AR™3GSF DUV ANTI-REFLECTANT

For Microlithography Applications

Regional Product Availability

- North America
- Europe, Middle East and Africa
- Latin America
- Asia-Pacific

Description

AR3GSF is an organic, PFOS-and-surfactant-free, thermally cross-linking, bottom anti-reflectant designed to provide outstanding reflection control under DUV photoresists for excellent CD control over topography. Relative to other organic anti-reflectants, AR3GSF provides excellent conformality over topography.

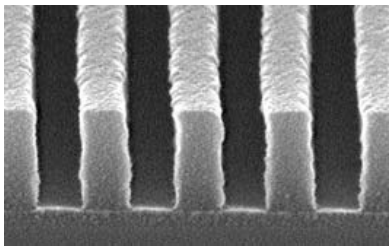
AR3GSF has been formulated to work as a system with a wide range of DUV photoresists to meet sub-180 nm design rules. It also acts as a chemical barrier between photoresist and substrate, presenting a common substrate for all layers. This product can be used to replace PFOS containing anti-reflectant coatings such as AR2 and AR3 with minimal process modification.

AR3GSF is available in three dilutions: AR3GSF-600 and AR3GSF-900 which are formulated for coatings in the range of 500 – 1,500Å over reflective substrates.

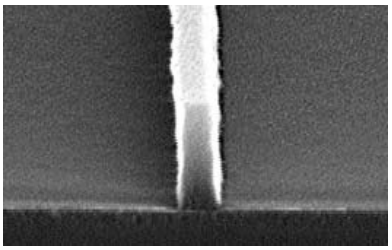
Advantages

- Optical density = 9.6/µm
- First minimum thickness = 600Å over reflective dielectrics
- E0 swing < 3%
- Etch Ratio of 1:1.75 AR3GSF to DUV Resist for Ar/O_2 Plasma Etch
- Product Dilutions Targeted at 600Å, and 900Å
- Compatible with many common EBR solvents
- Excellent CD Control over topography
- Good conformality for excellent step coverage

Figure 1. Lithographic Performance with ESCAP type Photoresist



130nm 1:1 Lines/Spaces



110nm Isolated Lines

Table I. Process Conditions	
Thickness*	500Å–1,500Å depending on substrate stack
Cure Temperature	195°C - 205°C/sec. Proximity Hotplate

*Optimum AR3GSF film thickness will depend on substrate reflectivity, topography, transparency, thickness, and desired etch performance.

Equipment Preperation

When converting DUV anti-reflectant plumbing from BARL™ or CD-11™ to AR3GSF, first flush lines with cyclohexanone or gamma-butyrolactone solvent to thoroughly remove previous BARC residues. When converting DUV anti-reflectant plumbing from AR2™, AR3™, DUV30™, DUV32™, DUV42™, or DUV44™ to AR3GSF, first flush lines with propylene glycol methyl ether acetate or ethyl lactate to thoroughly remove previous BARC residues. Next, flush lines again with propylene glycol methyl ether acetate, ethyl lactate, or AR3GSF to provide a compatible solvent medium for AR3GSF.

Substrate

AR3GSF is compatible with a wide range of substrates, including silicon, SiO_2, polysilicon, Si_3N_4, TiN, and aluminum. Do not use adhesion promoters such as hexamethyldisilazane (HMDS) on silicon or SiO_2.

Coat

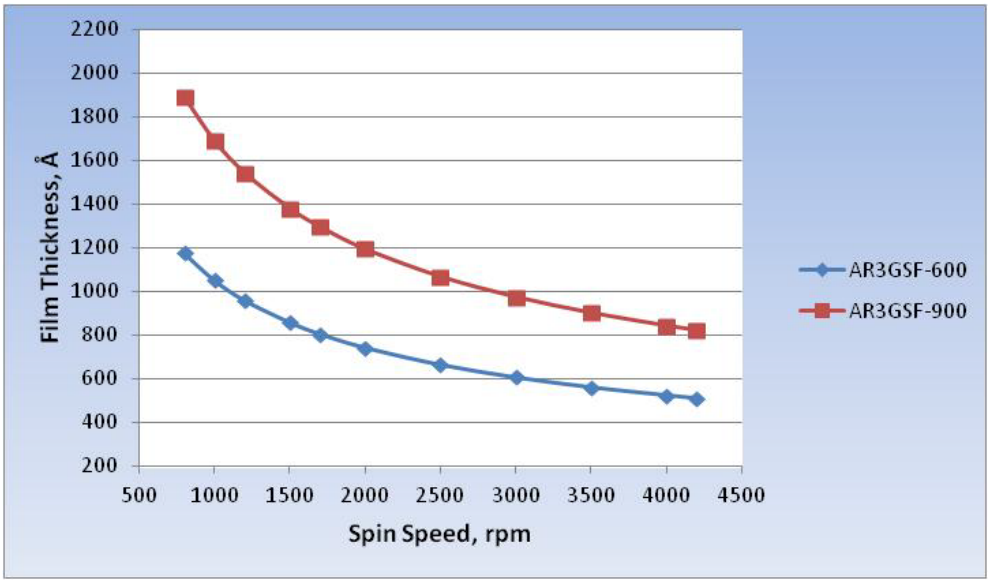
AR3GSF is spin bowl compatible with common spin-coating and EBR solvents (see *Table 2*). Dedicated spin bowl and drain lines are not required. Do not use adhesion promoters, such as HMDS between AR3GSF and resist layers.

Keep spin cup Temperature and humidity below 23°C and 47% to avoid potential phase segregation during the process.

Table 2. Compatible Solvents	
Ethyl Lactate	3-Pentanone
Propylene Glycol Methyl Ether	Cyclohexanone
Propylene Glycol Methyl Ether Acetate	-Butyrolactone
70% PGME/30% PGMEA	Methyl Ethyl Ketone

Figure 2 shows the relation between spin speed and AR3GSF film thickness for 8-inch substrates. AR3GSF is available in two dilution levels targeted at 3000rpm. Nominal film thickness may vary slightly due to process, equipment, and ambient conditions.

Figure 2. Spin Speed Curves AR3GSF



Cure

A one-step 195°C – 225°C, 60 second cure process is recommended. The cure temperature determines the interfacial resist profile. For ESCAP resists, increasing cure temperature minimizes undercut; decreasing cure temperature minimizes footing.

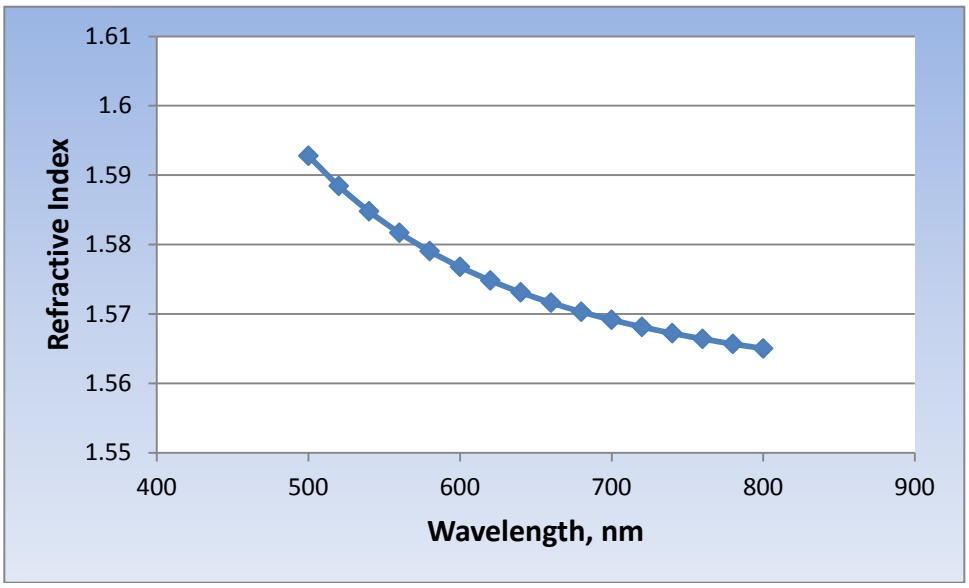
Film Thickness Measurement

Optical constants, n and k, at 248 nm and Cauchy coefficients of AR3GSF are found in Tables 3 and 4 respectively. *Figure 3* shows the refractive index of AR3GSF as a function of wavelength.

Table 3. Optical Constants @ 248 nm	
n	1.46
k	0.47

Table 4. Cauchy Coefficients	
n_1	1.556
n_2	3.6e+5
n_3	1.4e+13

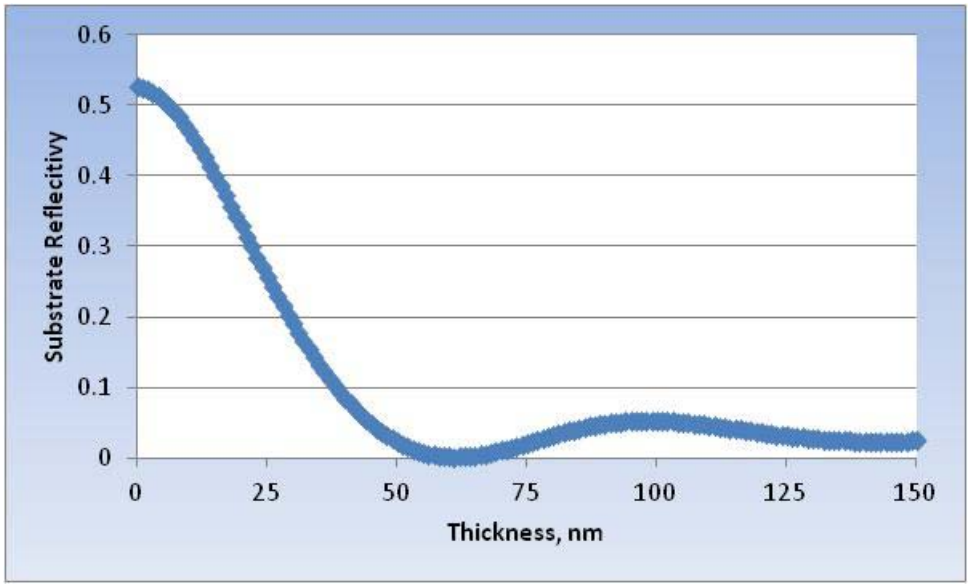
Figure 3. AR3GSF Dispersion Curve



Reflection Control

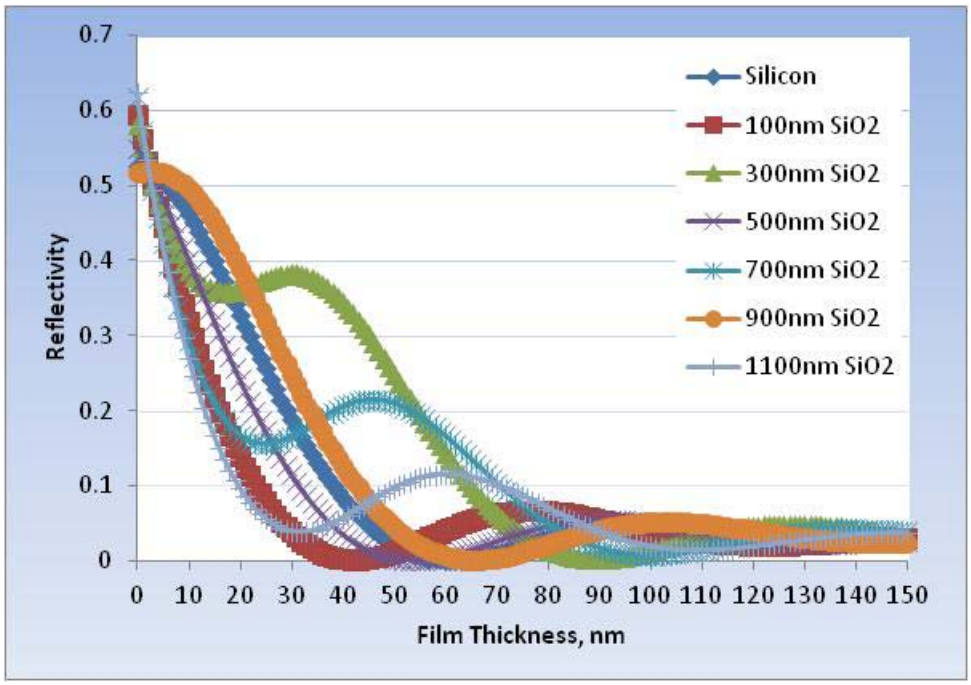
Figure 4 show the modeled reflectivity of AR3GSFwith respect to thickness for silicon. *Figures 4 and 5* were generated using Prolith Version 14.1.1.1.

Figure 4. AR3GSF Reflectivity over Silicon



Contour plots of reflectivity over varying thicknesses of SiO_2 over Silicon appear in *Figure 5*

Figure 5. AR3GSF Reflectivity over SiO_2 (on Si)

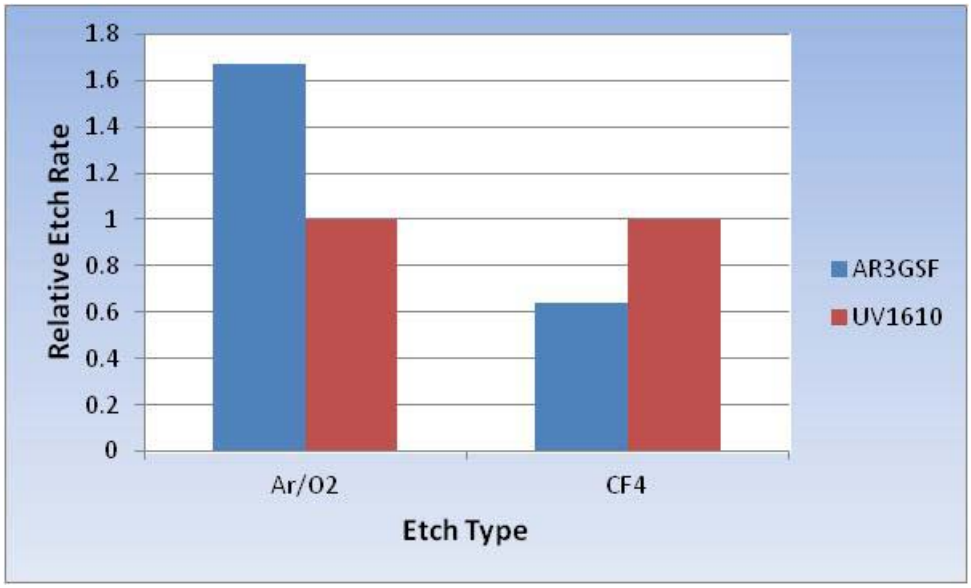


Etch Information

Table 5 lists the basic etch recipes used to examine the etch rate performance of AR3GSF relative to a standard DUV photoresist. The etch performance of AR3GSF is displayed in *Figure 6*.

Table 5: Etch Recipes		
Gas	Ar/O_2	CF_4
Flow (sscm)	60/20	20
Power (W)	300	300
Pressure (mTorr)	10	10
Time (s)	30	30

Figure 6. Relative Etch Rate



Handling Precautions

Before using this product, associated generic chemicals or the analytical reagents required for its control, consult the supplier's Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on material 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 Dow Electronic Materials Technical Representative for more information.

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Contact:
North America: 1-800-832-6200
Taiwan: 886-37-539100
China: (+86) 21-3851-1000
Hong Kong: (+852) 2879-7333
Korea: (+82) 2-3490-0700
Japan: (+81) 3-5460-2200
Europe: (+41)(0)44-728-2111
www.dowelectronicmaterials.com