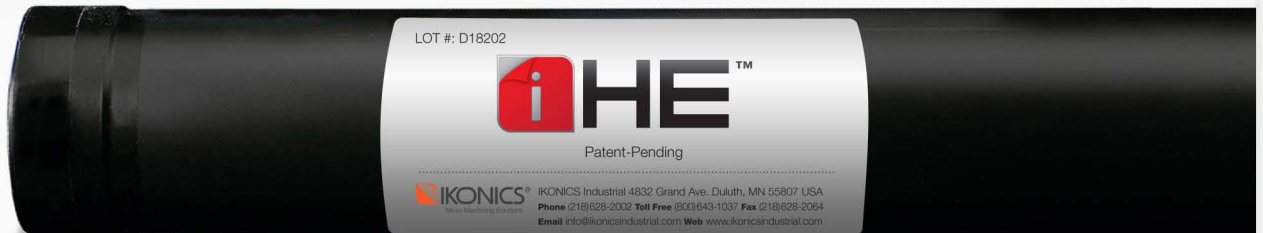




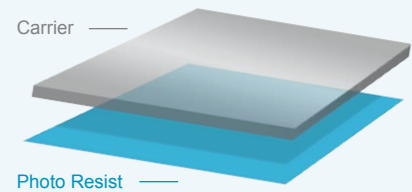
Industrial Photo-Machining Film



## iHE™ 75µm & 100µm Dry Film Photo Resist\*

iHE film is a tough UV-sensitive photoresist designed to meet the most challenging Photo-Machining needs. This film has excellent durability for the dry abrasive blasting of very hard and dense ceramic materials such as glass, alumina and silicon carbide or sapphire. Because it is a photolithography process, precision pattern feature positioning can be achieved to within 15µm. Unlike other photoresists requiring special adhesives, iHE film adhesion is activated by heat and pressure using a conventional Hot Roll Lamination system. It is specifically designed for processing "ON" the substrate. This permits precise registration of the phototool pattern onto the substrate. iHE film is water soluble so processing is simple and easy without the need for toxic chemicals. Removal is achieved soaking in heated water.

### iHE™ Two-Layer Film Structure



1. Carrier (smooth, harder side - resists fingernail test)
2. Photo resist layer (less smooth side)



#### Required Materials

- Double sided hot roll laminator with heated rolls.
- 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 (automated preferred) contact an IKONICS customer service representative.
- Abrasive media (180 to 400 Aluminum Oxide or Silicon Carbide).



#### Storage

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



#### Light Sensitive Product

iHE films are light sensitive during exposure and image development. Films have some tolerance to white light, but for best performance they 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

- 100 µm Feature Resolution (with 75 µm film)
- Deep Etching Ability
- User Friendly Process
- **Environmentally Safe**

\* Patent Pending



#### Safety Considerations

Refer to MSDS for safety information.

## 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, phototool image should be right-reading emulsion side down.

#### Recommended phototool print media include:

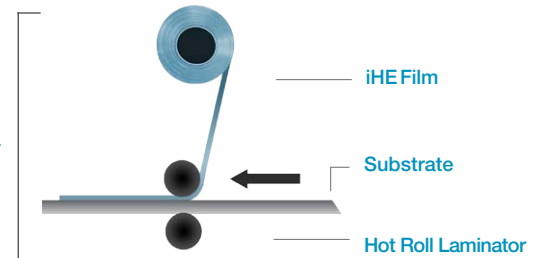
- Stat camera or Image Setter generated phototools are best for 95% of applications where moderate to precision tolerances are required. They produce sharp images and have excellent print density.
- Glass photomasks should be used for ultra-precision tolerances where positioning between features is critical.
- 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) iHE™ Film Application

iHE films must be applied using a hot roll laminator to ensure a uniform, wrinkle free application with optimum adhesion.

*Inside layer of roll is laminated to the substrate. Outside (carrier) layer rides against the heated roll of the laminator.*



- Lamination speed is about 0.2 – 0.25 m/min. (0.65 – 0.82 fpm).
- Pre-heat substrates >1 mm in thickness (60°C for best adhesion).
- Hot Roll temperature gauge setting should be such that the actual laminating roll temperature is between 65°C and 80°C (150°F – 175°F) needed for good adhesion. Roll nip pressures recommended are up to 3 bar (45 psig). Temperature and pressure are dependent upon the type and thickness of the substrate used and should be sufficient to allow good conformation of the film to the substrate surface.
- Raise lamination temperatures or slow lamination speed if adhesion is not sufficient.
- No hold times required other than to allow substrate and film return to room temperature.
- Remove the carrier once substrate is cool. **iHE is not oxygen sensitive**, removal of carrier will not cause film quality to degrade.

### 3) UV Exposure

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

- 1000 W to 5000W UV metal halide units typical of those used in the electronics industry are preferred units for iHE exposure.
- iHE can be exposed with or without the clear Carrier layer on. For the best film resolution, however, removal of the carrier is recommended and can be done right after lamination.
- Position the emulsion or printed side of the phototool down onto the film laminated substrate. The image should appear "right-reading".
- Align and register the phototool image to the film/substrate as required using alignment features or substrate edges.

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

- A vacuum frame built into the 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" (10 mm) UV clear glass on top of the phototool to maintain good contact with the film during exposure.**

#### Suggested UV Exposure Energy

Film	Exposure Energy
75 µm iHE	30-50 mJ/cm <sup>2</sup>
100 µm iHE	50-80 mJ/cm <sup>2</sup>

**Note:** Under-exposure can cause loss of entire image during development. Over-exposure can cause image growth due to UV light undercutting. Always use good, optically dense phototools. 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 and the type of image resolution needed. Contact an IKONICS representative if help is needed.

### 4) Image Development

iHE film becomes **INSOLUBLE** in water when it is exposed. The **UNEXPOSED** portion remains soluble in water. The development mechanism starts with the water "swelling" the resist. High pressure water is needed to remove the unexposed resist from the imaged areas, especially for small features. See specifications below.

- For **manual** development, place the exposed film with substrate in an upright vertical position supported to withstand water spray pressure (preferably located in a spray booth).
- For **automatic** development, an auto vertical double sided system is recommended. Contact an IKONICS representative for specifications.
- Specifications for temperature and pressure below are given here for both manual and auto spray systems.
  - 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 90-150 psi (6 – 10 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.
  - Typical development times are about 1 ½ minutes (75 µm) and 2 minutes (100µm).
- **After image is developed, keep substrate vertical to remove excess water** or use an air knife/dryer.

**Note:** Do not allow film to be soaked or subjected to water flowing from a faucet.

### 5) Drying of the Film/Substrate

- Be sure excess water is removed from the surface. See the above *Image Development* section of user guide.
- If possible, keep substrates vertical while drying.
- Convection oven dry ~140°F (60°C) for about 10 to 15 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.

### 6) Abrasive Machine/Etching

- Substrates such as wafers may need protection on the opposite (back side) or non-powder blasted side. A suitable film can be used during the lamination step. Contact an IKONICS representative if a film recommendation is needed.
- Protect the edges of the substrate (if not already protected with film). Use a commercial grade masking tape or fixtures to support substrates.
- Recommended abrasive is Aluminum Oxide or Silicon Carbide, 180 – 400 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).

**Hint:** For glass substrates where minimal chipping is required, use the smaller grit sizes (280/320/400).

- For Pressure Pot systems, use 40 to 60 psi (3 – 4 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

- For residue-free substrates, the iHE film is best removed by soaking in hot water 60°C – 75°C (140°F – 165°F) for 15 to 30 minutes. The film should lift from the substrate or will easily peel off. Cascading water or an ultrasonic bath can be used on delicate substrates to help remove the film.
- For faster removal, some higher pH additives can be used. Contact an IKONICS representative for suggestions.
- Rinse substrate in clean DI water and dry.



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