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## 1 Purpose

This SOP describes how to use the Rodgers RLE Lab electroplating apparatus for copper plating.

## 2 Safety

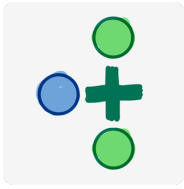
This process must be conducted with the electro cleaner and acid copper plating solutions in a fume hood. The operator must wear nitrile gloves or other gloves suited to resist highly acidic or basic solutions. The operator must wear safety glasses. The operator must wear long pants and closed-toed shoes. It is recommended that the operator wear vinyl or polyester chemical protective sleeves.

## 3 Parts and Materials

- 3.1 Two WEP DC Power Supplies
- 3.2 Two Lab Fish heater/stirrer units (w/ two magnetic stir bars if desired)
- 3.3 Six 1 L glass beakers
- 3.4 Two stainless steel strips
- 3.5 Two sets of alligator clip power supply leads
- 3.6 Electro-cleaning solution (under-hood storage)
- 3.7 Hydrochloric acid, 30% (if desired) (under-hood storage)
- 3.8 Krohn Acid Copper Electrolytic Plating Solution (under-hood storage)
- 3.9 Distilled water (large 5-gallon bucket and/or 1 gallon jugs)
- 3.10 Copper wire (under-hood storage)
- 3.11 Part(s) to be plated

## 4 Tools

In the Rodgers sanding and polishing drawer there is a variety of coarse, fine and very fine sandpaper, as well as polishing pads, if desired. In the lapping drawer there is a lapping plate and some 4 um garnet lapping paste, if desired.



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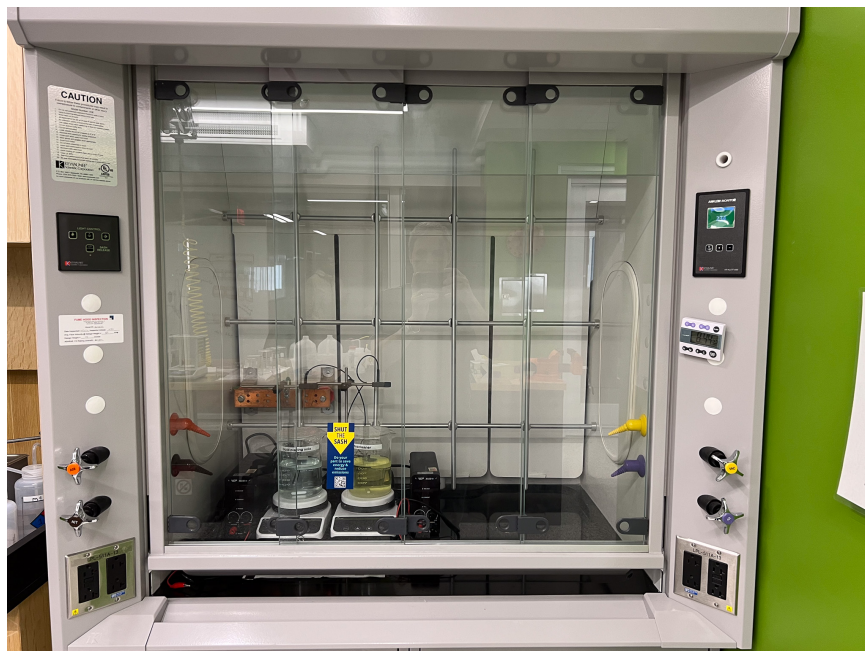
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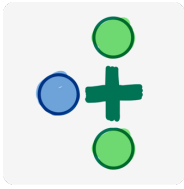
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## 5 Summary

- 5.1 Turn on heat/stir plates to warm up solutions
- 5.2 Polish and pre-clean your part
- 5.3 Electro-clean your part
- 5.4 Acid wash your part if desired
- 5.5 Plate your part
- 5.6 Rinse and nitrogen blow-dry your part



**Figure 1: The Rodgers RLE Lab chemical hood.**



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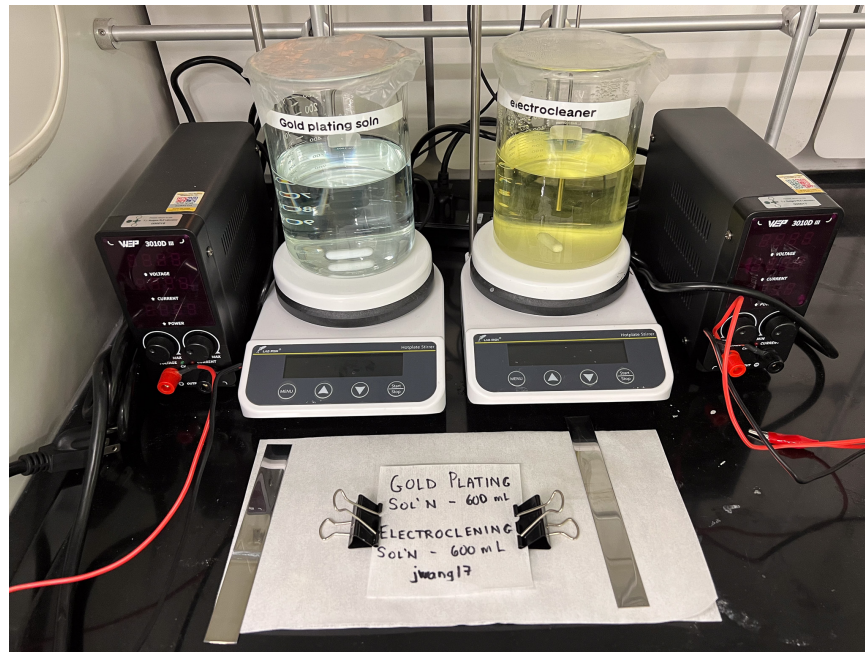


Figure 2: The electroplating setup. The gold plating solution would be replaced with the Krohn copper plating solution.



Figure 3: Source bottles for extra electro-cleaner and copper plating solution.

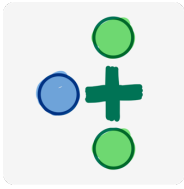
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## Protocol

- 5.7 Locate all necessary materials
- 5.8 Turn on stirring hot plates (switch is at front right)
  - 5.8.1 Electro-cleaner set to 50 C and 50-200 rpm
  - 5.8.2 Copper plating solution set to 25 C and 50-200 rpm
    - 5.8.2.1 Can be done at room temp. Setting of 25 C should yield a repeatable plating rate.
- 5.9 Sand and polish your parts, if desired, to remove excess dirt and oxidation, as well as to provide a smooth surface for electroplating
- 5.10 Clean your parts with Alconox detergent to remove residual polish debris
  - 5.10.1 If you did not polish or sand your part, you might be able to skip this step
- 5.11 Clean your parts in IPA
  - 5.11.1 Sonicate parts in IPA for 1 min
  - 5.11.2 Rinse in fresh IPA
  - 5.11.3 DI water rinse using 3 beakers
- 5.12 If repeating for many parts, after 2-3 parts refresh your rinse beakers
  - 5.12.1 Empty the first bath
  - 5.12.2 Pour the second bath into the first
  - 5.12.3 Pour the third into the second
  - 5.12.4 Refill the third bath
- 5.13 Electro-clean
  - 5.13.1 Attach stainless steel electrode to the positive power supply terminal, place inside cleaning beaker by hanging on the beaker rim
  - 5.13.2 Attach your part to, or hang it, on wire (preferably copper) and attach the wire to the negative terminal
  - 5.13.3 Either be ready to dip your part into the electro-cleaner for the desired time or (preferred) find a way to hang the part so that it is fully-submerged
  - 5.13.4 Set timer for desired time (1 minute default) and either turn on the power supply for that amount of time, or dip the part if you are not hanging it
  - 5.13.5 If the power supply voltage is less than 5 V, increase the current limit of the power supply (the knob on the right) so that the full 5 V is attained.
    - 5.13.5.1 Note, keep an eye on the voltage during plating because the plating current requirement may increase over time. Increase the current limit accordingly.
- 5.14 DI water rinse using 3 beakers



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5.15 Clean off any remaining electro-cleaner

5.15.1 Dip part in 30% HCl

5.15.2 15 seconds should be enough

5.15.3 Move the sample around while in the acid

5.16 Rinse in DI water using 3 beakers

5.17 Plate

5.17.1 Attach stainless steel electrode to the positive power supply terminal, place inside plating beaker by hanging on the beaker rim

5.17.2 Attach your part to, or hang it, on wire (preferably copper) and attach the wire to the negative terminal

5.17.3 Either be ready to dip your part into the plating solution for the desired time or (preferred) find a way to hang the part so that it is fully-submerged

5.17.3.1 Set power supply voltage between 3 and 6 volts.

5.17.3.2 Copper plating requires 0.07 - 0.2 amps per square inch of part surface area

5.17.3.3 Resultant plating rate could be 25 - 50 um per hour

5.17.3.4 Rate depends on many factors such as the size of your plate, size of the counter electrode, plating solution concentration and current limit set on the power supply

5.17.3.5 Experiment beforehand and consult with Dr. Nagle.

5.17.4 If the actual power supply voltage is less than your setpoint, increase the current limit of the power supply (the knob on the right) so that the desired voltage is attained.

5.17.4.1 Note, keep an eye on the voltage during plating because the plating current requirement may increase over time. Increase the current limit accordingly.

5.17.5 Set timer for desired time (20 minute default for ½ oz copper, i.e., 18 um) and either turn on the power supply for that amount of time, or dip the part if you are not hanging it

5.18 Rinse in DI water using 3 beakers

5.19 Rinse in IPA

5.19.1 Blow off with nitrogen or allow to air dry

## 6 Inspection

Check your part and the quality of the film under one of the stereo-microscopes. If the quality is not great, it is likely that you need to refine the polishing and cleaning steps 5.9 through 5.11.

## 7 Revision History

<i>Document Number</i>	<i>Rev</i>	<i>Change comments</i>	<i>Reviser</i>	<i>Date</i>
SOP-0002	v1.0	Initial release	S. Nagle	2023.11.22
	v1.1	Added notes about current limit on the power supplies. Sections 5.13.5 and 5.17.4.	S. Nagle	2024.02.21