ELECTRONIC MATERIALS
MICROELECTRONIC TECHNOLOGIES

ROHM AND HAAS

UV5™ POSITIVE DUV PHOTORESIST

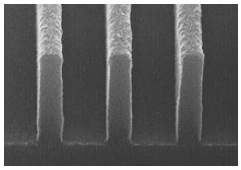
For DUV Applications

DESCRIPTION

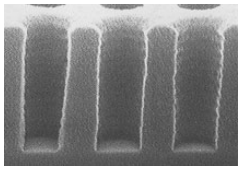
UV5 positive DUV photo resist has been optimized to provide vertical profile imaging of isolated and semi-dense features for device production design rules to 150 nm. This resist is ideally suited for use with AR2™ Anti-reflectant and a variety of inorganic substrates. UV5 offers metal etch resistance equivalent to that of conventional i-Line photoresists. Its minimal sensitivity to PEB temperature variation (3 nm/°C), superior etch resistance, wide process window, and very low bias properties provides high yielding device fabrication. UV5 is compatible with 0.26N developers (2.38% TMAH).

See *Figure 1* for lithographic performance and *Table 1* for recommended process conditions.

Figure 1. Lithographic Performance (0.53 NA, 0.74σ)



150 nm 1:2 Lines/Spaces on Silicon



250 nm 1:1 Contact Holes on Silicon

FEATURES & LITHOGRAPHIC PERFORMANCE

- Sizing Energy
  - 10.0–20.0 mJ/cm² for isolated, semi-dense lines, and contact holes
- Depth of Focus
  - 1.2 µm DOF for 180 nm semi-dense lines
  - 0.8 µm DOF for 180 nm isolated lines
  - 0.8 µm DOF for 250 nm contact holes
- Resolution
  - <150 nm resolution for isolated and semi-dense lines
  - 200 µm resolution for contact holes
- >2-hour post-exposure delay stability
- >6-month shelf life
- <3 nm/°C post-exposure bake sensitivity
- 150°C thermal stability
- <20 nm CD range across wafer @ 250 nm

SUBSTRATE

UV5 photoresist is compatible with a wide range of substrates including silicon, silicon nitride, organic and inorganic anti-reflective materials (*Figure 2; next page*). A hexamethyldisilazane (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.

Table 1. Recommended Process Conditions

	Reflective Substrates	Non-reflective Substrates
Thickness	6,000–10,000Å	6,000–10,000Å
Softbake	130°C/60 sec. Proximity Hotplate	135°C/60 sec. Proximity Hotplate
PEB	135°C/90 sec. Proximity Hotplate	130°C/90 sec. Proximity Hotplate
Developer	MEGAPOSIT™ LDD-26W @ 21°C, 45 sec. single puddle	MEGAPOSIT LDD-26W @ 21°C, 45 sec. single puddle

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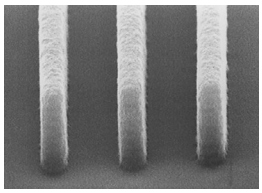
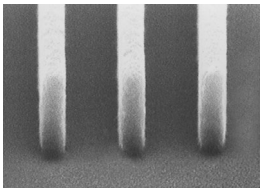
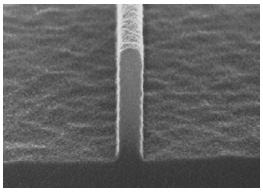
Figure 2. Substrate Compatibility



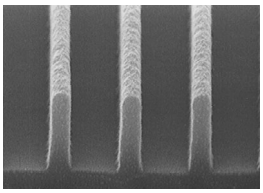
180 nm 1:2 Lines/Spaces on BARL™



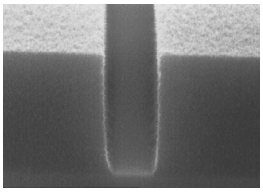
180 nm 1:2 Lines/Spaces on AR2



180 nm 1:2 Isolated Line on SiON



160 nm 1:2 Lines/Spaces on SiN

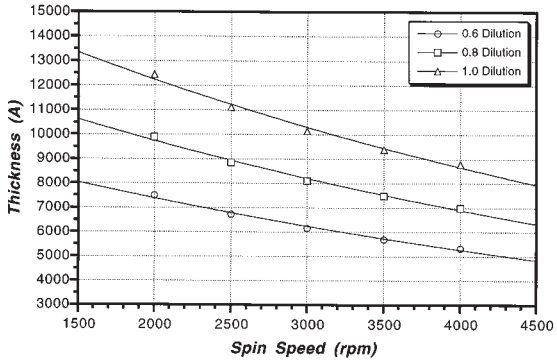


250 nm Space on Si_3N_4

COAT

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

Figure 3. Spin Speed Curve



SOFTBAKE

The recommended softbake processes for reflective and non-reflective substrates are listed in *Table 2.*

Table 2. Softbake Process Conditions

	Reflective Substrates	Non-reflective Substrates
Temperature	130°C Proximity Hotplate	135°C Proximity Hotplate
Time	60 sec.	60 sec.

FILM THICKNESS MEASUREMENT

Figure 4 shows the refractive index of UV5 as a function of wavelength. Cauchy coefficients are listed in *Table 3,* next page.

Resist thicknesses of 6,000–10,000Å were used to characterize UV5. *Figures 5* and *6* (next page) display the E_0 and CD interference curves for silicon, BARL 900 and AR2.

Figure 4. Dispersion Curve

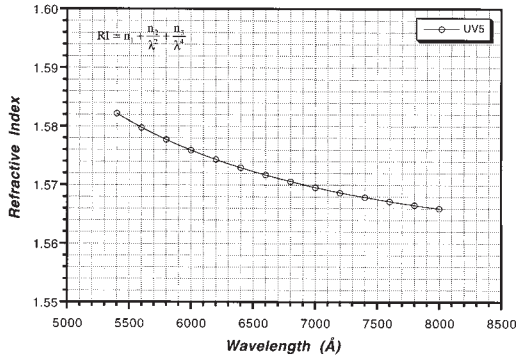


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Table 3. Cauchy Coefficients	
n_1	1.5566
n_2	4.76e5
n_3	7.86e12

Figure 5. Interference Curves—Bulk E_0

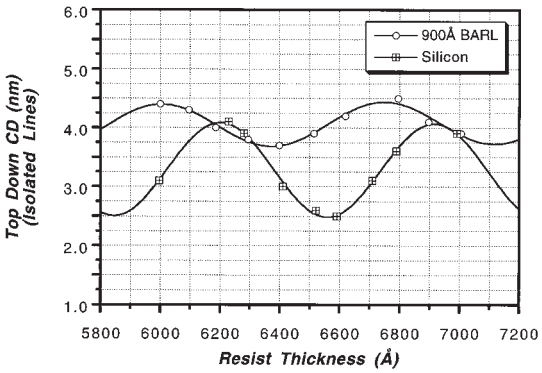
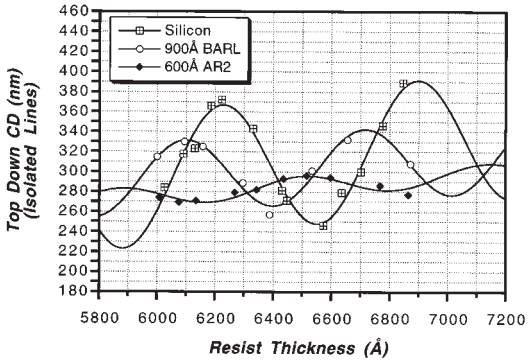


Figure 6. Interference Curves 250 nm Isolated Lines



EXPOSE

Figure 7 displays the absorbance curve for the unexposed UV5 film. *Table 4* lists the parameters needed for resist modeling.

Figure 7. Absorbance Curve

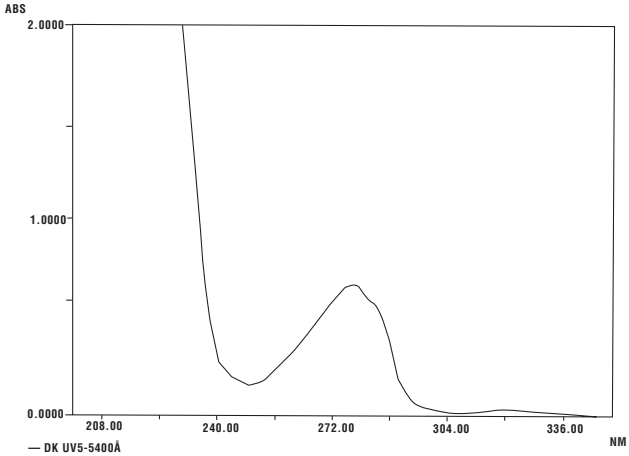


Table 4. Prolith Parameters	
Dill A Value	0.0476
Dill B Value	0.5389
Dill C Value	0.00968 cm^2/mJ
R_{min}	1.92 Å/sec.
R_{max}	2,620 Å/sec.
Acid Generation Coefficient	0.051 cm^2/mJ
n	7.72
RI @ 633 nm	1.57
RI @ 248 nm	1.71

*Chemically-amplified resists require additional modeling parameters currently being determined. Please see your TSR for an updated copy of modeling parameters.

POST-EXPOSURE BAKE

A 5-degree temperature differential (softbake lower than PEB) is used to reduce standing waves on reflective substrates. Non-reflective substrates require no temperature differential. The recommended PEB conditions for reflective and non-reflective substrates are listed in *Table 5*. *Figure 8* (next page) shows the PEB sensitivity of UV5.

Table 5. Post-exposure Bake Process Conditions		
	Reflective Substrates	**Non-reflective Substrates**
Temperature	135°C Proximity Hotplate	130°C Proximity Hotplate
Time	90 sec.	90 sec.

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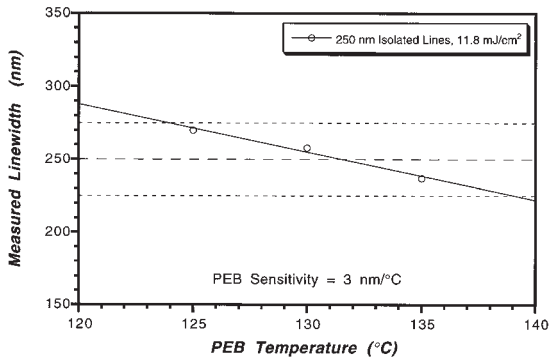
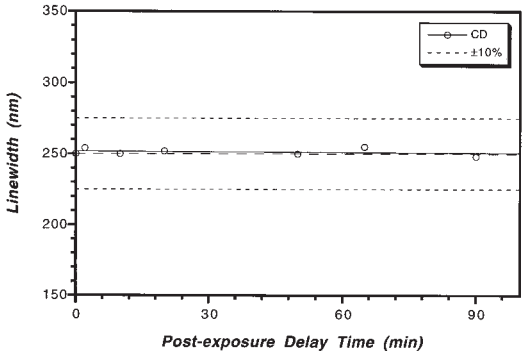
Figure 8. PEB Sensitivity



POST-EXPOSURE DELAY STABILITY

The delay stability for UV5 photoresist is shown in *Figure 9* to be greater than 90 minutes in a chemically-filtered environment.

Figure 9. Delay Stability



DEVELOP

UV5 is optimized for 0.26N developers (*Figure 11*). A 45-second single puddle with no pre-wet is recommended for most applications including lines/spaces and contact holes. *Figure 10* shows the dissolution rate as a function of exposure dose.

Figure 10. Dissolution Curve

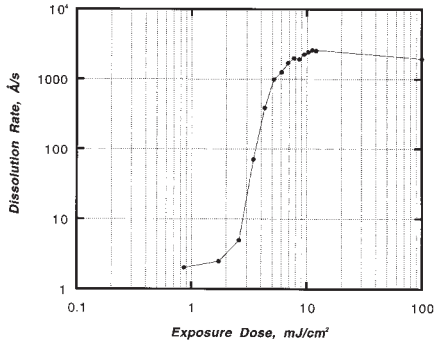
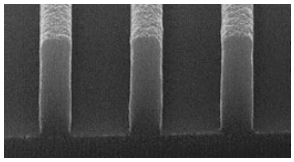
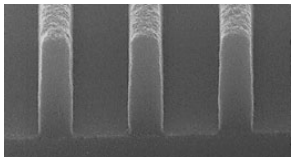


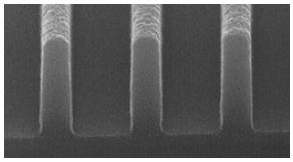
Figure 11. Developer Compatibility
180 nm 1:2 Lines/Spaces on AR2



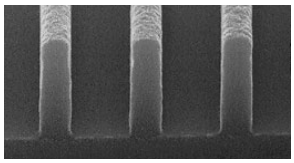
LDD-26W



MF™ CD26



MF-86MX

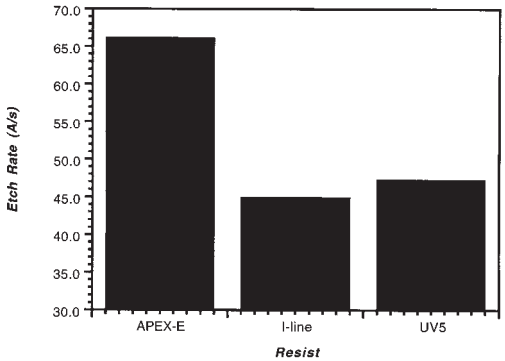


Competitive 0.26N

ETCH RESISTANCE

Figure 12 shows the etch performance of UV5 with a chlorine based metal etch process. Blanket etch studies were performed in an Applied Materials, Model 5000 etcher.

Figure 12. Etch Resistance vs. Resist



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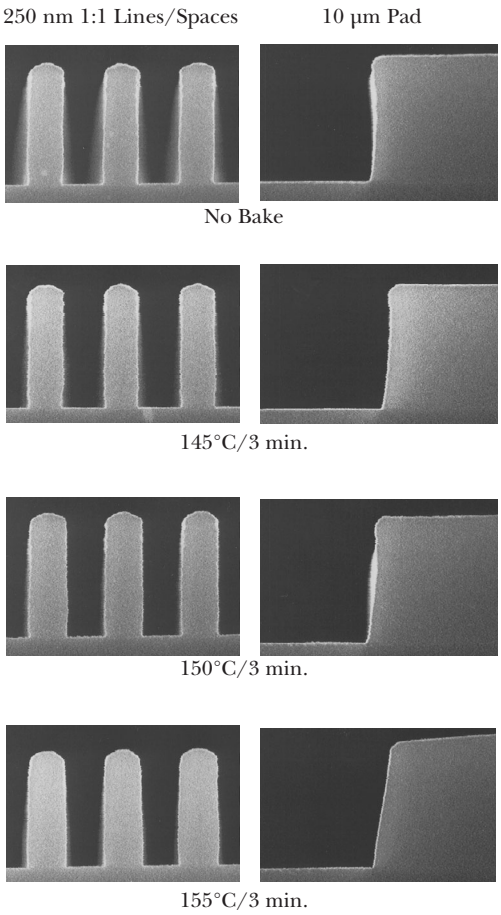
HARDBAKE

Figure 13 displays the thermal flow characteristics of UV5 photoresist.

Figure 13. Thermal flow Characteristics



PHOTORESIST REMOVAL

UV5 can be removed with MICROPOSIT REMOVER 1165®. A two-bath process is recommended with each bath at a temperature of 80°C. The first removes the bulk of the photoresist and the second removes residual traces of photoresist. Consult specific remover datasheets for additional process information.

HANDLING PRECAUTIONS

UV5 is a combustible liquid and vapor; keep away from heat sparks and open flame. Irritation to eyes, nose and respiratory track can occur. Use with adequate ventilation and avoid breathing vapors and mists. Wash thoroughly after handling and always wear chemical goggles, gloves and suitable protective clothing. In case of eye or skin contact, flush affected areas with plenty of water for at least 15 minutes. Contact a physician at once.

Consult Product Material Safety Data Sheet before using.

STORAGE

Store UV5 only in upright, sealed, original containers in a dry area at 30–50°F (-1–10°C) away from heat and sunlight. Keep away from alkaline materials, acids and oxidizers. Keep container closed when not in use.

WASTE TREATMENT

UV5 contains ethyl lactate 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 UV5 and residues therefrom is made in compliance with all applicable environmental regulations.

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