Shipley

i-Line Photoresist

Advanced i-Line Materials

MEGAPOSIT® SPR®220 Series Photoresist

SPR220 i-Line photoresist is a general purpose, multi-wavelength resist designed to cover a wide range of film thicknesses, 1–10 µm, with a single coat process. SPR220 also has excellent adhesion and plating characteristics, which make it ideal for such thick film applications as MEMs and bump processes.

Features:

- Broadband, g-Line and i-Line capable
- >10 µm film thickness in a single coat with good uniformity
- Fast photospeed: 210 mJ/cm² for 1.1 µm lines/spaces @ 4.0 µm film thickness (i-Line)
- Excellent wet and dry etch adhesion
- Au, Cu and Ni/Fe plating without cracking
- MIF and MIB developer compatible

See *Table 1* for recommended process conditions and *Figure 1* for various applications.

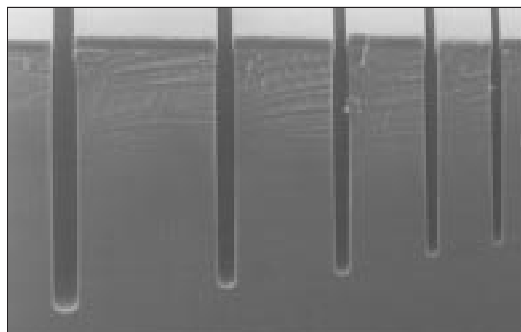
Table 1. Recommended Process Conditions

	1.1 µm to 4.0 µm Thickness*
Thickness:	1.1 µm–4.0 µm
Softbake:	115°C/90 sec. Contact hotplate
Expose:	ASML PAS 5500/200 i-Line (0.48 NA, 0.50σ)
PEB:	115°C/90 sec. Contact hotplate
Developer:	MF®-24A @ 21°C, 60 sec. single spray puddle
	4.0 µm to 10.0 µm Thickness*
Thickness:	4.0 µm–10.0 µm
Softbake:	30 sec. step-down to 115°C/90 sec. Contact hotplate**
Expose:	ASML PAS 5500/200 i-Line (0.48 NA, 0.50σ)
PEB:	115°C/90 sec. Contact hotplate
Developer:	MF®-24A @ 21°C, 60 sec. double spray puddle

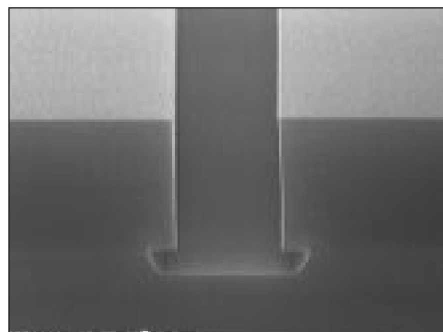
*Recommended for isolated spaces as well
**Refer to softbake section for further details

All data shown within this flyer used the process conditions listed above unless otherwise stated.

Figure 1. Various Applications



Etched Trenches (Bosch Process)
4 to 10 µm Features (up to 100 µm deep)



Wet Wafer Etch (1:5 HF 5 min.)
2 µm Feature

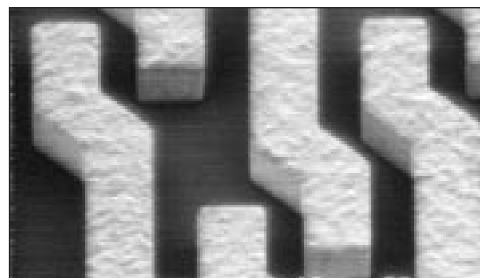


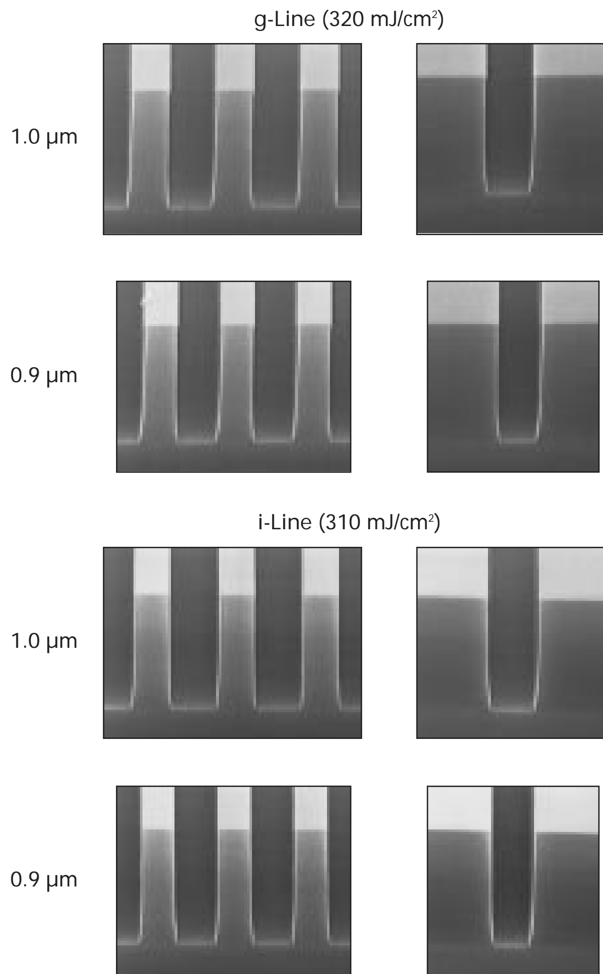
Image courtesy of TriQuint

Gold Plated Deposit
5 µm Features

	Table 2. Photospeed and Linearity of Dense Lines/Spaces at Various Thicknesses		
	Film Thickness (µm)	Photospeed* (mJ/cm²)	Linearity (µm)
g-Line	1.2 µm	210	0.65
	3.0 µm	320	0.90
	7.0 µm	470	1.80
i-Line	1.2 µm	160	0.45
	3.0 µm	310	0.90
	5.0 µm	380	0.90

*See *Table 6* for recommended develop conditions

Figure 2. Resolution at 3.0 µm Film Thickness



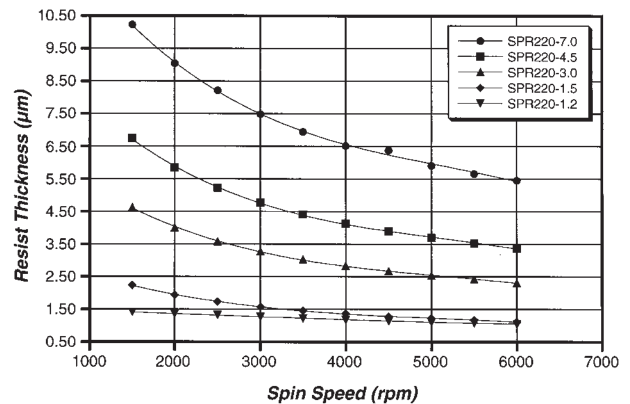
Substrate

SPR220 is compatible with a wide range of substrates, including but not limited to silicon, aluminum oxide, gold, copper and nickel-iron. A hexamethyldisilizane (HMDS) based MICROPOSIT® primer is recommended to promote adhesion with substrates that require such treatment. Vacuum vapor priming at 120°C for 30 seconds with concentrated HMDS is recommended.

Coat

Figure 3 shows the relation between spin speed and resist thickness for 4-inch substrates. Nominal film thickness may vary slightly due to process, equipment and ambient conditions.

Figure 3. Spin Speed Curves



Coat Uniformity @ 7.31 µm, standard deviation = 0.036 µm, (33 points)

Softbake

The recommended softbake process for SPR220 for films up to 4.0 µm is 115°C for 90 seconds on a contact hotplate. For films greater than 4.0 µm, use a 30-second ramp in temperature (step-down to hotplate) to 115°C and hold for a minimum of 90 seconds.

Film Thickness Measurement

Figure 4 (see next page) shows the refractive index of SPR220 as a function of wavelength. Cauchy coefficients are listed in *Table 3*. Refractive index and dill parameters are listed in *Table 4* and *Table 5*, respectively (see next page for these tables).

Expose

The absorbance curves for the unexposed and exposed resist film are shown in *Figure 5*.

Figure 4. Dispersion Curve

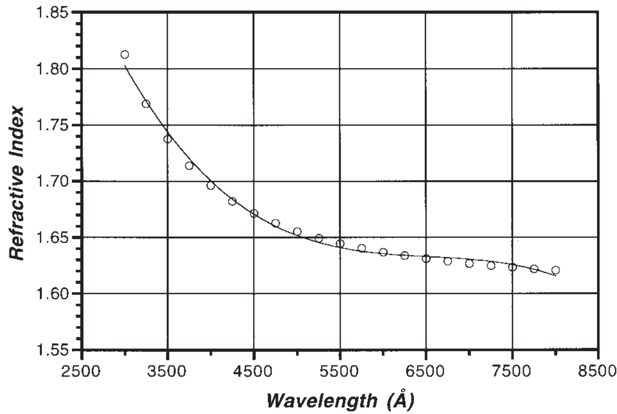


Table 3. Cauchy Coefficients	
n_1	1.6035
n_2	9.7122e+5
n_3	8.2082e+12

Table 4. Refractive Index	
RI @ 365 nm:	1.73
RI @ 405 nm:	1.30
RI @ 436 nm:	1.67
RI @ 633 nm:	1.63

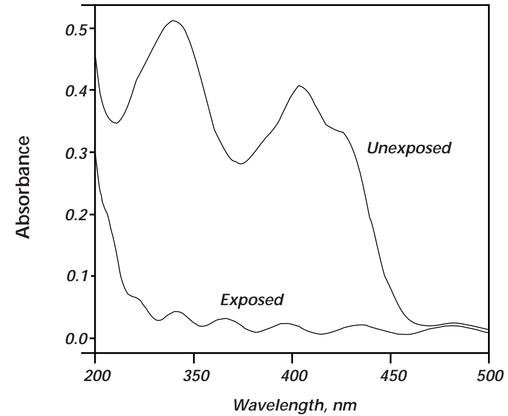
Table 5. Dill Parameters

	365 nm	405 nm	436 nm
Dill A	0.5250	0.7075	0.4242
Dill B	0.0298	0.0173	0.0150

Post-exposure Bake

Post-exposure bake (PEB) is run at the same temperature as the softbake. With thicker films (above 4 µm), a hold time is used between exposure and PEB to allow water (which is necessary to complete the photo-reaction) to diffuse back into the photoresist film. Thick films should use a minimum hold time of 35 minutes.

Figure 5. Absorbance Curves



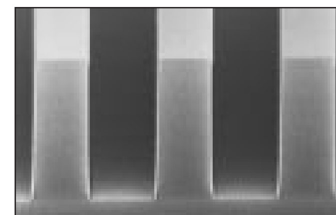
Develop

SPR220 is optimized for 0.24N developers. Thicker films or high-throughput processes can utilize 0.26N developers. SPR220 has also been formulated for use in metal-ion free and metal-ion bearing developers, as demonstrated in *Figure 6*. See *Table 6* for recommended develop conditions.

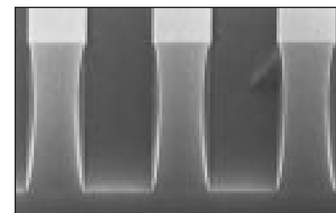
Table 6. Recommended Develop Conditions

	1.2 µm FT	3.0 µm FT	5.0 µm FT	7.0 µm FT
MF-24A	40 sec. SP	60 sec. SP	60/60 sec. DP	60/60 sec. DP
MF-26A	40 sec. SP	60 sec. SP	80 sec. SP	60/60 sec. DP
M452		3 min. Imm.	3 min. Imm.	3 min. Imm.
M453			3 min. Imm.	3 min. Imm.

Figure 6. Developer Compatibility



MIF (MF-24A)



MIB (M452)

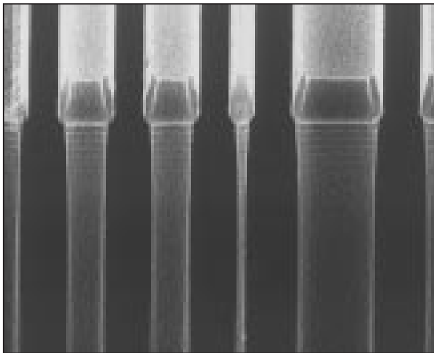
Etch Resistance

Figure 7 shows the etch performance of SPR220 with a Bosch Etch process (100:1 etch selectivity).

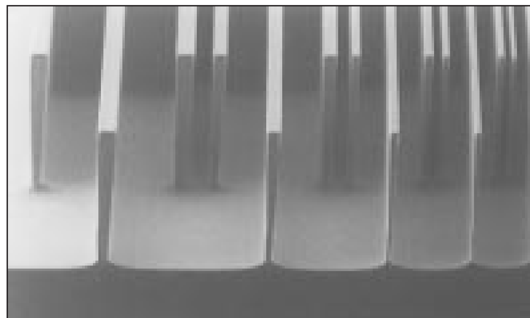
Photoresist Removal

SPR220 can be removed with MICROPOSIT® REMOVER 1165. A two-bath process is recommended with each bath at a temperature of 80°C. The first bath removes the bulk of the photoresist and the second removes residual traces of photoresist. Please consult specific remover data sheets for additional process information.

Figure 7. Etch Performance



Etched Lines (Bosch Process)
2.5 to 10 µm Features (up to 200 µm deep)



Etched Lines
5 to 20 µm Features (up to 100 µm deep)

Handling Precautions

CAUTION! SPR220 is a combustible liquid containing ethyl lactate, anisole and n-amyl acetate. Handle with care. Ground and bond all containers when handling or transferring combustible materials. Contact with eyes, skin and mucous membranes can cause irritation. In case of eye or skin contact, flush affected areas with plenty of water for at least 15 minutes. If irritation persists, contact your physician immediately. Avoid breathing vapors or mists. Use with adequate ventilation. It is highly recommended that during handling chemical goggles, chemical gloves and protective clothing be worn.

Please consult the Material Safety Data Sheet prior to use.

Waste Treatment

SPR220 contains ethyl lactate, anisole and n-amyl acetate and may be included with other wastes containing similar organic solvents to be discarded for destruction or reclaim in accordance with local, state, and federal regulations.

It is your responsibility to ensure the disposal of SPR220 and residues therefrom is made in compliance with all applicable environmental regulations.

Storage

Recommended storage for SPR220 is in an upright position in a dry area at 40–60°F. Keep away from oxidizers, acids, and bases. Keep container sealed when not in use.

For Industrial Use Only. The information is based on our experience and is, to the best of our knowledge, true and accurate. However, since the conditions for use and handling of the products are beyond our control, we make no guarantee or warranty, expressed or implied, regarding the information, the use, handling, storage, or possession of the products, or the application of any process described herein or the results sought to be obtained. Nothing herein shall be construed as a recommendation to use any product in violation of patent rights.

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