

Here's a **detailed explanation** of how to etch a **PCB using hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), citric acid, and salt**, including **chemistry, materials, mixing, temperature, and safety**.

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## OVERVIEW: Why This Etchant Works

This etchant relies on:

- **Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>)** – a mild oxidizer
- **Citric Acid** – a weak organic acid that helps dissolve copper ions
- **Salt (NaCl)** – boosts conductivity and helps generate reactive chlorine species

Together, they:

- **Oxidize copper metal (Cu)** from the PCB
  - **Dissolve it into solution** as Cu<sup>2+</sup> ions
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## MATERIALS NEEDED

Item	Quantity	Notes
Hydrogen Peroxide	100 ml (3% pharmacy grade)	Oxidizing agent
Citric Acid	1 tsp (~5g)	Food-grade or lab-grade
Salt (NaCl)	½ to 1 tsp	Table salt, non-iodized preferred
Plastic or Glass Container	1	No metal!
Warm Water Bath	Optional (40–50°C)	For faster etching
Tongs/Gloves/Goggles	Required	Safety gear
Copper-Clad PCB	Your blank PCB board	Cleaned before use

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## MIXING INSTRUCTIONS

1. **In your plastic/glass container:**
    - Add **100 ml hydrogen peroxide (3%)**
    - Stir in **1 tsp citric acid**
    - Add **½ tsp of salt** and stir well
    - Optional: Slightly warm the solution to **40–50°C** in a hot water bath (NOT over flame!)
  2. **Check pH** (optional but ideal): Should be slightly acidic (~pH 2–4)
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## PREP THE PCB

1. Cut your copper-clad board to size.
  2. Clean it with:
    - o Fine steel wool or abrasive pad
    - o Acetone or isopropyl alcohol
  3. Apply your **etch-resistant mask**:
    - o **Toner transfer, permanent marker, or photoresist film**
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## ETCHING PROCESS

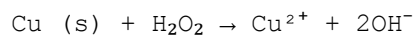
1. Place your masked PCB **copper side up** in the solution.
  2. Gently swirl the container or use a soft brush occasionally.
  3. You'll see **bubbles and the copper slowly disappearing**.
  4. **Etch time** depends on temp and agitation:
    - o ~**10–20 minutes** at 50°C
    - o ~**30–60 minutes** at room temperature
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## WHAT'S HAPPENING CHEMICALLY?

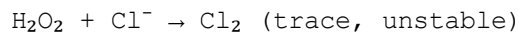
### Oxidation of Copper:

Hydrogen peroxide oxidizes copper metal:



Citric acid helps keep the  $\text{Cu}^{2+}$  ions dissolved in solution by forming **copper citrate** complexes.

Salt (NaCl) may generate **trace amounts of chlorine**, boosting oxidation slightly:



## AFTER ETCHING

1. Remove the PCB with plastic tweezers or tongs.
2. Rinse thoroughly under running water.
3. Scrub off the resist with acetone or alcohol.
4. Neutralize the used solution with **baking soda** (slowly sprinkle until fizzing stops).
5. Dispose of it **according to local regulations** (it contains copper ions).



## SAFETY TIPS

- Always wear **gloves and safety goggles**
- Perform in a **well-ventilated area**
- Never mix with bleach or acids like HCl (produces chlorine gas)
- Do **not use metal containers**



## PRO TIPS

- Heating to **45–50°C** cuts etch time in half
- Stirring speeds up the etch
- You can re-use the solution 1–2 times, but it gets weaker
- Store in **dark bottles** if saving for short-term reuse (label clearly)

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Would you like a **PDF version** or printable **step-by-step guide with diagrams**?