ELECTRONIC MATERIALS
MICROELECTRONIC TECHNOLOGIES

MICROPOSIT™ LOL™ 1000 AND 2000 LIFTOFF LAYERS

For Microlithography Applications

DESCRIPTION

Microposit LOL 1000/2000 Liftoff Layer is an enhanced dissolution rate, dyed PMGI (polymethylglutarimide) solution used for lift-off processes requiring tight CD control, such as GMR thin film head, gallium arsenide, and other leading-edge semiconductor applications. The LOL bilayer lift-off process is suitable for applications where a thin layer of metal is sputtered or evaporated in an additive process. CD variation due to etch bias inherent in subtractive processes is eliminated, resulting in superior metal line width control. Attack on the substrate by an etchant is eliminated.

ADVANTAGES

- Submicron lift-off capability
- Dissolution rate optimized for controlled undercut
- Excellent adhesion to thin film head and semiconductor substrates
- Developed to work with DUV, and 193 nm photoresists
- Compatible with g-, h-, and i-Line and 193 nm photoresists
- Compatible with TMAH and metal-ion-containing developers
- Residue-free removal using standard Microposit Remover 1165
- Simplified process—no DUV flood exposure, silylation or chlorobenzene required
- Excellent batch-to-batch consistency

Table 1. Suggested EBR Solvents
Cyclopentanone
Ethyl Lactate

Table 2. Suggested Line Solvents
Cyclopentanone
Ethyl Lactate

Figure 1. LOL1000 on Si at 200°C/5 min. with 0.5 micron SPR™950

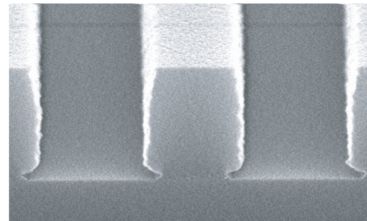
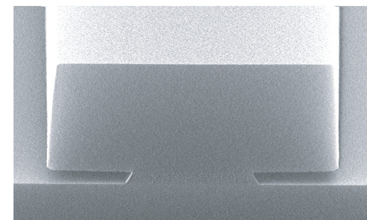


Figure 2. LOL2000 on Si at 200°C/5 min. with 5.0 micron SPR950



SUBSTRATE PREPARATION

LOL lift-off layers provide excellent adhesion over a variety of substrates, including titanium, nickel-iron, tantalum, copper, silicon and silicon nitride. Surfaces should be clean and dry before application of LOL. If increased adhesion is required, a dehydration bake of 125°C for 30–60 minutes can be used. Use of an HMDS prime is not required for most substrates. For silicon, the optimum contact angle for maximum adhesion is 35°.

COAT (LOL)

LOL provides uniform defect-free coating over a thickness range of 500–1,200Å. The film thickness versus spin speed plot displayed in *Figure 3 (next page)* provides the information required to meet process-dependent thickness specifications. For optimal lift-off, an LOL film thickness greater than the sputtered metal coating thickness is recommended.

LOL can be dispensed with low viscosity resist pumping systems (1–3 cSt) or nitrogen pressure dispense systems. Pumping and coating systems should be compatible with cyclopentanone. A dedicated spin bowl and drain should be used for LOL products. When photoresist is mixed with LOL, a very viscous film is formed that can cause the drain line to clog.

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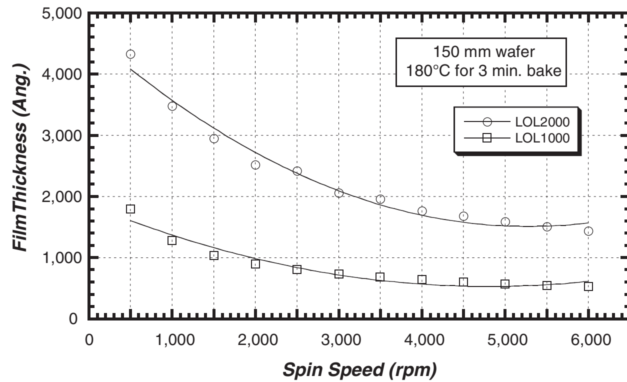
Figure 3. Spin Speed vs. Thickness



EDGE BEAD REMOVAL (LOL)

Microposit EC Solvent 11 is recommended for removing LOL build-up occurring at the edge of the wafer during spin coating. EC Solvent 11 is free of EGMEA, as well as acetone and xylene. EC Solvent 11 can be used with coating equipment designed to include an edge bead removal process.

CURE (LOL)

A key feature of LOL is the ability to optimize the desired undercut by adjusting the dissolution rate through softbake.

Figure 4 shows how bake time and temperature affect dissolution rate to control undercut profile. Either hotplate or convection ovens can be used for softbake process steps. Again, selection of optimal bake time and temperature is based on the specific application requirements for undercut and top imaging resist selection.

Figure 4. Dissolution Rate

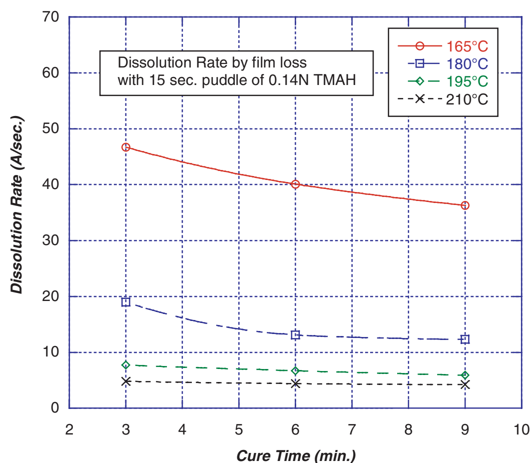


Table 3. Recommended Process Conditions

LOL1000 Thickness	550–1,850Å
LOL2000 Thickness	1,850–4,250Å
LOL Cure	140–225°C/1 to 10 min.

FILM THICKNESS MEASUREMENT (LOL)

The n and k values at 193 nm, 248 nm and 365 nm are shown in *Table 4*. Cauchy coefficients for LOL products are shown in *Table 5*. This information is required for measurement tools calculating film thickness. For tools not requiring Cauchy coefficents, use the refractive indices listed in *Table 4*.

Table 4. Optical Constants (all bakes for 3 min.)

	436 nm		365 nm		248 nm		193 nm	
	n	k	n	k	n	k	n	k
140°C	1.616	0.088	1.542	0.078	1.669	0.041	1.570	0.175
150°C	1.610	0.082	1.546	0.067	1.674	0.037	1.567	0.168
160°C	1.600	0.068	1.550	0.047	1.679	0.035	1.582	0.152
170°C	1.585	0.055	1.553	0.031	1.680	0.031	1.579	0.144
180°C	1.569	0.037	1.557	0.016	1.676	0.026	1.572	0.135
190°C	1.559	0.016	1.563	0.007	1.669	0.021	1.563	0.125
200°C	1.553	0.002	1.565	0.004	1.663	0.018	1.552	0.120
210°C	1.553	0.002	1.566	0.003	1.663	0.018	1.548	0.12

Table 5. Cauchy Coefficients (all bakes for 3 min.)

Temperature	n1	n2	n3
140°C	1.568	-9.7E+04	6.3E+13
150°C	1.566	-7.7E+05	5.7E+13
160°C	1.559	-5.1E+04	3.7E+13
170°C	1.552	1.8E+05	2.8E+13
180°C	1.542	3.1E+05	1.9E+13
190°C	1.529	5.7E+05	5.5E+12
200°C	1.521	5.1E+05	2.5E+12
210°C	1.521	5.2E+05	2.3E+12

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EXPOSE (IMAGE LAYER)

A key feature of LOL products is that exposure is not required to enhance dissolution, thus eliminating a process step in production. It is the softbake parameters that are primarily used to control the dissolution rate of LOL. However, exposure and profile of the image layer does affect level of undercut by speeding the development of the imaging resist, allowing more time for the developer solution to be in contact with the LOL layer.

POST-EXPOSURE BAKE (IMAGING LAYER)

Although PEB is not needed for LOL, PEBs may be used for optimization of top imaging layers. See image layer data sheet for PEB recommendations.

DEVELOP

LOL products are compatible with both TMAH, metal ion free (MIF), and metal ion bearing (MIB) developers. The lift-off undercut is produced by the difference in dissolution rate between the top imaging resist and the LOL for a given developer. The choice of optimum developer parameters depends on individual process requirements and equipment used.

EVAPORATE/SPUTTER METAL

LOL products are compatible with processing conditions used to sputter metal in standard PVD tools. Step coverage achieved from a specific metal deposition system will affect final liftoff strip times and deposited metal pattern.

STRIP (DEPOSITION LIFTOFF STEP)

Remover 1165 is recommended for use in stripping LOL products, top coat photoresist, and excess deposited metal. For removing metallized liftoff layers, use Remover 1165 at 50°C/60 min. for first tank and 30 min. for second tank.

HANDLING PRECAUTIONS

Before using this product, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

CAUTION! Keep combustible and/or flammable products and their vapors away from heat, sparks, flames and other sources of ignition including static discharge. Processing or operating at temperatures near or above product flashpoint may pose a fire hazard. Use appropriate grounding and bonding techniques to manage static discharge hazards.

CAUTION! Failure to maintain proper volume level when using immersion heaters can expose tank and solution to excessive heat resulting in a possible combustion hazard, particularly when plastic tanks are used.

STORAGE

Store products in tightly closed original containers at temperatures recommended on the product label.

DISPOSAL CONSIDERATIONS

Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the user's responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Rohm and Haas Electronic Materials Technical Representative for more information.

ELECTRONIC MATERIALS

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