Tutorial: Applying a Photosensitive Dry Film Resist for Electro-Etching

Materials required:

- Transparent mask of the design – the black areas will be etched
- Metal blank

Tools required:

- Pan of water
- Tape
- Sheet of glass
- X-Axto knife
- Spray bottle of distilled water
- Squeegee
- Laminator
- 2 small sheets of glass or Plexiglas
- 4 binder clips
- UV light source
- Sodium carbonate
- Sodium hydroxide for stripping the film after etching

The technique I use for photosensitive dry film is:

1. Print the design on a sheet of transparence film. The black portions of the mask will be etched. – I use an inkjet printer because I feel it gives better coverage of the black areas. I

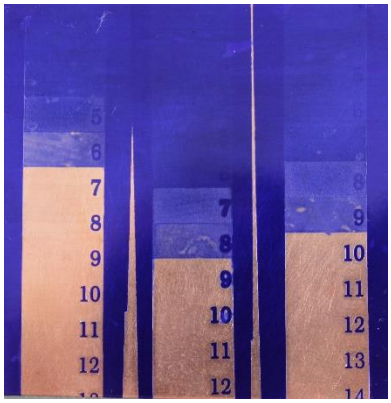
also use inkjet transparency film to keep the mask from smearing. I flip the design left to right before printing (see a later step as to why).

2. Clean and degrease the metal blank. – I do a light scrub with Penny Brite, rinse with water, dry, and wipe with denatured alcohol or acetone.
3. Place the metal blank in a pan of water.
4. Cut a piece of photosensitive dry film slightly larger than the metal blank.
5. Remove the protective film from one side of the photosensitive dry film using two small pieces of tape stuck to opposite sides of a corner, and float the remaining photosensitive dry film, sticky side down, in the pan of water. – The photosensitive dry film seems to lay flatter when the Mylar film from the inside of the roll is removed first.
6. Remove the metal blank from the pan, place it on a sheet of glass, and spray it with distilled water.
7. Lift the photosensitive dry film from the water by holding two corners and apply it to the metal blank. – The film can still be fairly easily moved around at this point.
8. Using light pressure, squeegee the film from the center of the blank to the edges, all around, to remove most of the water.
9. Trim the film to the edges of the metal blank. – I use an X-Acto knife
10. Place the metal blank on a dry paper towel and squeegee out the rest of the water, from the center of the blank to the edges, using a fair amount of pressure. Pat the metal blank dry.
11. Sandwich the metal blank between two sheets of plain paper and run the sandwich through a laminator, one or more times, to help bond the film to the metal. – I run it through my laminator to a surface temperature of around 150°F.
12. Let the metal blank cool, place the mask on top of the film side of the metal blank, and sandwich them between two sheets of Plexiglas or glass. – I turn the transparency film over so the ink side is on the bottom next to the photosensitive dry film. I have found this gives me a crisper edge to the etching because light cannot angle in under the ink from the side and partially expose the film under the edges of the mask. I sandwich the blank with the film and the design mask between two 5”x5” sheets of 1/8" Crystal Clear Cell Cast Plexiglass and hold it together with four binder clips.
13. Expose the sandwich to an UV light source. – The exposure time is dependent on the film, the UV light source, and the distance from the light source to the UV film. I calibrated my exposure setups using a 21 step Stouffer transmission scale. I try for an exposure number of “6” or “7”. I have two UV light sources that I commonly use:
    - A Makartt 36W Nail Dryer Gel Curing UV Nail Lamp with the two outside bulbs removed. My normal exposure time is about 1 minute.
    - A desk lamp with an Atshark E27 A19 7W LED UV Ultraviolet Blacklight AC100-240V light bulb, 5 inches above the sandwich. My normal exposure time is about 2 minutes

14. Remove the metal blank from between the Plexiglas sheets and remove the protective Mylar film from the top of the photosensitive dry film by sticking a small piece of tape to one corner and pulling up. – The design will barely be visible in the exposed film at this point.
15. Place the metal blank in a 1-1.5% solution of sodium carbonate and gently wipe away the unexposed areas of the film. – I use a 1.5% solution of sodium carbonate at room temperature. I gently wipe the surface with a soft foam paint brush for about 1 minute and then rinse it under cold running water while gently rubbing any remaining unexposed film away with my fingers.
16. Spray the film with a weak acid solution to stop the development process and rinse with water. – I use a 3:1 solution of distilled water and white distilled vinegar.
17. Expose the developed film to the UV light again to harden the developed film. – I expose it to the UV light source for an additional 2 minutes. The film turns even a darker blue/purple than it was following development.

Calibrating the UV Light Source

I calibrate my exposure setups using a 21 step Stouffer transmission scale.



The picture on the right is the sample exposures I made to calibrate one of my UV light sources. The strip on the left was exposed for 1 minute, the center strip for 2 minutes, and the right strip for 3 minutes. The number of significance is the first number where the little graduated strips are no longer visible and the bare copper is clean.

I have found that an exposure number of "6" or "7" works well for me.

Preparing the Sodium Carbonate (Na_2CO_3) Solution

Caution – Please wear eye protection while preparing and using the sodium carbonate solution.

Sodium carbonate, also known as washing soda, soda ash or soda crystals, may be purchased from most grocery stores. It may be in the soap/detergent section.

I add 15 grams (about 2 teaspoons) of sodium carbonate to 1 liter of distilled water to make a 1.5% solution.

Preparing the Sodium Hydroxide (NaOH) Solution

Caution – Please wear rubber gloves, a dust mask, and eye protection while preparing and using the sodium hydroxide solution.

Sodium hydroxide, also known as lye and caustic soda, may be purchased from many grocery stores or hardware stores. It may be in the drain cleaner section.

Caution: Dissolving sodium hydroxide is an exothermic reaction. Always add the sodium hydroxide to the water.

I add 10 grams (a little less than 2 teaspoons) of sodium hydroxide to 1 liter of distilled water to make a 1% solution. Immediately shake or stir the solution to help dissipate the heat being generated.