

The logo features a red square with a white lowercase 'i' inside, positioned to the left of the large, bold, black letters 'PMTM'. A small 'TM' trademark symbol is located to the upper right of the 'M'.

About i-PM™ Film

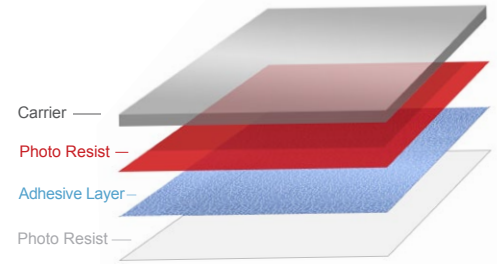
i-PM film is a tough UV-sensitive photoresist designed to meet the most challenging Photo-Machining needs. This film has excellent durability for etching very hard and dense ceramic materials such as glass, alumina and silicon carbide. Because it is a photolithography process, precision pattern positioning can be achieved to within 15u. Unlike other photoresists requiring special adhesives, i-PM film has a built-in adhesive and can be applied dry and without heat. It is specifically designed for processing

“ON” the substrate. This permits precise registration of the Phototool pattern onto the substrate. i-PM film is water soluble so processing is simple and easy without the need for toxic chemicals.

i-PM™ Four-Layer Structure

- Carrier (shiny, harder side)
 - Photo resist layer (duller side)
 - Adhesive layer
 - Protective slip sheet (dull, softer side)
- * Standard film thickness is 100 µm (4mil)

Four-Layer Film Structure



Required Materials

- Hot roll lamination system recommended
- UV Exposure Device with UV output wavelength in the 365nm range.
- Water Developing nozzle such as a high pressure sprayer. For automated developers, contact an IKONICS Customer Service Representative
- Dryer/oven – manual or auto conveyor
- Powder blasting system
- Abrasive media (120 to 320 Aluminum Oxide or Silicon Carbide)



Safety Considerations

- Refer to MSDS for safety information.



Storage

- Store packaged film in cool, dry areas
- Do not refrigerate
- IKONICS warrants this product free from defects for 12 months



Light Sensitive Product

i-PM films are light sensitive during exposure and image development. Although the film has some tolerance to white light, it should be used in a yellow or safe light environment to prevent premature exposure. General purpose gold or yellow fluorescent lamps, red ortho-safelights or yellow incandescent bug lights can also be used.

Advantages

- Dry Film Photo Resist
- Self-Adhesive
- 100 µm
- Deep Etching Ability
- User Friendly Process
- **Environmentally Friendly**

1 Phototool Preparation

Generate a **POSITIVE** working Phototool master of the pattern being machined.

- Phototools should have dense, black areas with sharp, clean edges. D-max of 3.0 or higher is recommended.
- The black areas of the phototool are powder blasted.
- Since this film is processed “ON” the substrate, photo-tool image should be right-reading emulsion side down.

Recommended Phototool print media include:

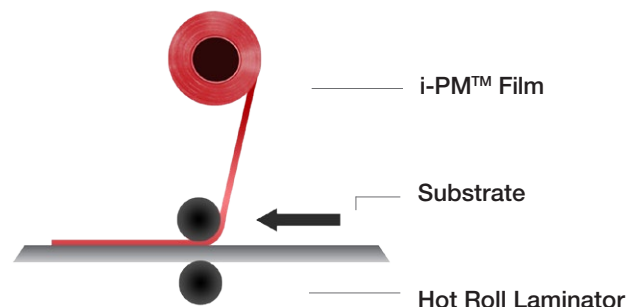
- Stat camera or Image Setter generated phototools are best for 95% of applications where moderate to precision tolerances are required. They produce sharp images and have excellent print density.
- Glass Photomasks should be used for ultra-precision tolerances where positioning between features is critical.
- IKONICS AccuArt films can be used with inkjet printers where precision features or positioning are not required.

Note: Vellums and transparency papers are **not** recommended.

2 i-PM Film Application

i-PM films are best applied using a hot roll laminator to ensure a uniform, wrinkle free application with optimum adhesion.

- Remove the Protective Slip Sheet (thinner/softer side) using a piece of tape on one corner.
- Film can be applied at room temperature or elevated temperatures using a hot roll laminator. Lamination temperature is not critical, however warmer lamination can help film flow characteristics to ensure conformation over some rough surface substrates.



3 Film UV Exposure

Note: A flat-bed UV exposure unit, such as the IKONICS 26-1KS or equivalent, is required.

- i-PM can be exposed with or without the clear Carrier layer on. For the best film resolution, however, removal of the carrier is recommended.
- Position the emulsion or printed side of the phototool down onto the film laminated substrate. At this point, the image should appear right-reading.
- Align/register the phototool image to the film/substrate as required.

Suggested UV Exposure Energy (~Time)

| UV Light Source | Lamp Distance | Exposure Energy | Exposure Time |
|-------------------------|---------------|---------------------------|-----------------------|
| 1000 Watt mercury Vapor | 18 in/45 cm | 65-100 mJ/cm ² | Approximately 20 sec. |
| 5000 Watt Metal Halide | 40 in/100 cm | 65-100 mJ/cm ² | Approximately 10 sec. |

Note: Under-exposure can cause loss of entire image during development. With good, dense phototools, this should not be an issue. Exposure times are suggested guidelines only. These times can vary based on the type of UV unit, age of the lamp, and local voltage ranges. Contact an IKONICS INDUSTRIAL representative if help is needed.

4 Image Development

i-PM becomes insoluble in water when it is exposed. The unexposed portion is very soluble in water, especially in warm water (see below). The development mechanism starts with the water “swelling” the resist. Light water pressure can be used when the development cycle begins. Slowly build the pressure as the color of the developed film lightens. See specifications below.

- For manual development, place the exposed film with substrate in an upright vertical position supported to withstand water spray system (preferably located in a spray booth).
- For automatic development, place on conveyor and set speed based on type and size of equipment. See specifications for temperature and pressure below.
- Develop the film with warm water between 100°F — 120°F (38°C — 49°C).
 - ▶ Water pressure (at the nozzle) using a single flat spray misting nozzle should be between 150-225 psi (10 – 15 bar). Higher pressures associated with power washers should be used with caution to prevent loss of image during development.
- Spray in a gentle, sweeping motion until the image develops completely. Keep the spray nozzle about 8 -12 in. (20 - 30 cm) away and moving at all times during this step.
 - ▶ **Hint:** Stop spraying and check to see if a haze appears. If so, development is not complete. Continue to spray until haze no longer appears. A white (incandescent only) light will show the haze better and can be used during development.
- After image is developed, remove excess water by blotting the surface with an absorbent lint-free cloth, or preferably use an air knife/dryer.

Note: DO NOT allow film to be subjected to water flowing from a faucet or soaking. Average development time for a 4mil (100µm) film with a manual nozzle (above) is about 1-2 min.

5 Drying of the Film/Substrate

- Be sure excess water is removed from the surface. See **Image Development** (above) section of user guide.
- Convection oven dry ~140°F (60°C) for about 5 to 10 min. Room temperature-dry for about 1 to 2 hours. Film is dry when the surface is uniform in color.

Note: High humidity conditions may require longer room temperature drying times.

Note: targets can be used on the phototool to line up with markings on the substrate to help with registration.

- Ideally, a vacuum frame built into UV exposure unit should be used to ensure good contact between the phototool and the film/substrate. Some vacuum frames are too shallow to accommodate the substrate thickness, and some substrates (i.e. wafers) are too fragile for a vacuum frame.
 - ▶ In these cases, instead of using a vacuum frame, place a piece of 3/8 in. (10 mm) UV clear glass on top of the photo-tool to maintain good contact with the film during exposure.

6 Abrasive Machining Etching

- Protect the edges of the substrate (if not already protected with film). Use a commercial grade masking tape.
- Recommended abrasive is Aluminum Oxide or Silicon Carbide, 120 – 320 mesh/grit size, depending on the level of image detail and material being etched. Finer details may require the use of a smaller particle size (higher grit number).
- For Pressure Pot systems, use 40 to 80 psi (3 – 5 bar) and a 1/8 in. (3 mm) nozzle diameter. For Siphon Systems use pressures 1.5x to 2x higher.
- For manual abrasive machining operations, maintain nozzle at a uniform distance from the surface (3 to 6 in. – 7.5 to 15 cm), and continually sweep area being etched in an even pattern. Do not concentrate in any one area – keep the nozzle moving.
- Automated abrasive etching requires custom made equipment to achieve desired results. This is recommended where controlled uniformity of depth and high productivity is required. An IKONICS representative can assist in locating an automated powder blasting manufacturer in your area.

7 Photo Resist Removal

- i-PM films are best removed after soaking the substrate in warm/hot water for about 30 min. The film is now softened and will easily come off. Cascading warm/hot water can be used on delicate substrates to remove the film.
- Rinse substrate in clean water and dry.



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