TECH TALK

E-etching Copper and Silver with Copper Nitrate

BY BEN DORY

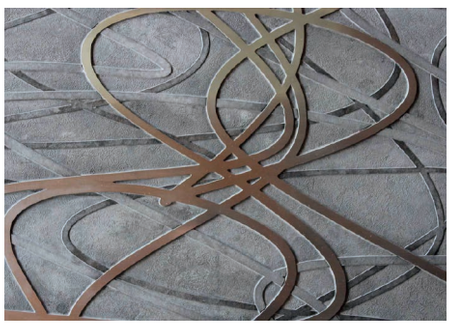
FOR MOST PEOPLE, the term *electrolysis* only appears in science textbooks and classrooms, although we also encounter the term *electrolytes* in advertisements for energy and recovery drinks. What does electrolysis have to offer metalsmiths? Through a process called e-etching, we can use electrolysis to etch copper and its alloys, as well as sterling silver.

This update of my 2015 SNAGtech article is an introductory guide for bringing e-etching into the classroom and studio. It also includes some new possibilities for using e-etching techniques, demonstrated through the work of artists Marissa Saneholtz and Bryan Parnham. Their daily practices exemplify two particular instances in which this process thrives, respectively: etching for champlevé enamel and silver etching.

Copper nitrate in solution is a particularly unique and effective option for metalsmiths. This piece is intended to be a useful general resource to create more process alternatives for metalsmithing studios. Our position on studio and environmental safety is reflected through how we approach chemical-heavy processes like etching. E-etching with copper nitrate is more efficient, safer, and cleaner than traditional methods.

E-ETCHING: THE PROS AND CONS

My aim has been to create a home studio in which there is no place for caustic acids or salts. Likewise, while teaching, cleanliness, safety, cost, and volume are always considerations. Etching with copper nitrate creates a way to eliminate acid, with the added bonus of etching both copper and sterling. This discovery comes from much experimentation with other solutions. Ferric chloride and ferric nitrate are slow, taking patience and babysitting to reach the desired etching depth. Nitric was always out of the question; the benefits and even the limits of other methods far outweigh the precautions and safety measures needed to use and dispose of this acid responsibly. E-etching with copper sulfate is slow, and an acceptable depth is hard to reach. E-etching with salt water, while successful when moving between copper and steel, creates erratic results, and bath chemistry changes quickly, as chlorine ions combine into new compounds. For all e-etching, the surface can appear microcrystalline with the best results, like fine sandblasting. Edges do not undercut, as with acid. Rather, they fillet slightly where the horizontal and vertical walls join.



Alfonso Crujera
Gpplh 13, 2003
Zinc printing plate created using e-etching
19 3/4 × 19 3/4"
Photo: Luvier Casali

FINDING A SOLUTION THROUGH PRINTS

The cross-disciplinary nature of etching means that metalsmiths can draw from a wide variety of sources, especially printmaking, for inspiration in aesthetics, technique, and studio practice. Inquiries by printmakers over the past decades have led to the rediscovery of e-etching in the studio environment. Comprehensive guides written by these printmakers, both in print and online, are an invaluable resource for e-etching. When I began to think seriously about e-etching after working with Arthur Hash at the Penland School of Crafts, I found further inspiration from Alfonso Crujera, a printmaker in the Canary Islands. He champions copper sulfate for e-etching to prepare plates for intaglio, aquatint, and numerous other processes, as exemplified in his *Electro-Etching Handbook*. This book was my first exposure to a process that did not off-gas or need to be refreshed.

53925IMPO.(PDF_D_2017) Text.indd 28 4/25/18 3:07 PM

Bryan Parnham
New Structure Necklace, 2016
silver and industrial primer
12 × 6"
Photo: Bryan Parnham

HELPFUL TERMS:

Electrolyte: A solution that contains ions, which can be either positively or negatively charged particles.

Electrolysis: A chemical reaction caused by passing an electric current through an electrolyte. This usually causes decomposition—or in other terms, etching.

Electrolytic (E)-etching: Forcing an electric current from a DC power source to metal plates in a charged solution to selectively remove surface material.

COPPER NITRATE IS:

Efficient: Only one bath needs to be made. Solutions can be taken from a larger bath as needed and returned when etching is complete.

Self-perpetuating: The end result of etching is more copper nitrate. Newly available copper ions bond with the nitrate to start the reaction anew.

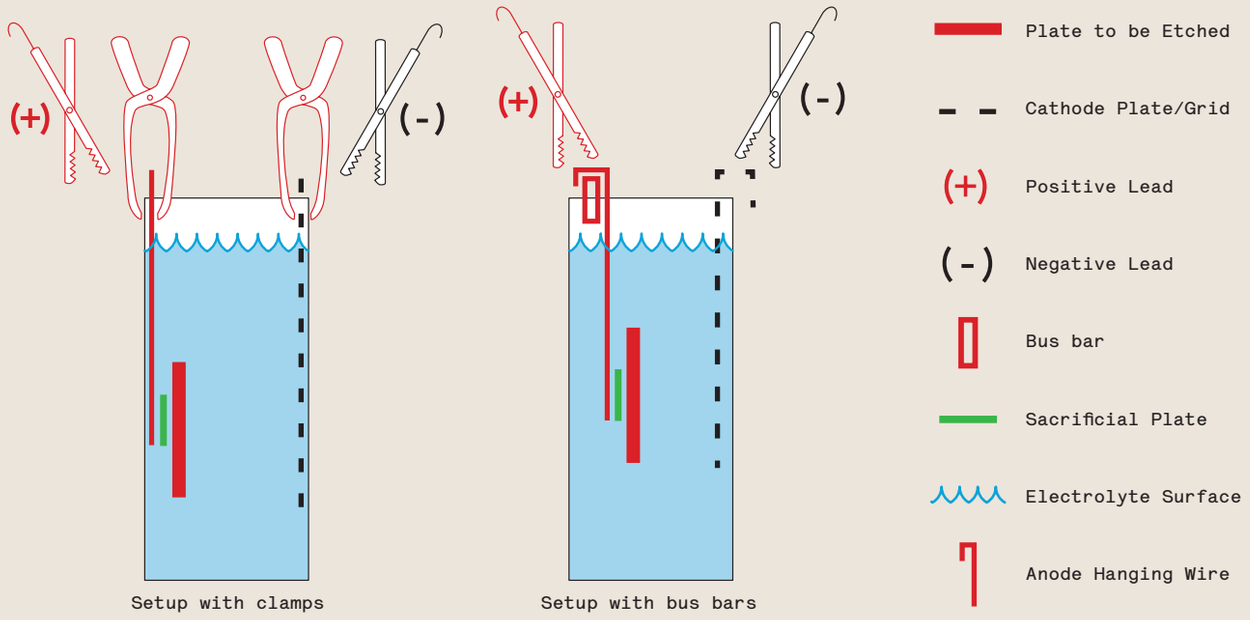
Consistent: The amperage raises to a steady current, which results in an even etch. Likewise, the results are replicable with the same bath over time.

Safe: There is no off-gassing; disposal is only necessary when the bath is not useful anymore, and the solution may be safely stored.

Easy: The only upkeep is to maintain the water level if it evaporates.

53925IMPO.(PDF_D_2017) Text.indd 29 4/25/18 3:07 PM

Setting Up Your E-Etching Bath



E-etching with copper sulfate has replaced traditional techniques in many studios around the world in which health and safety are a priority. Printmakers' techniques in setup and preparation, even though they aim for different results, are invaluable resources. But again, the end goals of etching for metalsmiths is often very different that those of printmakers. R.L Jackson's article "Relief Electro-Etching for Champlevé Enameling" published by the Guild of Enamellers (http://www.guildofenamellers.org) led me to copper nitrate, which has become my sole etching solution for copper and silver.

BUYING COPPER NITRATE

When looking to purchase copper nitrate for your studio, consider The Science Company (www.sciencecompany.com) as a reliable source. Cupric nitrate is sold from 100g to 2.5kg. Cheaper—but non-credentialed—options are available on eBay. The specific chemical that they sell is cupric nitrate trihydrate.

MIXING SOLUTIONS

Wear gloves, eye protection, and a mask when working with the copper nitrate crystals. This is a precaution; the crystals are not a fine dust and do not release caustic fumes. Since 1 ml of distilled water equals 1 g, mixing solutions by mass can be quite simple. A 25% solution of copper nitrate in water provides great etching results. To mix this, begin by zeroing a metric scale with your chosen container on top. Add water until the mass matches the volume that you want, and set to the side. In a separate container, measure out the copper nitrate to a mass that is 1/4 of the water mass, then add copper nitrate to the water. Always add your chemicals to water—not vice versa, to avoid a potential undesirable reaction—and stir until the crystals have dissolved.

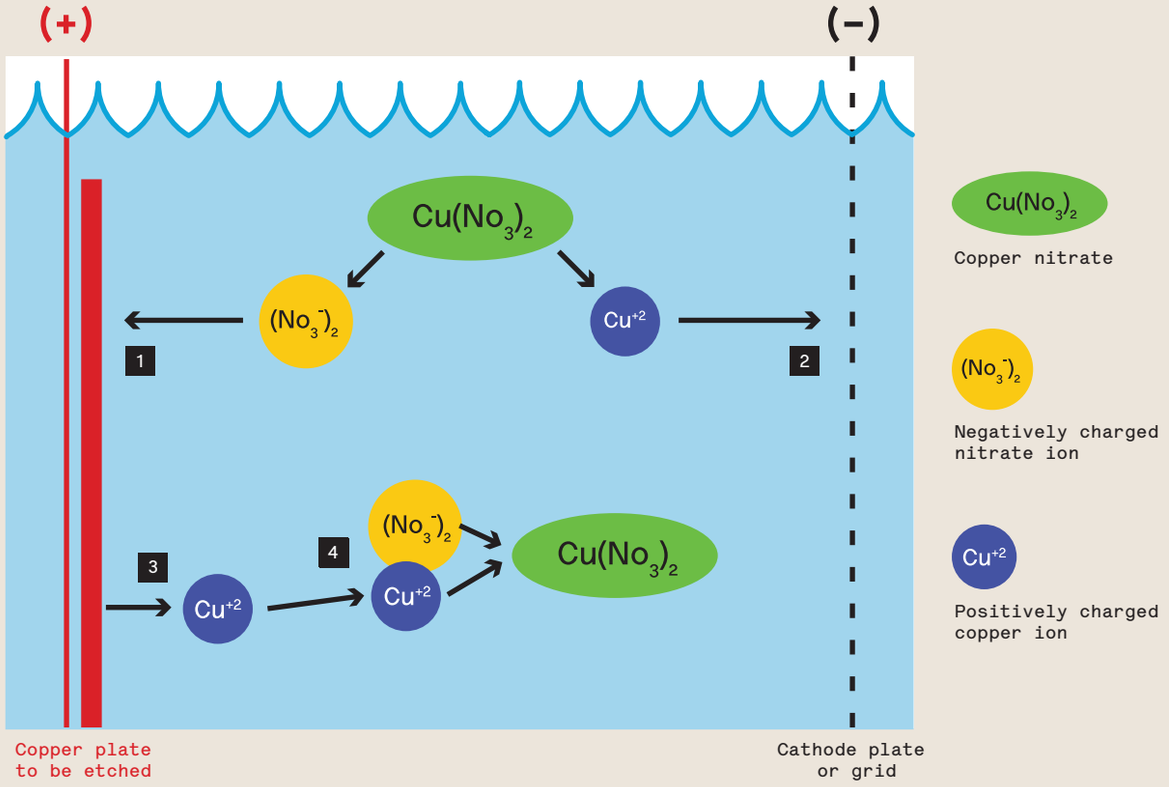
MATERIALS AND SUPPLIES

- DC power source: This can be a plating rectifier (3A will be plenty for the vast majority of projects). A DC wall plug with wires stripped at the end is cheap and useful if you are etching small pieces (the amperage rating is not high enough for larger pieces).
- Copper nitrate: This only needs to be purchased once, and 500g should run about $30.
- Positive and negative leads with alligator clips: Traditionally the positive lead is red, and the negative, black.
- Plastic or glass container large enough to submerge your piece, with room for a cathode sheet.
- Cathode: These should be copper, silver, or stainless steel sheet or mesh, and approximately half to the same size as the surface area to be etched. You should match copper to copper and silver to silver, but stainless works for both.
- Extra metal: This is to connect the leads to your plates. Think of these as consumables, as they may etch along with your work.
- Copper or silver anode: This is the plate you will etch.
- Materials or tools for suspending your plates, like clamps or bus bars.
- Distilled water
- Etching resists: Vinyl, BioLac, Lascaux acrylic resist, tape, spray paint, paint pen, waxes, oil-based crayons, and other materials will all work well.
- Steel wool or steel scraps in water for converting copper ions.
- Washing soda/soda ash or baking soda for neutralizing
- An N95 particulate mask (at least)
- Nitrile/latex/rubber gloves

Your bath does not need to be complicated. Make sure your container has vertical walls. For an even, consistent etch, it is essential that your plates are parallel to each other. Sometimes you will have to back your plates to get them to hang vertically in curved containers or from bus bars. The best results come when the plates are two to four inches apart. Double-check your leads to ensure that the plate you want to etch (anode) is attached

53925IMPO.(PDF_D_2017) Text.indd 30 4/25/18 3:07 PM

The Chemistry



The process begins with copper nitrate $Cu(No_3)_2$ in solution with H_2O

When a current runs through each lead:

The charge at each electrode separates the $Cu(No_3)_2$ into oppositely charged ions

1. $(No_3^-)_2$ is attracted to the positively charged exposed areas of the copper plate
2. Cu^{+2} is attracted to the negatively charged cathode grid, plating the surface
3. $(No_3^-)_2$ oxidizes the exposed copper, releasing Cu^{+2} from the plate and into the solution
4. Cu^{+2} bonds with the free $(No_3^-)_2$ creating new $Cu(No_3)_2$

The process repeats as long as a current is present.

53925IMPO.(PDF_D_2017) Text.indd 31 4/25/18 3:07 PM

to the positive line. Use a sacrificial plate to connect the anode wire to your work to help prevent etching the back of the plate.

ETCHING

A few easy habits will help ensure etching success. Turn the power on or off before you handle the plates. Slow down and lower the voltage to improve the quality of the etch. Corners will stay sharper and etched surfaces will be more refined. If the voltage is too high, you will start to see bubbles at the surface of your solution. This is *hydrolysis,* or the separation of water molecules. You want the electricity to focus on your copper nitrate solution. Record the volume of solution, percent solution, voltage, resist and distance of your plates. Your results are replicable—good and bad!

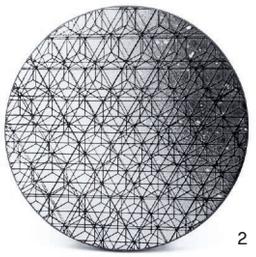
FROM THE FIELD

Marissa Saneholtz implements e-etching with copper nitrate for both her personal work in champlevé enamel and while teaching at Bowling Green State University. Traditionally, you need to etch halfway through the copper for the enamels to hold, and Saneholtz does this to great success. Familiar masking techniques such as nail polish and PnP work well with this process. Saneholtz has used a 25% solution steadily for two years, with her rectifier between 4 and 4.5 volts.

Bryan Parnham has implemented copper nitrate for etching sterling silver. He utilizes PnP and Puretch to create refined geometric patterns in metal surfaces. Additionally, Parnham experiments with photo transfer processes. When etching silver, metal solids will accumulate in your bath. These will settle to the bottom and not interfere with further etching. Conversely, they can be removed and stored. Parnham refines the silver solids with Hauser & Miller, which will take your scraps and sweeps and refine them for a check, credit, or traded for new metal with a discount (http://www.hauserandmiller.com/refine/). In his process, 3x6-inch sterling plates are etched for roughly forty-five minutes, adjusted for more or less exposed metal. Parnham sets his rectifier to 3 volts in a 25% solution. His bath has been used continuously for more than two years.

Ben Dory is a studio jeweler in Savannah, Georgia and the lead technician in the rapid prototyping lab at the Savannah College of Art and Design.

1



2

5

3

4

1
Bryan Parnham
Daniel Tryptich, 2016
copper, silver,
industrial primer, photo
2 1/2 × 2 1/2" (each panel)
Photo: Mercedes Jelinek

2
Bryan Parnham
New Structure Brooch, 2017
silver and industrial primer
3 × 3"
Photo: Bryan Parnham

3
Marissa Saneholz
The traditions were hers to change, 2017
copper, enamel, decal,
sterling silver, pearls,
silk, stainless steel
3 × 1 1/2 × 3/8"
Photo: Sara Brown

4
Marissa Saneholz
She could only ignore it for so long, 2015
copper, enamel, found
object, sterling silver,
stainless steel
2 1/4 × 2 1/2 × 1/4"
Photo: Sara Brown

5
Marissa Saneholz
The hits just keep coming, 2016
copper, enamel, pearls,
sterling silver,
stainless steel
2 × 3 1/3 × 1/4"
Photo: Sara Brown

53925IMPO.(PDF_D_2017) Text.indd 32 4/25/18 3:07 PM

Copyright of Metalsmith is the property of Society of North American Goldsmiths and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.