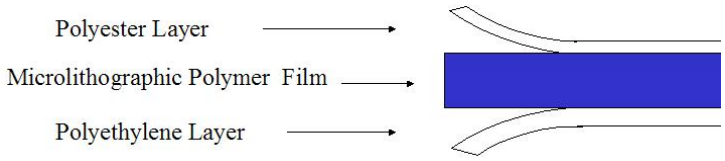
DuPont™ MPF™
MX Advance 100 Series
DATA SHEET & PROCESSING INFORMATION

High Resolution Micro Lithography Photopolymer Film for MEMS, Semi Additive Processes, and Stainless Steel Etching, and HDD Suspension Arm Fabrication

Product Features/ Applications

- Negative working, aqueous processable dry film photoresist



- Suitable for semi-additive process application with electrical plating.
- Suitable for print and etch process application with acid etching process.
- Wet lamination compatible.
- Compatible with surfaces:
  - Copper
  - Stainless Steel

Available Thickness:	15µm and 25µm
Unexposed Color in Yellow Light:	Green
Exposed Color in Daylight:	Blue
Exposed Color in Yellow light:	Green
Print-Out (Phototropic) Image:	Strong
Contrast to Copper:	Strong
Odor:	Low

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PART 1: SURFACE PREPARATION

Surface must be free of any kind of organic contamination and metal oxides from previous processes. It is recommended, whenever possible, to clean the surface with light acid solution (2-3% sulfuric acid solution) followed by D.I. water rinse and dry with nitrogen gas. Cleaning immediately prior to lamination is recommended to remove surface particles and avoid recontamination.

Control Tests:

- Water Break Test: ≥ 30 seconds
- R_a : 0.10-0.3 µm R_a : 2-3 µm

Chemically Cleaned Copper

Alkaline Spray Cleanerfor removal of organic contaminants followed by a spray microetchant for conversion coating (chromate) and/or copper oxide removal (about 2-2.5µm; 80-100 microinch etch). A 10% sulfuric acid spray may be used between alkaline cleaner and microetchant to help with the conversion coating removal. In this case only 1.5µm (60 microinch) microetch depth is required. To remove residual salts after microetching from the copper surface, an acid rinse or efficient water spray rinsing have been employed successfully. In-line systems for prelamination cleaning may not require an antitarnish treatment after chemical preclean to preserve the cleaned surface. Non-in-line systems with hold times of several hours will require antitarnish. For antitarnish selection: see “Electroless Copper with Antitarnish”.

Electrochemically Cleaned Copper

Conveyorized systems combining reverse current electrochemical cleaning and microetching are offered to effectively remove chromate conversion coatings with minimal copper removal. The alkaline electrochemical cleaner first removes trace organics and chromates. After a rinse, a microetch removes about 0.8µm (30 microinches) of copper. Following a second rinse an antitarnish may be applied.

PART 2: Lamination

The main objective of the lamination step is to provide intimate contact between the polymer and the substrate, eliminating any air entrapment, ensuring the polymer flows into the substrate cavities encountered on the surface roughness, maximizing the polymer adhesion.

HRL Hot Roll Laminator Conditions

- Pre-Heat: Optional
- Roll Temperature 105°C ± 5°C (221°F ± 9°F)
- Roll Speed: 0.6 - 1.5 m/min (2-5 ft/min)
- Air Assist Pressure: 0-2.8 bar (0 - 40 psig)

Note: for ≥ 1.4 bar use heavy-duty rolls)

- Water Flow Rate, each valve (YieldMaster* models only): 5-15 ccf/min

Note: use distilled water; hard water is acceptable but may cause scale build-up and clog nozzles.

PART 3: Post-Lamination Hold Time

- Panels may be exposed immediately after lamination; however, allow enough time to cool to room temperature before exposure (about 15 minutes; use accumulator in in-line systems).
- Maximum hold time (guidelines):
  Wet Lamination: 24 hours
  Dry Lamination: up to 1days
  Hold times should be determined empirically based on the temperature and relative humidity of the storage area.

Note: Guideline- Remove within 5 days after lamination.

Laminator Conditions

DuPont ASL-24 & ASL-24/Yieldmaster® Film Laminator

- Seal Bar Temp.: 60 ± 10°C (140 ± 18°F)
- Lam. Roll Pressure: 3.0-5.0 bar (43-72 psig)
- Lamination Temp.: 105 ±5°C (220 ± 9°F)
- Seal Time: 1-4 seconds
- Seal Bar Pressure: 3.5-4.5 bar (50-65 psig)
- Lamination Speed: 1.5-3 m/min (5-10 ft/min)
- Water Flow Rate, each valve (Yieldmaster® models only): 5-15 cc/min

***Note*:** use distilled water; hard water is acceptable but may cause scale build up and clog nozzles.

Note: Reduced lamination roll pressure and/or temperature may be required in tenting applications to avoid tent breakage and resist flow into through-holes.

Performance on Flexible Substrates

MPF™ MX Advance 100 can be used successfully on thin core laminate and flexible substrates.

PART 4: Exposure

Resolution (Lines & Spaces)

- In Optimized Production Environment(hard contact, high intensity exposure, good development and rinse control):10micron L/S
- In Lab Environment: 8micronL/S

Exposure Intensity

- ≥ 5 mW/cm2 at the photoresist surface for 200-250 µm (8-10 mil) L/S resolution; higher intensities are desirable for finer L/S.

***Note**: Do not remove polyester coversheet film. Coversheet has minimum light absorption and provides protection against mask contamination.*

***Note**: MPF MX Advance has peak absorption at 365nm, i-line exposure lamps are highly recommended*

***Note**: 20 mW/cm2 or higher intensity is recommended for high resolution*

Recommended Exposure

MPF™ MX Advance	115	125
mJ/cm2	32 – 64	100 - 200

***Note**: The high end of the recommended exposure range should be used for aggressive applications.*

***Note:** All intensity and energy measurements were made at the polymer film surface with an International Light IL-1400A radiometer and an SSD001A Super Slim UV detector probe (275-400 nm sensitivity).*

PART 5: Development

Chemistries/Make-up

Na_2CO_3 Concentration
Pattern Image >30um 0.85%
Pattern Image <30um 0.50%

- **Sodium carbonate, anhydrous, (soda ash), Na_2CO_3**
  Working solution: 0.85 wt%. Use 8.5 g/l (0.071 lb./gal) e.g. for a 100 gallon sump use 7.1 lb.
- **Sodium carbonate, monohydrate; $Na_2CO_3 \cdot H_2O$**
  Working solution: 1.00 wt%. Use 10 g/l (0.083 lb./gal; e.g. for a 100 gallon sump use 8.3 lb.)
- **Potassium carbonate (potash; K_2CO_3)**
  For make up use either potassium carbonate powder, i.e. anhydrous (potash) K_2CO_3 or a liquid concentrate such as DuPont D-4000 developer (40% concentrate): Working solution: 1.0 wt%. For 100 liter solution use 1.5 liter of D-4000 or 3¡.23 Kg of anhydrous potassium carbonate (For 100 gal solution use 1.5 gal of D-4000 or 7.1 lb. of anhydrous potassium carbonate).

Equations to calculate required amounts for desired wt% of working solutions:

- Na_2CO_3: kg Na_2CO_3 = wt% x sump vol liters x 0.01
  lb. Na_2CO_3 = wt% x sump vol gallons x 0.083
- D-4000: liters (or gallons) D-4000 = wt% x sump vol liters (or gallons x 0.018)
- K_2CO_3: kg K_2CO_3 = wt% x sump vol liters x 0.01
  lb. K_2CO_3= wt % x sump vol gallons x 0.083

Control Test:

Titration of fresh developer solution (e.g. 25ml), before defoamer addition, with 0.1 N HCl to the Methyl Orange end point.

wt% = N x ml HCl x FW x ml Sample
(N= acid normality; FW = formula weight)

FW of Na_2CO_3 =106
FW of $Na_2CO_3 \cdot H_2O$ = 124
FW of K_2CO_3 = 138

Development conditions

- Spray Pressure: 1.4-2.0 bar (20-30 psig)
- Spray Nozzles: high impact direct-fan nozzles preferred; a combination of cone and fan nozzles may be preferred if film tent breakage is experienced.
- Chemistry:
  Na_2CO_3: 0.7-1.2 wt%; 0.85 wt% preferred
  $Na_2CO_3 \cdot H2O$: 0.8-1.3 wt%; 1.0 wt% perferred
  K2CO3: 0.8-1.2 wt%; 1.0 wt% perferred
- Temperature: 27-35°C (80-95°F); 30°C (85°F) preferred

Dwell Time

- Breakpoint: 50-65 %
- Time in Developer (Dwell Time), at 1.4 bar (20 psig) spray pressure, 50% breakpoint. 30°C, fresh developer solution at recommended carbonate concentrations

MPF™ MX Advance	MX115	MX125
Time to clean (TTC)	6.5 secs	10 secs
Total development time	13 secs	20 secs

Note: Total time in developer = Time to clean divided by Breakpoint

- Shorter times to clean are achieved at higher temperatures, higher carbonate concentrations, and higher pressures.
- If developer conveyor speed is too fast for match with other in-line equipment: lower soda ash concentration down as far as 0.5wt%. Consider lowering temperature. Do not lower spray pressure below recommended levels.

Rinsing & Drying Recommendations

- Rinse water: hard water (150-250 ppm $CaCO_3$ equivalent). Softer water can be hardened by the addition of calcium chloride or magnesium sulfate. If hard water is not available, a first soft water rinse may be followed by a dilute acid rinse, followed by a water rinse.
- Rinse temperature: 15-25°C (60-80°F)
- Rinse spray pressure: 1.4-2.4 bar (20-35 psig). Use high impact , direct-fan nozzles.
- Effective Rinse Length: 1/3-1/2 of length of developer chamber; >1/2 preferred.
- Drying: blow dry thoroughly; Hot air perferred.

Controls:

- For batch processing: adjust conveyor speed to maintain desired breakpoint; dump developer solution when development time has become 50% longer than for fresh solution.
- Developer conveyor speed: Now testing

Hold Time after Development before etching 0-5 days

Note: minimize white light exposure during post development hold to prevent film embrittlement.

Developer Maintenance

Clean at least once a week to remove resist residue, calcium carbonate (scale), defoamer, and dye from developed resist. Dye build-up can be minimized by the use of anti-foam.

PART 6: Etching (For P&E Application)

- MPF™ MX Advance 100 series resists are compatible with most acid etchants, e.g. cupric chloride (free HCl normality ≤ 3.0 N), H_2O_2/H_2SO_4, and ferric chloride.

PART 7: Plating

MPF™ can be used for semi-additive copper pattern plating process with acid copper. MX Advance has a strong resistance to lifting and underplating.

Process for Prelate Cleaning Process sequence:

- Acid or Neutral Cleaner: 38-50°C, 2-4 min.
- Spray and / or Tank Rinse : 2 min.
- Microetch – based on available Cu thickness
- Spray and / or Tank Rinse : 2 min.
- Sulfuric acid 8 5-10vol%) dip: 1-2 min.
- (Optional : spray rinse 1-2 min.)

PART 8: Stripping

Aqueous Caustic (NaOH or KOH) Conveyorized Stripping

- Stripper Dwell Times (seconds) at 55°C (130°F), 1.7 kg/ cm2 (25psig), over recommended exposure range:

MPF™ MX Advance	115	125
1.5 wt% NaOH	20 sec	35 sec
3.0 wt% NaOH	18 sec	30 sec

Note:

- Dwell Time = 2x Time to strip resist
- High caustic concentrations produce larger skin sizes and higher loading capabilities.
- KOH generally produces smaller skin sizes than NaOH.

  Particle Size at 1.5% NaOH: sheet
  Particle Size at 3.0% NaOH: sheet

- Solubility of Stripped Particles : Non-Soluble
- Physical Characteristics of Stripped Particles (e.g. Stickiness) : Non sticky
- Higher stripping temperature increases the stripping rate.
- Stripping rate can be increased with higher impact sprays. Use higher pressures and/or high-impact spray nozzles. Avoid low impact deflector nozzles.
- Time to strip increases with white light exposure. A 20% increase in strip time over 8 days exposure is not unusual.
- Higher levels of exposure increase Time-to-Strip: Slightly

Defoamers

Additives for foam control may not be required depending on equipment design and operation. However, if defoamer is needed, use at 0.8 ml/ liter (3 ml/gallon) for resist loadings up to 0.6 mil-m2/liter (25 mil-ft2/gal).

Controls/ Solution Maintenance:

- Preferred: Continuous replenishment (feed & bleed) using board count.
  Maintain resist loading at ≤ 0.4 mil-m2/liter (≤ 15 mil-square feet/ gallon).
- Batch: up to 0.5 mil-m2/liter (20 mil-square feet/ gallon). Maintain breakpoint at ≤50% by lowering conveyor speed or by starting batch stripping with a lower breakpoint and changing the solution once breakpoint moves above 50%. However, low breakpoints can lead to attack of solder on plated work, or cause copper oxidation.
- Filtration Systems

Spray stripping equipment should contain a filtration system to collect and remove resist skins to avoid nozzle clogging, to extend stripper life, and to avoid resist skins from reaching the rinse chamber. The most effective filter systems collect the stripper skins immediately after they were generated, before entering recirculation pumps, and they feature continuous removal of skins from the stripper solution.

Equipment Cleaning

- Cleaning of Equipment Drain and flush with water. Fill unit with 5 wt% KOH or NaOH, heat to 55°C (130°F), and circulate (spray) for 30 minutes to dissolve photoresist particles. Then drain the unit. Repeat procedure if required to remove heavy residues. Remaining blue dye stains on equipment may be removed by circulating 5 vol.% HCl at 55°C (130°F) for 30 minutes (HCl can damage stainless steel). Then drain the unit, fill with water, recirculate for 30 minutes, and drain. There are also proprietary cleaners available which may offer better results.

Storage

Temperature:	5 - 21°C (40-70°F)
Relative Humidity:	40 - 60%

Safe Handling

Note safety and industrial hygiene precautions. Consult the Material Safety Data Sheet (MSDS) of any chemical used. MSDS's for DuPont™ MX Series DryFilm are available from your DuPont Representative.

Safe Lighting

- Protect photoresist through lamination and development steps from UV radiation and visible light up to 450 nm by use of yellow, amber or gold fluorescent "safe lights".
- High intensity (≤ 70 footcandles) yellow "safe light" causes a change in steps held and should be avoided.

Waste Disposal

For questions concerning disposal of photoresist waste refer to the latest DuPont literature and Federal, State, and Local Regulations.

For more information, please contact your local representative.

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