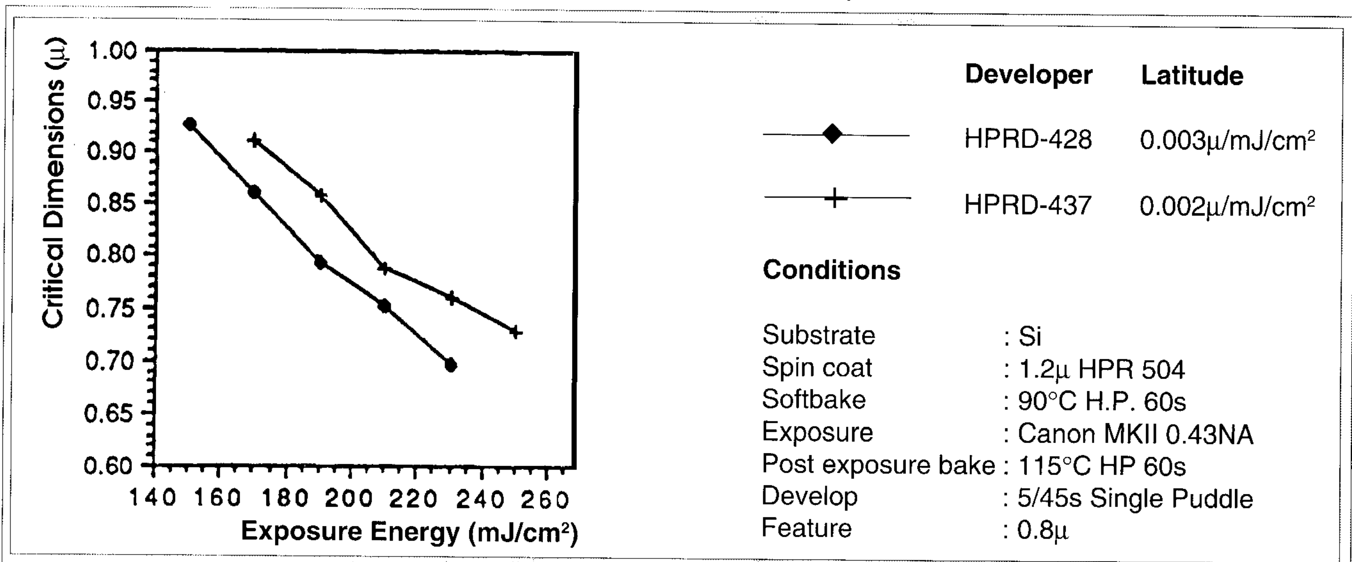

Figure 4

Figure 5 shows 1μ lines and spaces, easily obtainable in production from the system HPR 504 / HPRD 428, using a 0.30 NA g-line stepper

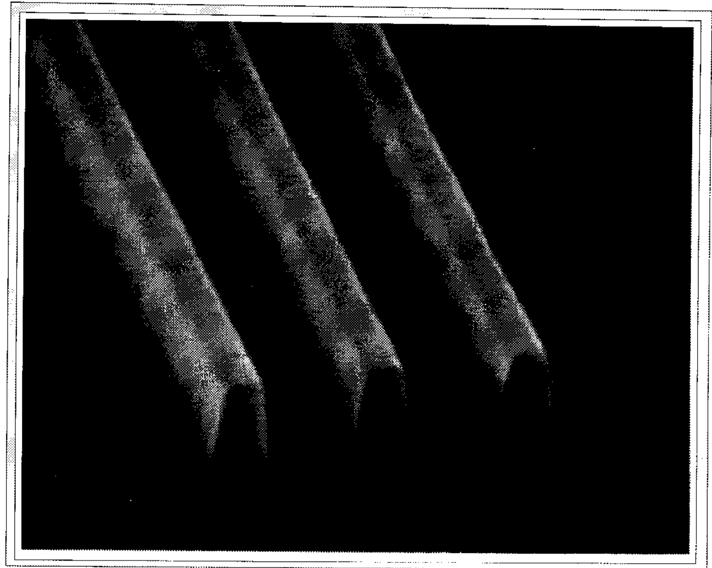

Figure 5 : 1μ lines and spaces in HPR 504 developed with HPRD 428

HPR 504 exhibits linearity at optimum exposure down to submicron geometries as can be seen from Figure 6.

Substrate	: 0.6μ SiO_2
Spin coat	: Nominal 1.28 μ
Softbake	: 110°C HP
Exposure	: GCA DSW 4800 240 mJ/cm²
Develop	: HPRD 428 2/20/2/25s double puddle
Measurement	: ITP System 80

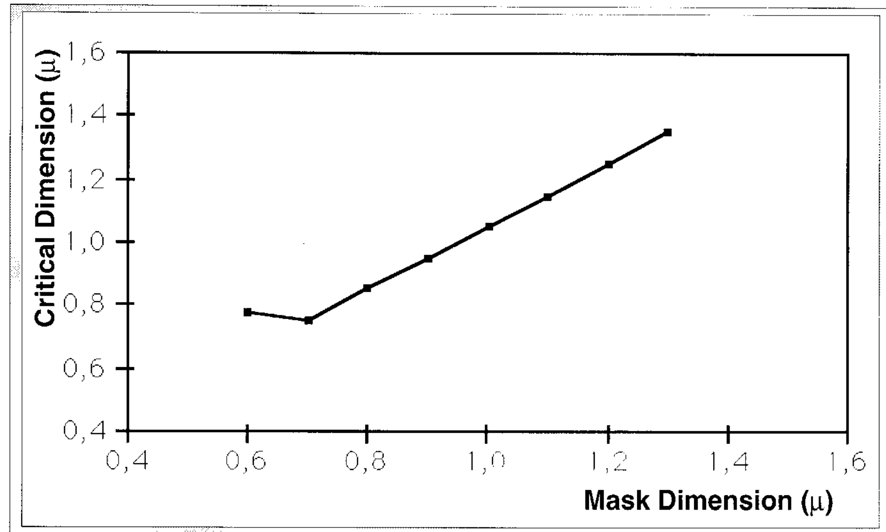

Figure 6 : HPR 504 linearity to mask dimension

Substrate	: Silicon
Spin coat	: 2.2μ HPR506
Softbake	: 100°C HP, 60s
Exposure	: CANON MKII 0.43NA
Develop	: HPRD 429 2/16s single puddle

Figure 7

Projection exposure

The information on this page gives an example of the exposure latitude and resolution that can be expected using scanning mirror projection systems.

Figure 8 shows 3µ lines and spaces, printed in HPR 506 using the conditions listed below.

Substrate	: Silicon
Spin coat	: Nominal 1.85 µ
Softbake	: 110°C, 50 s, HP
Exposure	: Micralign 230
Develop	: HPRD 419 Immersion, 60 s

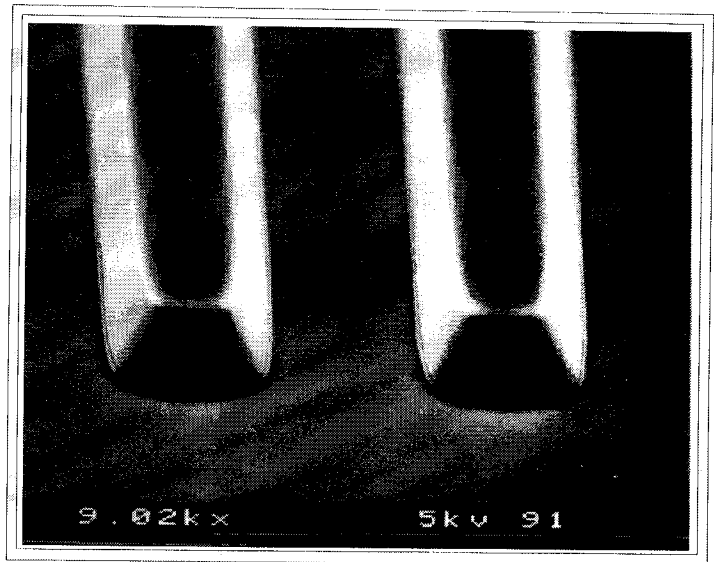

Figure 8

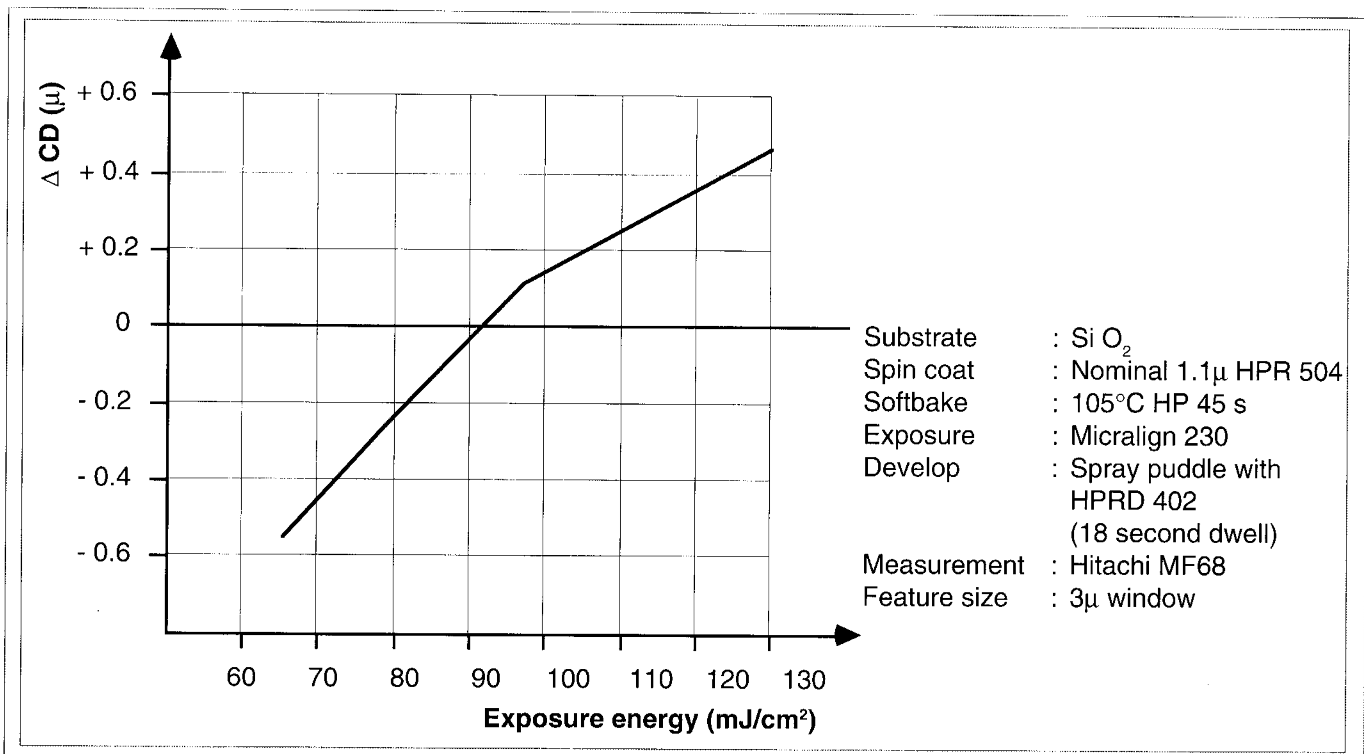

Figure 9 : CD variation using HPRD 402 - projection exposure

Develop

Choices of MIF & MIC, for track or tank

Either metal-ion containing or metal-ion free developers are available for HPR 500 Series.
Tank or track developer systems can be used successfully.

Developers available are listed below:

Product	Type	Normality	Application	Typical Dwell/ Immersion time
HPRD 419	MIC	.23	Tank	60 to 90 s
HPRD 402	MIF	.33	Track	15 to 25 s
HPRD 428	MIF	.25	Track	40 to 50 s or 20 to 25 s double puddle
HPRD 429	MIF	.31	Track	15 to 25 s
HPRD 437	MIF	.25	Track	40 to 50 s or 20 to 25 s double puddle

Hardbake

The purpose of this bake is generally to improve image stability, adhesion and chemical/plasma resistance.

Recommended conditions:

Method	Time	Temperature
Convection	20 to 30 min	120 ± 5°C
Hotplate	40 to 60 s	120 ± 5°C

Thermal stability

HPR 500 Series resists have good thermal stability, even higher temperatures can be implemented after standard deep UV treatment. Image size, image bulk, and process conditions / methods, all have an influence on thermal stability.

Ion implant

Stopping power

HPR 500 Series resists can be used as a mask during ion implantation of Phosphorus, Boron, Arsenic, etc. using various doses. Typical applications include channel stop implant, emitter-collector implant, extrinsic base layer implant, threshold adjustment, selective source-drain implantation.

Wet etch

Wet chemical resistance

HPR 500 Series resists have suitable chemical resistance for successful wet etch processes, and is used as a mask to wet etch doped / undoped oxides, polysilicon and aluminium.

Resist strip

HPR 500 Series resist can be effectively stripped using Microstrip 2001.

Microstrip 2001 is a non-phenolic and non-chlorinated stripper.

Alternatives are :

- Suitable solvents (if the resist has not seen temperatures above 110°C).
- Hot mineral oxidizing acid cleaning mixtures. (eg. Sulfuric / Peroxide, Nitric).
- Oxygen Plasma Equipment

Review the OCG Microstrip 2001 product bulletin.

Dry etch

Good selectivity

HPR 500 Series resists also have suitable plasma etch resistance to give good selectivity in plasma etch processes.

HPR 500 Series can be used in both PE and RIE mode with either Fluorine or Chlorine based gas chemistries. Patterning with HPR 504 can be applied to most thin films requiring dry etching in the manufacture of semiconductor devices on silicon or III V substrates (eg. polysilicon, Si O_2, silicides, aluminum and its alloys, silicon nitride, Ga As etc.).

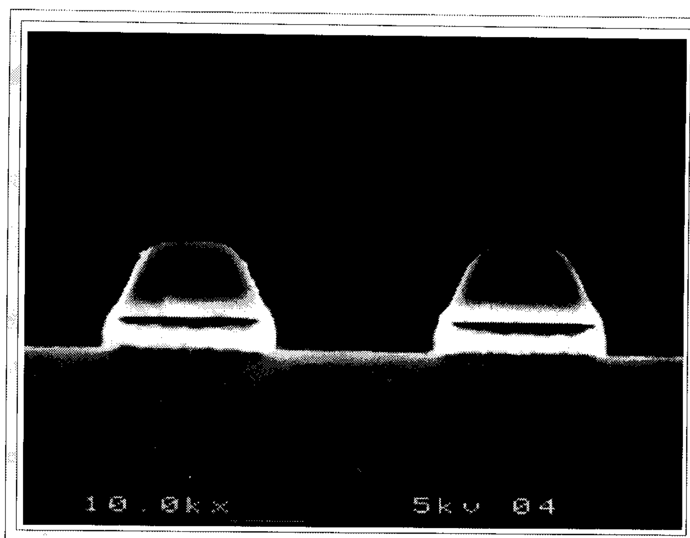

Figure 10

Figure 10 shows HPR 506 used as a mask during dry etching of Al/Si (1%). Single wafer etcher (Balzers SWE 654) was used in plasma mode, with a $SiCl_4/Cl_2$ based gas chemistry.

Technical data

		HPR504	HPR 505	HPR506	HPR 507	HPR 508
Solids (%)	Min	25.5	28.3	31.2	34.2	36.6
	Max	26.5	29.3	32.2	35.2	37.6
Viscosity (cps)	Min	36.0	50.0	90.0	150.0	250.0
	Max	40.0	56.0	100.0	170.0	270.0
Water Content	< 0.5%					
Filtration	0.2μ (absolute)					
Refractive Index	1.64 (dry film)					
Flash Point	55°C (closed cup)					

Trace Metals	
Impurity	Concentration
Na	< 200 ppb
K	< 200 ppb
Cu	< 125 ppb
Zn	< 35 ppb
Fe	< 200 ppb
Ni	< 35 ppb
Ca	< 100 ppb
Al	< 100 ppb

OCG resist products are subjected to stringent production tests to ensure consistent performance and purity.

Certificates of analysis

Certificates of Analysis are available for each production batch.
Each certificate details the relevant analytical and functional specifications together with the measured results.
Analytical data includes solids content, viscosity and impurity levels.
Functional test data shows film thickness and photospeed results.

General

Unit size : HPR 500 Series resists are shipped in 4l bottles to minimize bottle change frequency.

Storage : It is recommended that HPR 500 Series resists are stored in temperature controlled areas at approx 10°C when storing for an extended period of time (eg. longer than 1 month). In general protect from heat and light.

Shelf-life : One year from date of manufacture, if stored between 4 and 10°C in original sealed container.

Safety : Review the Material Safety Data Sheet thoroughly before using this product.
This gives information on: Normal handling procedures; hazardous ingredients; fire, explosion, and health hazard data; toxicology; procedures for dealing with spills / leakages; shipping, reactivity and physical data.
HPR 500 Series resists contain organic solvents , store in a well ventilated area away from all sources of ignition.
Adequate ventilation during coating and stripping is necessary to maintain vapour concentrations within acceptable safety limits.
Use only in strict accordance to your facility's safety requirements.

Compatibility : HPR 500 Series resists are compatible with most commercially available photoresist processing equipment.
Compatible materials include stainless steel, glass, ceramic, high density polyetylene, high density polypropylene, Teflon, or equivalent material.

Further information available

Wafer Photoresist Process Procedure for Waycoat HPR Positive Resist in Contact Exposure Systems.

Wafer Photoresist Process Procedure for Waycoat HPR Positive Resist in Perkin Elmer Corp. Micralign Projection Mask Aligners.

The Chemistry and Technology of Positive Photoresists. A. Stein

Àutomated in-line Puddle Development of Positive Photoresists.

High Purity Photoresists : Manufacturing Technology and Quality Issues. R.F. Leonard etal.

More processing information can be obtained from your local OCG representative.
For analytical test methods contact your local OCG representative.
Production SQC-data is available contact your local OCG representative.

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