SU-8 XFT 75 & 100

Permanent Negative Epoxy Photoresist

Description

The SU-8 XFT series is a high contrast, epoxy-based photoresist designed for micromachining and other micro-electronic applications, where an ultra-thick, chemically and thermally stable image is desired. SU-8 XFT has been formulated for ultra thick film processes with improved adhesion and lower coating stresses. Film thicknesses of 50 to >200 microns can be achieved with a single coat process. The SU-8 XFT series has excellent imaging characteristics and is capable of producing very high, over 5:1 aspect ratio structures, with near vertical sidewalls.

Features

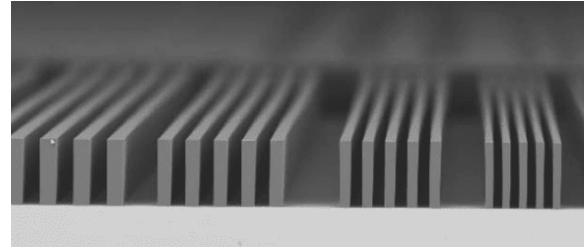
- High aspect ratio imaging of ultra-thick structures
- Vertical sidewalls
- i-line (365 nm) and broadband processing
- Improved adhesion
- Reduced coating stress
- 50 to >200 µm film thickness in a single coat

PROCESSING GUIDELINES

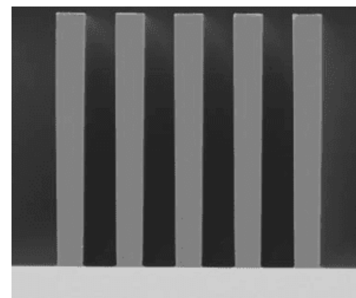
The following conditions represent Kayaku Advanced Materials' recommendation for a baseline process for 50 to 200 µm thick films on silicon. It is expected that a certain amount of optimization will be required for customer specific systems, facilities, substrate, and application.

Substrate Preparation

To obtain maximum process reliability, substrates should be clean and dry prior to applying SU-8 XFT resist.



Contact aligner exposure
Left to right: 25 µm, 20 µm, 15 µm and 14 µm L/S in 100 µm SU-8 XFT100 coating



Contact aligner exposure
14 µm features, 100 µm SU-8 XFT100 coating

Coat

SU-8 XFT resists are available in two standard viscosities, 22,000 cSt for SU-8 XFT75 and 45,000 cSt for SU-8 XFT100. The film thickness vs. spin speed curve is displayed in Figure 1. The curve was generated on a 6-inch (150 mm) silicon wafer using a closed bowl configuration.

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 100 rpm/second.
(3) Spin at 300 rpm for 30 seconds with acceleration of 1000 rpm/second.

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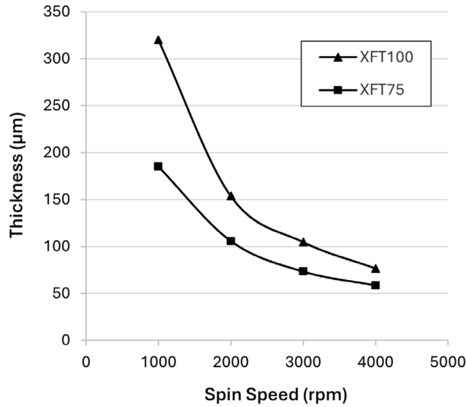

Figure 1. SU-8 XFT Series Thickness vs. Spin Speed

Edge Bead Removal (EBR)

During the spin coating step, a build up of photoresist may occur on the edge of the substrate. In order to minimize contamination of the hotplate, this thick bead should be removed. This can be accomplished by using a small stream of solvent (Kayaku Advanced Materials' EBR PG) at the edge of the wafer either at the top or from the bottom.

By removing any edge bead, the photomask can be placed into close contact with the wafer, resulting in improved resolution and aspect ratio.

Soft Bake

A level hotplate with good thermal control and uniformity is recommended for use during the soft baking step of the process. Table 1 shows the recommended soft bake temperatures and times for various film thicknesses of SU-8 XFT.

Thickness	Soft Bake Time	
microns	minutes @ 65˚C	minutes @ 110˚C
50	3	7
75	4	10
100	5	15
150	5	25
175-200	5	35-45

Table 1. Soft Bake Times

Optical Parameters

The dispersion curve and Cauchy coefficients are shown in Figure 2. This information is useful for film thickness measurements based on ellipsometry and other optical measurements.

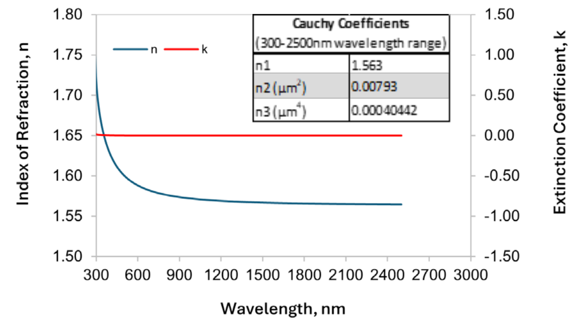

Figure 2. Cauchy Coefficients

Exposure

To obtain vertical sidewalls in the SU-8 XFT resist, we recommend the use of a long pass filter to eliminate UV radiation below 350 nm. A typical exposure dose with measured intensity at 365 nm is listed in Table 2.

Thickness	Exposure Energy
microns	mJ/cm2
50	235-260
75	260
100	260
150	260
175-200	260-300

Table 2. Exposure Dose

Post Exposure Bake (PEB)

PEB should take place directly after exposure. Table 3 shows the recommended temperatures and times.

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Thickness	PEB Time	
microns	minutes @ 65 ˚C	minutes @ 110 ˚C
50	2	8
75	3-4	8
100	5	10
150	5	10
175-200	5	12

Table 3. Post Exposure Bake Times

Development

SU-8 XFT photoresist has been designed for use in immersion or spray-puddle processes with Kayaku Advanced Materials' SU-8 developer.

The recommended baseline development times using an immersion process with mild agitation (40 rpm) through an orbital shaker are given in Table 4.

If using a spray/puddle process, 3-minute SU-8 Developer puddles are recommended.

Thickness	Development Time
microns	minutes
50	8-10
75	15-20
100	20-30
150	25-35
175-200	35-45

Table 4. Development Time for SU-8 Developer

Rinse and Dry

When using SU-8 developer, spray and rinse the developed image with fresh developer for approximately 10 seconds, followed by a second spray/rinse with developer for another 10 seconds if required. Air dry with filtered, pressurized air or nitrogen.

PHYSICAL PROPERTIES

(Typical values)

Property	Value
Adhesion Strength (MPa) Si/SiN/Cu /Glass (Soda Lime)	84/85/79 /55
Glass Transition Temperature (Tg, °C)	168
Thermal Stability (°C @ 5% wt. loss in N_2)	330
Coefficient of Thermal Expansion (CTE, ppm)	73
Tensile Strength (MPa)	70
% Elongation	5.5
Young's Modulus (GPa)	1.83
Dielectric Constant @ 28GHz	3.0
Dielectric Loss @ 28GHz	0.023
Water Absorption (% 85°C/85 RH, 24h)	0.46

Hard Bake (cure)

SU-8 XFT has good mechanical properties. However, for applications where the imaged resist is to be left as part of the final device, a hard bake can be incorporated into the process to further cross-link the material. This is generally only required if the final device or part is to be subject to thermal processing during regular operation. SU-8 XFT is a thermal resin and as such, its properties can continue to change when exposed to a higher temperature than previously encountered. A hard bake or final cure step is added to ensure SU-8 XFT properties do not change in actual use. We recommend using a final bake temperature that is 10°C higher than the maximum expected device operating temperature.

Depending on the degree of cure required, a bake temperature in the range of 150°C to 250°C and for a time between 5 and 30 minutes is typically used.

Note: The hard bake step is also useful for annealing any surface cracks that may be evident after development. The recommended step is to bake at 150°C for a couple of minutes

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Storage

Store SU-8 XFT 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 the 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, state, federal and/or international regulations.

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