

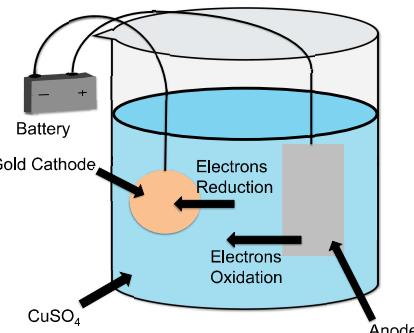
# Developing Electroplating Technique for Soft Lithography

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## Introduction & Background

Electroplating is a deposition technique that coats a metal object with a thin layer of another metal using electric current and a metal solution.



### Advantages:

- Electroplating is a fast deposition technique; it can deposit 500 nm/min
- It has better durability
- Enhances conductivity
- Ensures an excellent adhesion between the plated layer and the substrate

Typically, soft lithography molds are fabricated using a polymer photoresist called SU-8; however, this material can peel off. With copper electroplating, we aim to produce more durable molds for creating microfluidic devices.

## Fabrication of Microfluidics Devices

### Soft Lithography with SU-8

Silicon  
1  
2  
3  
4  
5

Photoresist  
Silicon  
1  
2  
3  
4  
5

PDMS  
Silicon  
1  
2  
3  
4  
5

PDMS  
1  
2  
3  
4  
5

PDMS  
Glass slide  
1  
2  
3  
4  
5

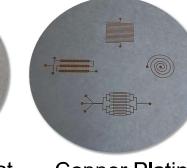
### Soft Lithography with Electroplating

(Electroplating)  
Silicon  
1  
2  
3  
4  
5

Gold  
Chromium  
Silicon  
1  
2  
3  
4  
5

Photoresist  
Copper  
Gold  
Chromium  
Silicon  
1  
2  
3  
4  
5

Copper  
Gold  
Chromium  
Silicon  
1  
2  
3  
4  
5



SU-8 Photoresist      Copper Plating

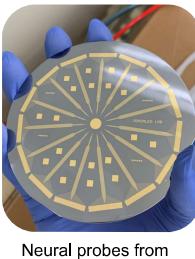
Although the copper plating process for microfluidics devices takes longer, it is expected to be more durable, making it a better long-term choice compared to SU-8.

## Applications

Electroplating can be used for the creation of microfluidic devices.



It can also be used in industry for electrodes as well as in neuroscience research for the production of neural probes for long-term real-time monitoring of brain activity in animals. The use of electroplating in the fabrication of probes enhances neural signal recording performance, as well as allowing for a more simplified process that makes the device much easier to mass produce than conventional devices.

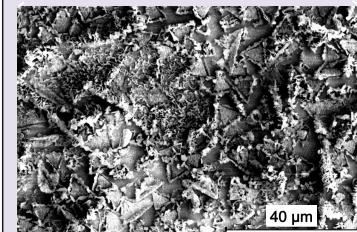


This kind of research has enabled electrophysiological studies for exploring the connectivity in brain regions and is central to developing treatments for neurological disorders such as Alzheimer's disease, epilepsy, and Parkinson's disease.

## Electroplating Results

Sample copper plated with old solution. A very rough surface is observed, which is assumed to be related to the high percentage of Cl on the surface.

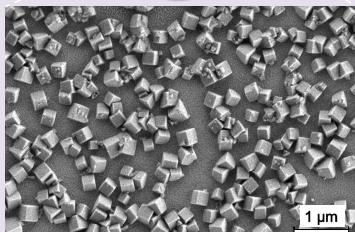
- 10 nm Cr
- 25 nm Au
- 5 min Cu plating
- Old Solution
- HCl Wetting



Atomic %, chemical mapping by SEM-EDS.  
Chlorine  
10 μm

A new solution was made for this sample to discard Cl contamination. A rough surface is still observed along with a decrease in Cl.

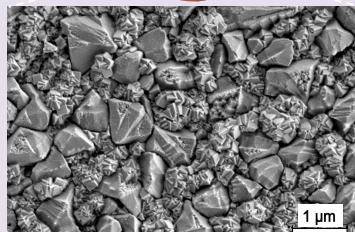
- 15 nm Cr
- 30 nm Au
- 5 min Cu plating
- New Solution
- HCl Wetting



Atomic %, chemical mapping by SEM-EDS.  
Chlorine  
10 μm

Electroplating of Cu on Cu without wetting solution. A more even surface is observed along with a better copper coverage. A different electroplated sample with wetting solution resulted in poor adhesion.

- 100 nm Cu
- 5 min Cu plating
- New Solution
- Different conductive layer



Atomic %, chemical mapping by SEM-EDS.  
Chlorine  
10 μm

## Future Directions

The next goal of the project is to optimize the copper electroplating process by reducing the percentage of Cl on the surface and to investigate gold electroplating protocols to finalize and share the Vanderbilt Operation of Procedures (VOPs) with the VINSE community. Future directions also include assessing the durability of soft lithography molds on copper-plated surfaces and exploring interdisciplinary collaboration with the biomedical field to fabricate neural probes using electroplating techniques.

## Acknowledgments

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