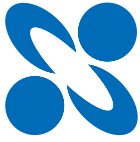


KMSF® 1000

Low Stress Dielectric Photoresist

Description

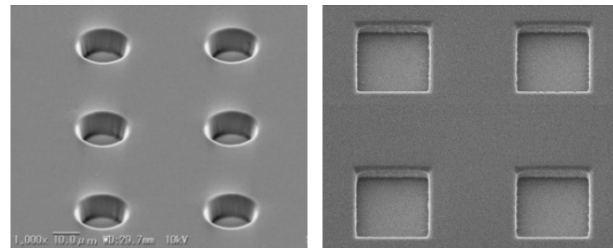
KMSF® 1000 is a negative tone, polyimide-based photo-dielectric for use as an ultra-low stress buffer, passivation or protective layer. It exhibits excellent warpage control especially critical for thin and large diameter substrates used in backend/assembly processing due to its low shrinkage, very low tensile modulus, and low thermal cure requirement. Film thicknesses of ~ 3 to 10 μm can be achieved in a single coat.

Features

- Negative-tone, photoimageable dielectric
- No warpage due to low shrinkage and tensile modulus
- I-Line /broadband sensitivity, 1:1 aspect ratio imaging
- Solvent development
- Low temperature cure < 200°C
- Good electrical properties
- High electrical reliability enabled by very low moisture absorption
- Low shrinkage on cure and thermal stability of lithographic patterns up to 290°C
- Excellent thermal and chemical stability

PROCESSING GUIDELINES

The following conditions represent Kayaku Advanced Materials' recommendation for a baseline process. It is expected that a certain amount of engineering and optimization will be required for customer-specific systems, facilities and application. For guidance on optimizing the process for a specific application, please contact your local Kayaku Advanced Materials Technical Sales Representative or Technical Support. The overall KMSF® 1000 lithography process flow is depicted in Figure 1.



Broadband Contact Aligner
Positive tapered 20 μm (left) and 50 μm (right) via features in 10 μm thick KMSF® 1000 coating

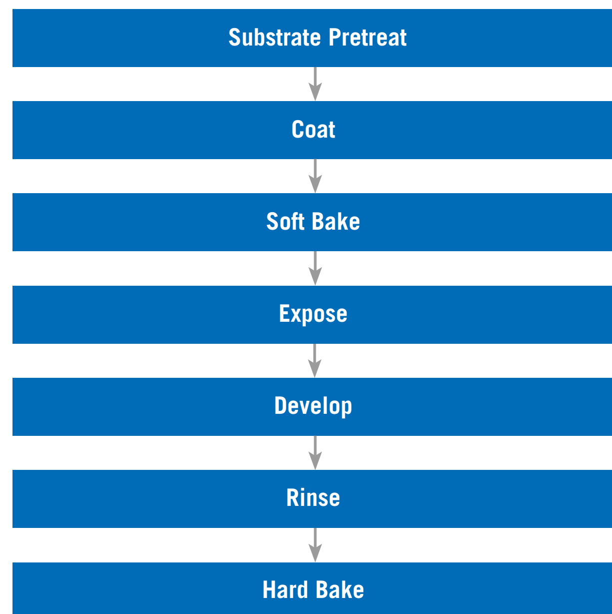


Figure 1: General lithography process flow

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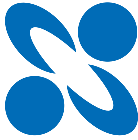

Substrate Preparation

To obtain maximum process reliability, substrates should be clean and dry (dehydration bake) prior to applying KMSF® 1000 photoresist. For best results, substrates should be cleaned with a piranha wet etch (using H_2SO_4 & H_2O_2) followed by a de-ionized water rinse. Substrates may also be cleaned using reactive ion etching (RIE) or any barrel plasma asher supplied with oxygen.

Coat

KMSF® 1000 resist is available in one standard viscosity of 260 cSt. The film thickness vs. spin speed curve is displayed in Figure 2. The curve was generated using a Brewer Science®, Model # Cee® 200 coater, static dispense on 6" (150 mm) silicon wafers and a soft bake of 110°C on a level hot plate. Please note the exact thickness obtained may be slightly offset from Figure 2. due to equipment type, setting differences and room conditions.

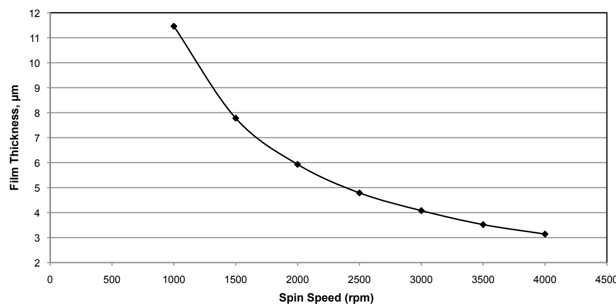

Figure 2. KMSF® 1000 Thickness vs. Spin Speed

Recommended Program

(1) Dispense 1 ml of resist for each inch (25 mm) of substrate diameter.
(2) Spin at 500 rpm for 5-10 seconds with acceleration of 500 rpm/second.
(3) Spin at 1000-4000 rpm for 30 seconds with acceleration of 500 rpm/second.

Edge Bead Removal (EBR)

Edge bead removal and backside rinse are recommended and can be accomplished by directing a small stream of Kayaku Advanced Materials' EBR PG at the edge and back of the wafer. For edge bead removal using EBR PG, please refer to the EBR PG technical data sheet.

Soft Bake

A 110°C soft bake for 3 to 10 minutes on a level hotplate with good thermal control and uniformity is recommended. KMSF® 1000 film remains slightly tacky after soft bake thus hard contact exposure should be avoided.

Optical Parameters

The dispersion curve and Cauchy coefficients are shown in Figure 3. This information is useful for film thickness measurements based on ellipsometry and other optical measurements.

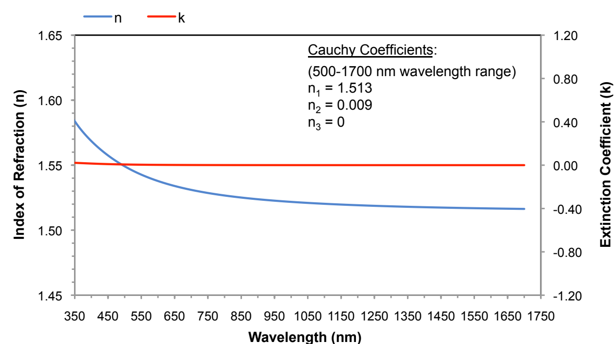

Figure 3. Cauchy Coefficients

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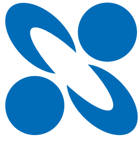


Exposure

KMSF® 1000 is compatible with i-Line and broadband exposure tools. The film typically remains tacky after soft bake therefore, hard contact alignment should be avoided. Bulk film thickness loss associated with exposure and development is typically observed. The film loss is a function of the exposure dose as depicted in Figure 4. Higher doses result in lower film loss and higher final film thickness. For minimum film loss, a broadband exposure dose greater than 400 mJ/cm^2 (high pressure Hg vapor lamp) measured at 365 nm is recommended.

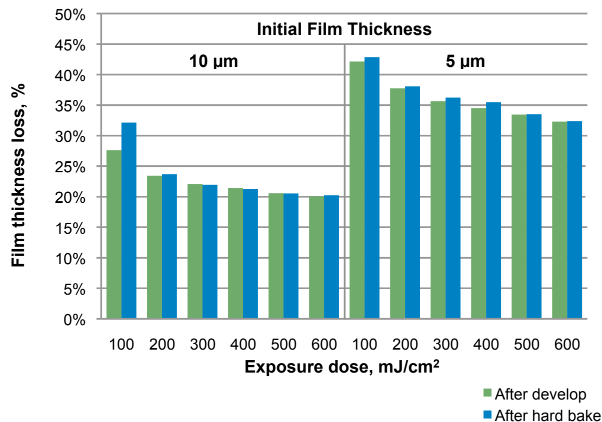


Figure 4. Percent film thickness loss as a function of dose and initial film thickness

Post Exposure Bake (PEB)

A PEB is not required and will not mitigate thickness loss after development.

Development

KMSF® 1000 resist is optimized for development in solvent-based KMSF® Developer using immersion, spray, puddle or spray/puddle methods. A typical spray puddle process at 23˚C would be 70 rpm, 60 seconds spray, 60 seconds puddle followed by a 60 seconds spray.

Rinse and Dry

Following development, spray rinse the developed image with fresh KMSF® Developer. A typical rinse process would be 70 rpm for 10 seconds followed by 2000 rpm for 15 seconds. Dry with filtered, pressurized air or nitrogen.

Hard Bake

A hard bake at 175˚C for 60 minutes is typically used and can be conducted on a hot plate or in an oven.

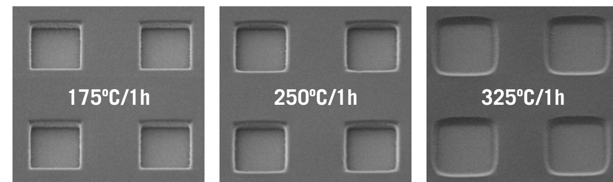
Rework

KMSF® 1000 is a permanent photoresist with limited rework ability post cure. Removal by a strong plasma ashing/RIE process is possible, with the following suggested starting conditions: Power 200 Watts, 50-80 sccm O_2, 8-10 sccm CF_4.

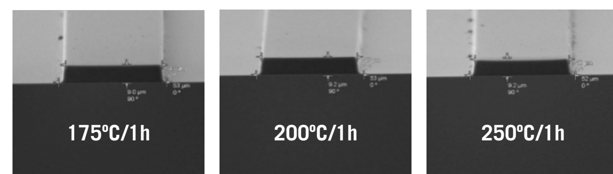
THERMAL PROPERTIES

KMSF® 1000 resist yields stable line/space and via profiles after long exposure to high temperatures. Resist reflow is observed at temperatures greater than 250˚C demonstrating compatibility with solder reflow and other high temperature processes.

Vias



Lines/Spaces



Process Conditions (10 µm film):
Soft Bake: 10 minutes at 110˚C
Broadband Exposure: 400 mJ/cm2 (intensity measured at 365 nm)

Figure 5. Dimensional stability of 50 µm features in 10 µm thick film with temperature

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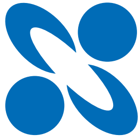
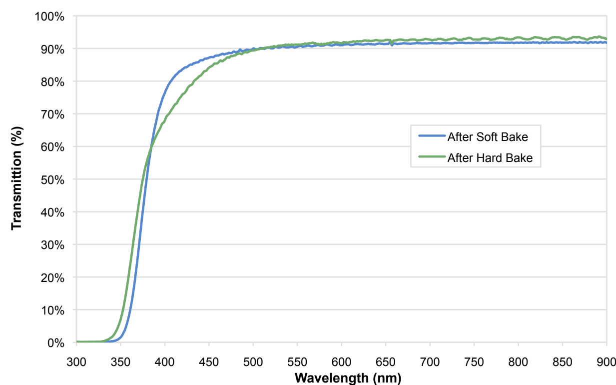


CHEMICAL RESISTANCE

KMSF® 1000 has been tested for chemical resistance (% film loss & appearance) and performs well in typical solvents, acids and bases. For additional detail, please contact your local Kayaku Advanced Materials Technical Sales Representative or Technical Support.

OPTICAL PROPERTIES



Process Conditions (10 μm film):
Soft Bake: 10 minutes at 110˚C
Broadband Exposure: 400 mJ/cm^2 (intensity measured at 365 nm)
Hard Bake: 60 minutes at 175˚C

PHYSICAL PROPERTIES

(Typical Values)

Property	Value
Shrinkage Post Cure (%)	2.17
Tg (˚C)	57
Thermal stability in N2, 5% wt. loss (˚C)	420
Young's Modulus (GPa)	0.14
Tensile Strength (MPa)	37
CTE α1 (<Tg) (ppm/˚C)	140
Elongation (%)	160
Residual Stress (MPa)	0.2
Electric Strength (kV/10 μm)	1.8
Volume Resistivity (Ohm.cm)	1.8×10^{15}
Dielectric Constant (1GHz)	2.6
Dissipation Factor (1GHz)	0.008
Moisture Absorption (23˚C/85%RH, 24h) (%)	0.1

Storage

Store KMSF® 1000 resist upright and in tightly closed containers in a cool, dry environment, away from direct sunlight at a temperature of 40-70˚F (4-21˚C). Store away from light, acids, heat and sources of ignition. Shelf life is thirteen months from date of manufacture.

Handling

Consult Safety Data Sheet (SDS) for details on the handling procedures and product hazards prior to use. If you have any questions regarding handling precautions or product hazards, please email productsafety@kayakuAM.com.

Disposal

The material and its container must be disposed in accordance with all local, federal and/or international regulations.

Disclaimer

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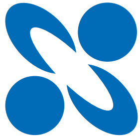

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