Transport Limited Electropolishing of Tungsten Wires

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The purpose of this project was to explore the Transport Limited Electropolishing (TLE) regime of voltages to better understand the mechanism and formation of long, thin needle tips. Past researchers have focused on the Convection Limited Electropolishing (CLE) regime, which occurs at higher voltages and yields a short, sharp tip[1]. However, for electroprinting applications where micrometer-sized drops have to be formed, TLE tips are favored. To accomplish this, a two-probe system consisting of a simple anode (150-micron tungsten wire) and cathode (a larger tungsten wire) was developed. The tips of each wire were submersed in a 2 molar potassium hydroxide solution, with an applied potential differential of 1.3 volts. Optical microscopy and high-speed imaging were employed to study the mechanism of porous film formation around the wire. Meniscus behavior was catalogued, showing the formation of a taper between the submersed and open-air portions of the wire. From these experiments, with the given wire thicknesses, it can be concluded that tip diameters of tens of microns can be achieved with fair accuracy. With a more advanced and automated setup, this procedure has the potential to yield needles of nearly any given thickness required.

References:

1. Kulakov, M.; Luzinov, I.; Kornev, K. G., Capillary and surface effects in the formation of nanosharp tungsten tips by electropolishing. *Langmuir* **2009,** *25* (8), 4462-8.