Etching

Etching is a process that is not carried out in schools as was once the case, when etching of printed circuit boards (PCBs) was a common process. It still, however, has the potential for some interesting chemistry or IDL work.

While there are various different methods for etching different metals, the one most suitable for schools is the etching of zinc. This can be etched with a copper sulphate based etchant. The process produces no nasty fumes or hazardous by-products and can be carried out quite quickly at room temperature.

SSERC has details for a low-hazard etching process of zinc sheet. Details of which can be found here (<http://www.sserc.org.uk/index.php/national-4/chemistry-in-society-n4/1129-subject-areas/chemistry/chemistry-national-4/chemistry-in-society-n4/3056-copper-etching>)

In brief the process for most etchings is:

## Preparation

**1 – Prepare your metal.**

You need to ensure that the metal surface is clean and grease free. Methods will differ for different metals but generally is best done by rubbing with a gently abrasive and then cleaning with propanone.

**2 – Cover your metal with impervious material**

The reverse of the sheet can be covered with electrical tape or similar (as long as it is waterproof) but the surface to be etched needs to be covered with a thin layer of an impervious substance. Wax is good as it is soft and easy to scrape away but nail varnish is another option.

An alternative approach, used when etching printed circuit boards, is to cover the area you want to keep and etch everything else away. The principle is the same as above.

**3 – Choose your design**

Don’t forget that if you are going to be printing from your design, the image will be reversed. Also, you will need practice to become familiar with the level of detail that will be possible with your chosen method.

**4 – Create your design**

Scrape away the covering to reveal your design. The idea is that where you have scraped off the covering, the etchant will be able to get at the metal and eat away at it while the rest of the surface is protected with the layer of wax or whatever you used.

## Etching

**Prepare your etch solution.**

Make sure you are using the right etchant – in particular, don’t mix the iron III chloride and sodium persulphate etchants for copper – mixing these will release toxic chlorine gas.

Make up an appropriate etching solution (several are listed in the table below).

**Set up your etch bath**

Make sure you have a container that is a suitable size and shape that will, for instance, allow you access to brush off accumulating debris for instance.

Set up in a fume cupboard if needed.

Place it on a hot plate or water bath if needed.

## The etching

The etch plate is placed in the bath of solution and left with occasional agitation. The precise details will vary between methods. Different combinations of metal and etchant will take different amounts of time. You will need to practice to find out how long the process will take in your particular case.

## Different etchant solutions

It is possible to etch a variety of metals, as long as you choose the right solution. Some of the solutions, however, are quite hazardous so it is preferable, where possible, to choose a combination of metal and solution that is of a low hazard.

There are many recipes for etching solutions.

|  |  |  |
| --- | --- | --- |
| **Metal** | **Etching solution** |  |
| **Aluminium** | 2 M sodium hydroxide solution at 60-70 °C.  Hazards: Corrosive to skin and eyes. | \\staffserver1\esoc$\My Pictures\GHS Pictograms\GHS pictograms-small\GHS-pictogram-acid-small.jpg |
| **Copper** | Dissolve 20 g of iron III chloride-6-water in 100 cm3 of 2.5 M hydrochloric acid.  Hazards: Corrosive to skin and eyes. | \\staffserver1\esoc$\My Pictures\GHS Pictograms\GHS pictograms-small\GHS-pictogram-acid-small.jpg |
|  | Dissolve 25g of sodium (or ammonium) persulphate in 100 cm3 of distilled water.  Hazards: Skin and respiratory sensitiser, skin and eye irritant, harmful if swallowed. | \\staffserver1\esoc$\My Pictures\GHS Pictograms\GHS pictograms-small\GHS-pictogram-silhouete_small.jpg  \\staffserver1\esoc$\My Pictures\GHS Pictograms\GHS pictograms-small\GHS-pictogram-Warning_small.jpg |
| **Iron** | **Fry’s reagent** - Dissolve 59 g of copper II choride-2-water in 40 cm3 of water and add 60 cm3 of concentrated hydrochloric acid.  Hazards: Corrosive to skin and eyes. | **\\staffserver1\esoc$\My Pictures\GHS Pictograms\GHS pictograms-small\GHS-pictogram-acid-small.jpg** |
|  | **Nital solution –** This is a solution of nitric acid in alcohol. It can become dangerously explosive. **Not recommended.** |  |
| **Lead** | Before use, mix together 50 cm3 of 5 M nitric acid and 50 cm3 of 15% (w/v) ammonium molybdate VI solution. (In use - Apply with a swab for 30 s before rinsing).  Hazards: Corrosive to skin and eyes. | \\staffserver1\esoc$\My Pictures\GHS Pictograms\GHS pictograms-small\GHS-pictogram-acid-small.jpg |
| **Zinc** | Mix 10g of copper sulphate and 10 g of sodium chloride. Dissolve in about 70 cm3 of hot water and dilute to 100 cm3 with more water. |  |
| **Glass** | Hydrofluoric acid  **HF is EXTREMELY dangerous and should not be used in schools** **except by experienced chemists**  It is possible to demonstrate the principle as follows:  Place less than 0.5 g of a fluoride in a test tube, set in a rack and pour in a few drops of concentrated sulphuric acid (CORROSIVE). Place a microscope slide across the top, which will end up with an etched, circular area |  |