PCB Immersion Tinning Solution

Chemical Tinning Solution.

Bare copper PCBs will oxidise and tarnish over a short period of time, impairing solderability and decreasing reliability of the finished circuit. Adding a tin coating to the PCB will somewhat alleviate this problem because tin has less of a tendency to tarnish, but still will over an extended time.

Commercial PCB fabrication utilises a soldering mechanism for coating the board with a layer of tin, which is impractical for the vast majority of electronics enthusiasts. Therefore, a chemical solution is required. This is commonly known as immersion tinning, and produces a very thin covering of shiny tin on all the copper surfaces of the PCB.

Immersion Tin chemicals required:

Citric acid ($C_6H_8O_7$) anhydrous or monohydrate	120 grams
Thiourea (CH_4N_2S)	4.0 grams per 100ml of tin citrate solution.
De-Ionised water(H_2O)	500mL

Synthesising a Tin(II) citrate solution:

Tin(II) citrate can be purchased in crystal form, but is difficult to find and quite expensive. However, it is extremely easy to synthesise using very inexpensive items, most of which an enthusiast may have in the workshop already.

- Measure two 2 metre lengths of lead free solder, which consists of 96% Tin and 4% Silver or 96% Tin and 4% Copper (Tin and Silver solder is preferred). These will act as the tin donors for the solution.

Note. Do not use Lead/Tin solder for this because the high content of lead is a pollutant to the final solution.

- In a glass container add 120 grams of citric acid crystals to 500ml of de-ionised water, and stir until it is dissolved.

Note. Citric acid crystals are readily available as a household cleaner. They should be purchasable from most hardware stores or larger supermarkets, but make sure they do not have any additives. Also, do not be tempted to use tap water, filtered or not. It must be de-ionised water.

- Fold the solder lengths into two flattened coils and hang them over the container containing the aqueous citric acid solution. These will act as an anode and a cathode, therefore make sure they have tails hanging over the top of the container so that an electrical current can be passed through them. Also make sure they are not touching each other inside the container and are not touching the bottom of the container.

- Using a variable power supply, capable of producing at least 1 Ampere of current, connect the positive and negative leads to the tin solder anode and cathode terminals hanging over the side of the container. The polarity is not important.

- Increase the voltage until the current reading is approx 1 Ampere. The voltage required will depend on several criteria, such as the container size, the solder coil dimensions, the quality of the citric acid etc.. So it is unknown what exact voltage will be needed.

- As soon as enough current is supplied, the tin solder inside the container will start to produce bubbles, therefore, make sure this is carried out in a well ventilated area. Keep the current on for at least 5 hours, adjusting to approx 1 Ampere when it strays, and the solution will turn a cloudy grey colour with some sedimentation. Every hour or so, reverse the polarity on the anode and cathode terminals. The longer this process is maintained, the more concentrated the solution will be, as long as the solder donors are intact.

- Once the reaction is finished, filter the solution into another container. A conical paper coffee filter will suffice for this as long as its end has been folder over twice. The final solution should be a slightly cloudy liquid of tin(II) citrate.

- Decant the tin(II) citrate solution into a suitable bottle and label it.

Immersion tinning method:

- Pour the required amount of tin(II) citrate solution into a container and add 4.0 grams of thiourea per 100mL of solution. Stirring until it is dissolved.

- Warm the solution up to approx 35°C to 40°C before use.

- In a suitable container, large enough to hold the PCB, pour in the tinning solution. Ensure that there is enough solution to fully submerge the PCB.

Note. It is not required that a huge volume of tinning solution is used, just enough to cover the PCB is usually all that is needed.

- Using a scotch bright pad, clean the copper surfaces of the PCB until shiny. It is important to clean the copper surface thoroughly for a good tin surface. A dull copper will produce a poorly adhered tin with a dull appearance.

- Place the PCB into the tinning solution and within a few seconds the surface will be coated with shiny metallic tin. Leave the board in the solution for about 20 minutes, intermittently agitating it so that no air bubbles get trapped inside the holes. The solution is not autocatalytic, therefore, it will never build up a layer of tin more than a few atoms thick, so once the board is fully covered in tin it can be removed.

- Rinse the board in cold tap water.

- If the deposited tin is a little dull, it can be brightened with rubbing lightly with a soft cloth.

- Pour the tinning solution into a separate bottle and label it appropriately.

Note. The tin plating solution can be used for several boards and should have a shelf life of a few weeks. Once it is depleted, make a new batch by adding thiourea to the tin(II) citrate solution. 500mL should suffice for many boards and the tin(II) citrate has a shelf life of years, as long as it is kept out of bright light and not exposed to extremes in temperature.