



KMSF[®] 2000

Low Dk/Df Photo-dielectric

Description

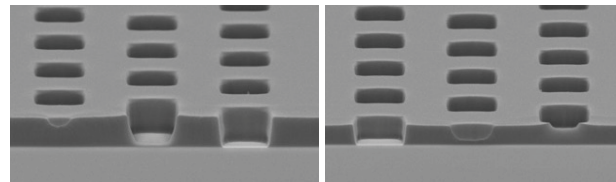
KMSF[®] 2000 is a negative-tone, low-temperature cure, PPE-copolymer-based photo-dielectric for high reliability heterogeneous design in advanced packaging. It provides a unique advantage offering through its improved pattern resolution, low temperature cure, and robust balance of mechanical and electrical properties. It is designed for an optimal cured film thickness of 5 to 10 μm .

Features

- Negative-tone, photoimageable dielectric
- 5-10 μm film thickness after cure
- i-Line /broadband sensitivity, 1:1 aspect ratio imaging
- Solvent development in PGMEA
- Low temperature cure $\leq 200^\circ\text{C}$
- Low Dk/Df electrical properties
- Low moisture uptake
- Good 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 applications. 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[®] 2000 lithography process flow is depicted in Figure 1.



10 μm (left) and 15 μm (right) vias in 10 μm thick film

Material Properties

Property	Value	
Process	Available Viscosities	~800 cSt ~1600 cSt
Mechanical Properties	Young's Modulus	1.6 GPa
	Tensile Strength	60 MPa
	CTE α I (<T _g)	60 ppm/ $^\circ\text{C}$
	Elongation	65%
	Residual Stress	14 MPa
Thermal Properties	T _g (DMA)	215 $^\circ\text{C}$
	5% Weight Loss Temp. in N ₂	390 $^\circ\text{C}$
Electrical Properties	Volume Resistivity	6.7×10^{16} ohm cm
	Breakdown Voltage	270V/ μm
	Dielectric Constant, (10–50 GHz)	2.5
	Dissipation Factor (10–50 GHz)	0.003
Water Absorption	Moisture Absorption (23 $^\circ\text{C}$ /85% RH, 24 Hours)	0.03%



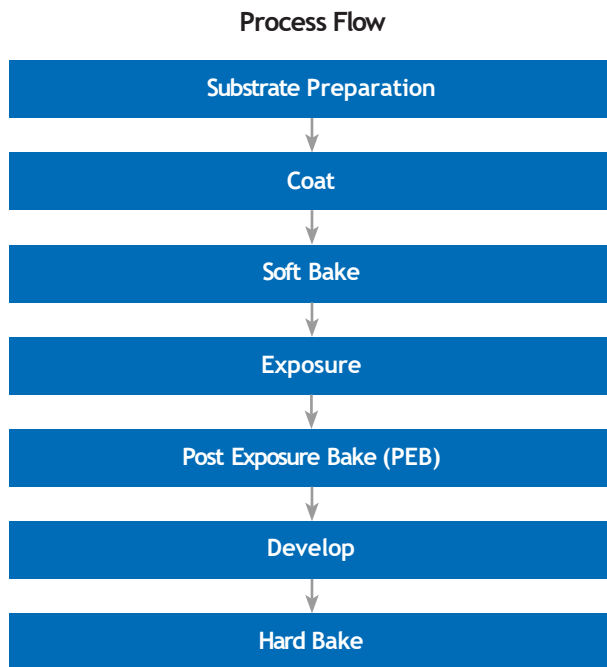


Figure 1. General Lithography Process Flow

Substrate Preparation

To obtain maximum process reliability, substrates should be clean and dry (dehydration bake) prior to applying KMSF® 2000 photoresist.

Coat

KMSF® 2000 resist is available in two standard viscosities to cover a final cured film thickness of 5-10 µm. The post soft bake, as coated film thickness vs. spin speed, is displayed in Figure 2. Please note the exact thickness obtained may be slightly offset from Figure 2. due to equipment type, setting differences and room conditions.

Recommended Coating Conditions

- (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 1000-3500 rpm for 30 seconds with acceleration of 500 rpm/second.

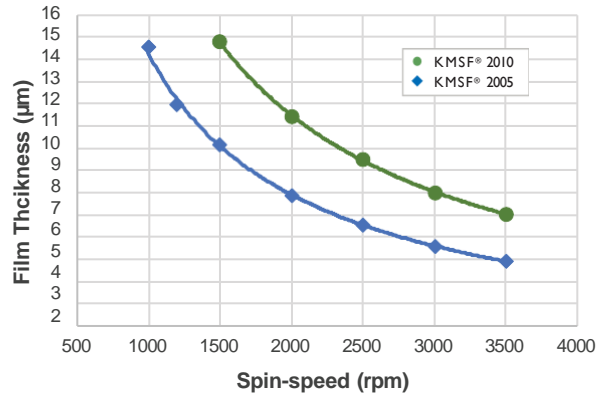


Figure 2. Thickness vs. Spin Speed

Edge Bead Removal (EBR)

KMSF® 2000 is compatible with industry standard EBR and back-rinse solvents such as cyclopentanone, as well as Kayaku Advanced Materials' EBR PG. For edge bead removal using EBR PG, please refer to the EBR PG technical data sheet.

Soft Bake

A 95°C soft bake for 2 to 4 minutes depending on the film thickness on a level hot plate with good thermal control and uniformity is recommended.

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.

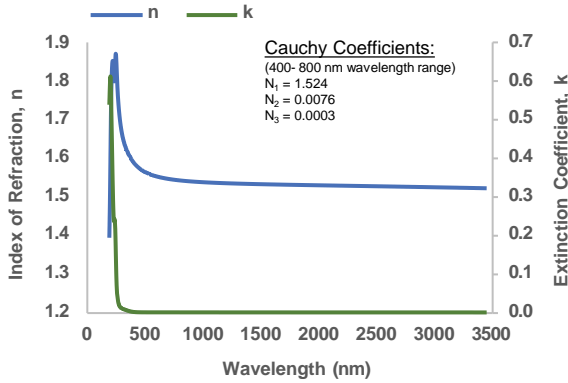


Figure 3. KMSF® 2000 n & k Values and Cauchy Coefficients

Exposure

KMSF® 2000 is compatible with i-Line and broadband exposure tools. Bulk film thickness loss associated with exposure and development is typically observed. A minimal broadband exposure dose of 250 mJ/cm² (high pressure Hg vapor lamp) measured at 365 nm is recommended.

Post Exposure Bake (PEB)

A PEB of 110°C for 2 minutes is required to effectively crosslink the exposed material.

Development

KMSF® 2000 resist is optimized for development in PGMEA using immersion, spray, puddle, or spray/puddle methods. For a 5 µm and 10 µm cured film thickness, 6 x 60 seconds puddle steps are recommended.

Bulk film thickness losses associated with the exposure and development are typically observed post-development. Film loss and shrinkage data is depicted in Figure 4.

Hard Bake (Cure)

A hard bake at 200°C for 1 hour in a nitrogen oven is typically performed to enable full crosslinking of the resin.

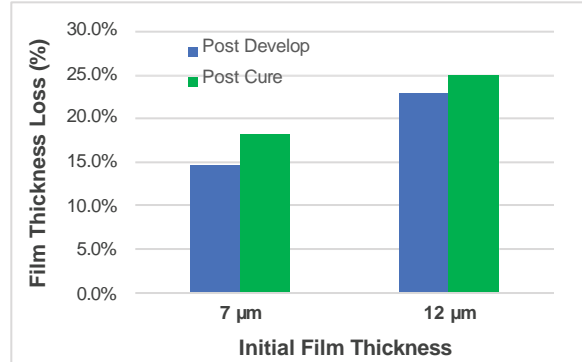


Figure 4. Percent Film Thickness Loss and Shrinkage Data

KMSF® 2000 Typical Process Summary

Process Steps	Conditions for 5 µm Thick Process with KMSF® 2005	Conditions for 10 µm Thick Process with KMSF® 2010
Substrate	150 and 200 mm Cu wafer	
Spin-speed	2500 rpm/ 30 seconds	1900 rpm/ 30 seconds
Soft Bake	95°C, 3 minutes (hot plate)	95°C, 4 minutes (hot plate)
Exposure	250 mJ/cm ² ABM broadband mask aligner with intensity measured at 365 nm	
PEB	110°C, 2 minutes (hot plate)	
Development	PGMEA-based developer 6 x 60 seconds puddle	
Hard Bake	200°C under nitrogen, 60 minutes	



Removal

KMSF® 2000 is a permanent resist with limited rework ability. If rework/removal is required, the resist should be baked at 250°C under air for 1 hour then stripped in a DMSO/TMAH remover at 85°C. Any residual layer may be removed with O₂ plasma.

CHEMICAL RESISTANCE

KMSF® 2000 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 Sales Representative or Technical Support.

Storage

Store KMSF® 2000 resists upright in tightly closed containers away from light, acids, heat and sources of ignition.

STORAGE TEMPERATURE

SHELF LIFE

Frozen (32°F/0°C)	13 months
Refrigerated (50°F/10°C)	6 months
Ambient (68-77°F/20-25°C)	6 months

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

Notwithstanding anything to the contrary contained in any sales documentation, e.g., purchase order forms, all sales are made on the following conditions: All information contained in any Kayaku Advanced Materials, Inc. product literature reflects our current knowledge on the subject and is, we believe, reliable. It is offered solely to provide possible suggestions for the customer's own experiments and is not a substitute for any testing by the customer to determine the suitability of any of Kayaku Advanced Materials, Inc. products for any particular purpose. This information may be subject to revision as new knowledge and experience becomes available, but Kayaku Advanced Materials, Inc. assumes no obligation to update or revise any data previously furnished to a customer; and if currency of data becomes an issue, the customer should contact Kayaku Advanced Materials, Inc. requesting updates. Since Kayaku Advanced Materials, Inc. cannot anticipate all variations in actual end uses or in actual end-use conditions, it makes no claims, representations, or warranties, express or implied including, without limitation any warranty of merchantability or fitness for a particular purpose; and the customer waives all of the same. Kayaku Advanced Materials, Inc. expressly disclaims any responsibility or liability and assumes no responsibility or liability in connection with any use of this information including, without limitation, any use, handling, storage or possession of any Kayaku Advanced Materials, Inc. products, or the application of any process described herein or the results desired or anything relating to the design of the customer's products. Nothing in this publication is to be considered as a license to operate under or a recommendation to infringe any patent right.