

## Electrolytic Tungsten Needle Sharpening

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Finely sharpened tungsten needles are essential tools required for the manipulation of small particles (1, 2, 3). They can be purchased commercially from Fine Science Tools at a cost of roughly \$100 for a set of ten needles. Tungsten needles can easily become damaged during routine use, and accidentally bumping the sharpened end of a tungsten needle immediately renders it useless. For laboratories that frequently isolate and manipulate small particles, the costs associated with purchasing tungsten needles from a commercial source can become significant over an extended period of time.

It is also useful for any analyst who frequently handles small particles to have a set of tungsten needles with a variety of shapes and various degrees of sharpening, ranging from fine to coarse (1, 2). Many analysts who handle small particles on a regular basis agree that there is a perfect needle — in terms of size and shape — for every particle. It is the author's experience that using needles of appropriate taper, curvature and fineness for a given particle decreases the time involved in sample preparation and minimizes the risk of losing or damaging the particle. The need for a wide range of needle shapes and fineness, the frequency with which needles get damaged, and the relatively high cost of commercial tungsten needles make it worthwhile to learn how to sharpen your own needles.

There are generally two methods used for sharpening tungsten needles: a chemical method, involving sodium nitrite, and an electrolytic method. Both have been previously described by others (1, 2). It is the

author's personal experience that the chemical method, while effective at sharpening tungsten needles, does not provide large degrees of control over the shape and fineness of the needle produced. The chemical method is also somewhat messy, requiring an open flame and producing a spatter of molten sodium nitrite in the work area. Therefore, the electrolytic method is preferred.

This method involves an electrochemical reaction between the tungsten wire and a piece of platinum wire immersed in a solution of potassium hydroxide. However, there are few detailed literature descriptions of how to sharpen tungsten needles using the electrolytic method, although there is a brief description in *The Particle Atlas* (1). This article provides a detailed description of one version of the electrolytic sharpening method, which will enable the reader to reproduce the setup in their own lab.

### SETUP FOR ELECTROLYTIC SHARPENING OF TUNGSTEN NEEDLES

McCrone Research Institute (McRI) has a setup for electrolytic sharpening of tungsten needles that the author has determined to be highly effective. This setup was duplicated so that the author's laboratory would have in-house capabilities to sharpen needles. All of the credit for the method belongs to McRI; the sole contribution of the author is to describe and document the setup.

The setup requires a variable transformer, as the ideal voltage for electrolytic sharpening is between 10V

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Figure 1. Variable transformer for electrolytic sharpening method.



Figure 2. Power cord cut from discarded electrical appliance.



Figure 3. The cut end of the power cord shown after splitting (left) and with alligator clips soldered to the wires (right).

and 20V (Figure 1).

The voltage needs to be applied across the tungsten needle and the platinum wire. In order to accomplish this, the power cord from a broken or discarded electrical appliance is cut off (Figure 2) and alligator clips are attached to the cut end of the cord. The alligator clips are attached by splitting the ends of the power cord, stripping the insulation with a wire stripper, and soldering the exposed copper wires to the clips (Figure 3).

A support system is required to hold the wires above a potassium hydroxide solution. The support system is composed of a support stand with a metal rod, a three-pronged clamp, and a clamp holder to connect the two (Figure 4).

The split wires from the power cord were taped to

small glass rods roughly 5 inches long with electrical tape. The purpose of the glass rods is to hold the wires in place with some stiffness, so any rigid pole is acceptable. A laboratory jack was purchased to hold the beaker with potassium hydroxide solution, which must be raised and lowered during needle sharpening (Figure 5).

Finally, the components were all connected and arranged in their final configuration. The power cord with attached alligator clips was wrapped around the support system and the glass rods held in place by the three-pronged clamp. The power cord was plugged into the variable transformer, and the voltage set to ~15V. A small beaker containing 1 M potassium hydroxide solution was placed on the laboratory jack, and the



**Figure 4.** The support system assembled to hold the wires for tungsten needle sharpening.

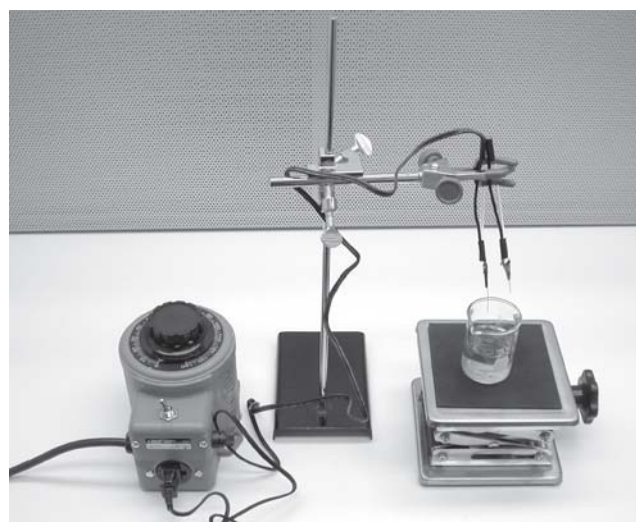
beaker was aligned under the two alligator clips as shown in Figure 6.

A piece of platinum wire (0.5 mm diameter) roughly 3 cm long was placed in one of the alligator clips, and the tungsten wire to be sharpened (also 0.5 mm diameter and 3 cm long) was placed in the second alligator clip. The platinum wire should hang lower than the tungsten wire, so that the platinum enters the solution first and the tungsten wire second.

Finally, the variable transformer is turned on (with a voltage between 10 and 20 V) and the laboratory jack is slowly raised until the platinum wire enters the solution, followed by the tungsten wire. Vigorous bubbling occurs near the tungsten wire when it enters the solution, evidence of the reaction taking place. The laboratory jack can be moved up and down to progressively sharpen the needle. The distance and speed of the laboratory jack movement together de-



**Figure 5.** A laboratory jack used to raise and lower the potassium hydroxide solution.



**Figure 6.** The final setup used for tungsten needle sharpening.

termine the taper of the needle. Needles can be gently bent prior to or during sharpening to introduce curvature as desired.

For added precision, a boom stereomicroscope can be placed in front of the glass beaker and a gooseneck lamp directed at the needle that is being sharpened. This enables the analyst to observe the need directly as it is being sharpened and to monitor its progress. The materials used by the author, including their costs and sources, are listed below in Appendix A. Purchasing used materials can considerably reduce costs, and

there are likely less expensive sources available to the budget-minded shopper.

## REFERENCES

1. McCrone, W.C. and Delly, J.G. *The Particle Atlas, Volume I: Principles and Techniques (Edition Two)*, Ann Arbor Science Publishers: Ann Arbor, MI, 1973.

2. Teetsov, A. "Preparation and Use of Needles and Micropipets for Handling Very Small Particles," *The Microscope*, **47(2)**, pp 63-70, 1999.

3. Teetsov, A. "An Organized Approach to Isolating and Mounting Small Particles for Polarized Light Microscopy," *The Microscope*, **50(4)**, pp 159-168, 2002.

## APPENDIX A. MATERIALS AND COSTS

- The variable transformer used is a Superior Electric Powerstat Model 3PN116C purchased new from Allied Electronics for approximately \$325.85.

- The alligator clips, type 270-380, were purchased from Radio Shack for \$3.07.

- The laboratory jack was purchased from Gorilla Scientific for \$35.85.

- The support system consisted of a support stand with rod (item Z509442), a clamp holder (item Z562491) and a three-prong benchclamp (item Z567574) were all purchased from Sigma-Aldrich for a total of \$95.63.

- Platinum wire can be purchased from Electron Microscopy Sciences for \$295 for a 10 foot roll, enough for an essentially endless supply of platinum wire.

- Tungsten wire can be purchased from Electron Microscopy Sciences for \$38 for a 20 foot roll, enough for approximately 120 tungsten needles.

- The glass beaker is a common laboratory supply, and most laboratories will not need to buy one. They are available from a variety of scientific supply companies, including VWR, Fisher Scientific and Sigma-Aldrich.

- Potassium hydroxide is a common laboratory chemical, and most laboratories will not need to buy it. It is available from a variety of chemical supply companies, including Sigma-Aldrich.

*Product prices are subject to change.*

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## LETTER TO THE EDITOR

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### Microspectrophotometry of Blood

I was pleased to read Larry K. Peterson's forensics article, "Microspectrophotometry (MSP) of Blood – An Update," in *The Microscope* (58:2, pp 81-84, 2010). It brought to mind a few other related papers, which may be of interest to readers:

- Stokes, G.G. "On the Reduction and Oxidation Colouring-matter in Blood," *Proceedings of the Royal Society*, 13, 355-364, 1864. Also cited in Hogg, Jabez, *The Microscope, its History, Construction, and Application*, George Routledge & Sons: New York, p 131, 1883.

- Macrae, Robert A., McClure, Joseph A. and Latimert, Paul. "Spectral Transmission and Scattering Properties of Red Blood Cells," *Journal of the Optical Society of America*, 51(12), pp 1366-1372, 1961.

- De Wael, K., Lepot, L., Gason, F. and Gilbert, B. "In search of blood – Detection of minute particles using spectroscopic methods," *Forensic Science Interna-*

*tional*, 180, pp 37-42, 2008.

G. G. Stokes, MA, was secretary of the Royal Society and Lucasian Professor of Mathematics at the University of Cambridge. Jabez Hogg, MRCS, FRMS, provides modified spectral graphs after Stokes's paper for arterial blood, venous blood, blood treated with acetic acid, and haematin. Hogg was a consulting surgeon to the Royal Westminster Ophthalmic Hospital and late president of the Medical Microscopical Society.

The Macrae paper looks at the spectra from about 350-550 nm and derives a predictive equation for blood spectral curves in terms of cell and layer parameters. In the De Wael paper, they look at IR and Raman Spectra as well as the visible spectrum.

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