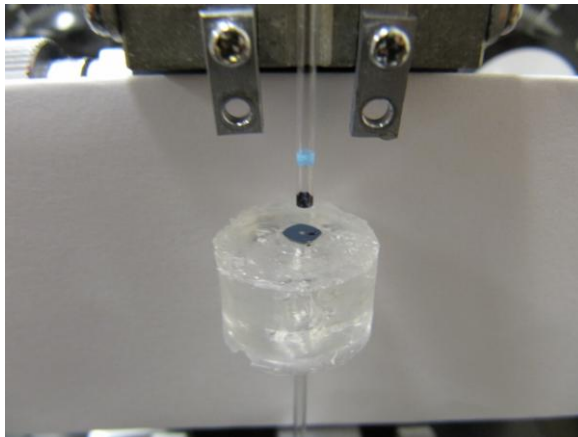


Assembling a TEM Electroosmosis Device

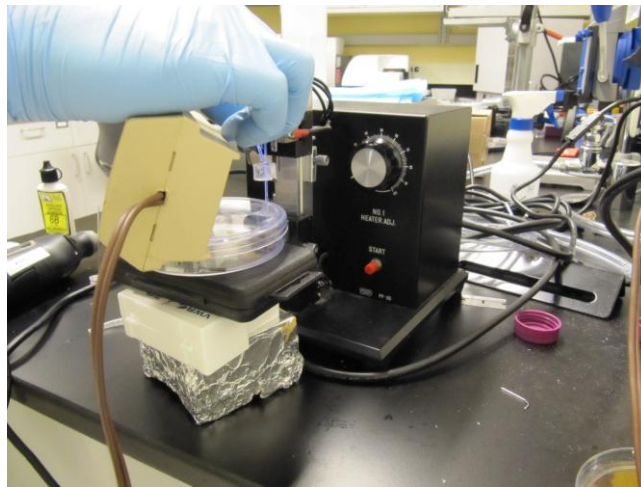
1. Cut out the “cap-end” from a 15mL conical tube:



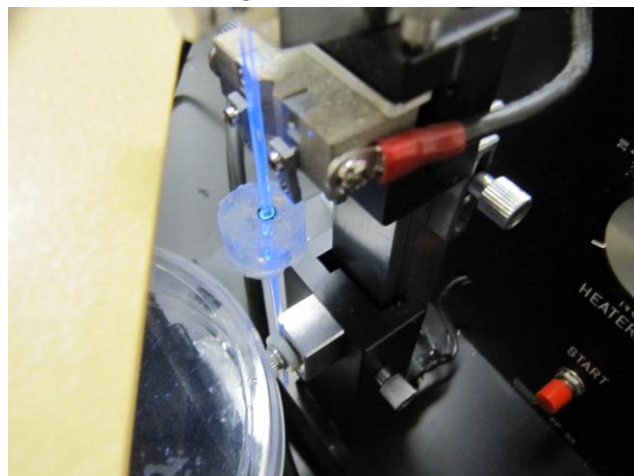
2. Seal the cutout, with the machined side down, onto glass and fill the mold with PDMS 184 (10:1 mixture of substrate and curing agent)
3. Leave the mold in the oven at 200°F for 1-2 hours
4. Upon removing the PDMS piece from the mold, insert a capillary tube through the center about halfway
5. The PDMS piece will act as a cushion for the chip. Put the PDMS/capillary device into the bottom holder of the vertical pipette puller. Place a TEM chip on top, membrane side up. Finally, put a second capillary tube in the top holder of the pipette puller:



6. Lower the top capillary tube onto the chip, making sure that the entire window of the chip is enclosed by the capillary tube. There should be enough pressure on the chip that there is some slight flexing. This is to insure that glue does not leak onto the membrane.
7. Using pulled pipettes, very *slowly* apply a thin layer of Norland Optical Adhesive UV glue (68) around the entire chip/capillary interface. Make sure that during this time the handheld UV light is on. This will cause the glue to start to cure which makes it more viscous, further preventing glue from leaking under the capillary tube.



8. Allow the UV glue to cure under the UV light for at least 10 minutes.

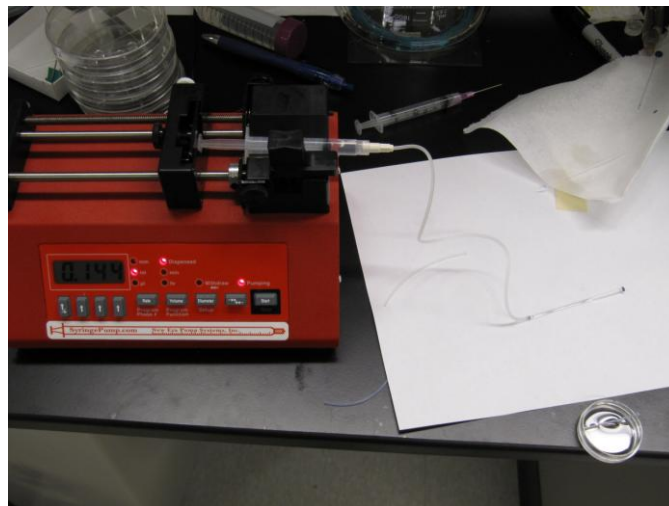


9. After 10 minutes, carefully remove the glued capillary tube with the chip on it. A razor may be required to separate any excess glue that may have leaked onto the PDMS. At this point, examine the TEM chip to make sure that the membrane is still intact.

10. While some steps were taken to prevent glue from leaking onto the membrane, it is still a possibility. Using the syringe pump, begin filling the device with water at a rate between **0.05** and **0.10 mL/min**.

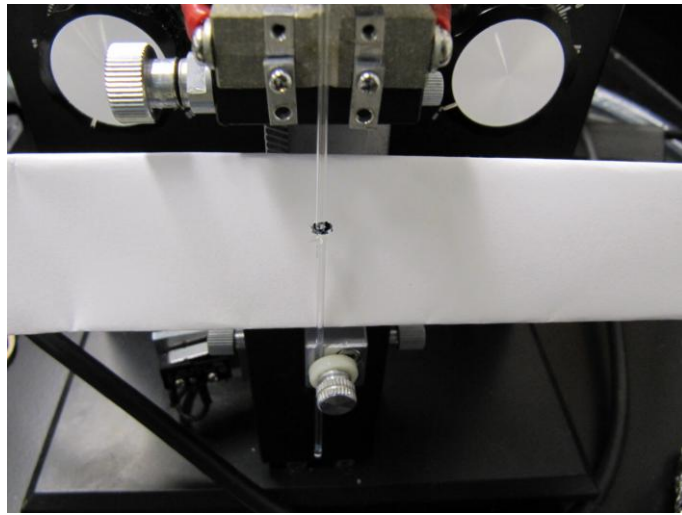


11. Fill the device about 90% of the way. If there was glue on the membrane, it would form an air-tight seal. At some point during this filling, you would hear an audible popping sound and water would shoot out of the chip. If this filling is successful, there should be no glue on the membrane.
12. Pipette **~3 μ L of PVP solution** (0.5mg/mL PVP in ethanol) onto the exposed surface of the chip.
13. Allow ample time for the PVP to dry. If the device is filled or shaken too much while the membrane is still wet, the membrane will most likely break.
14. After the PVP has dried, continue filling the device at a rate of **0.01 mL/min** until some water comes out of the membrane.

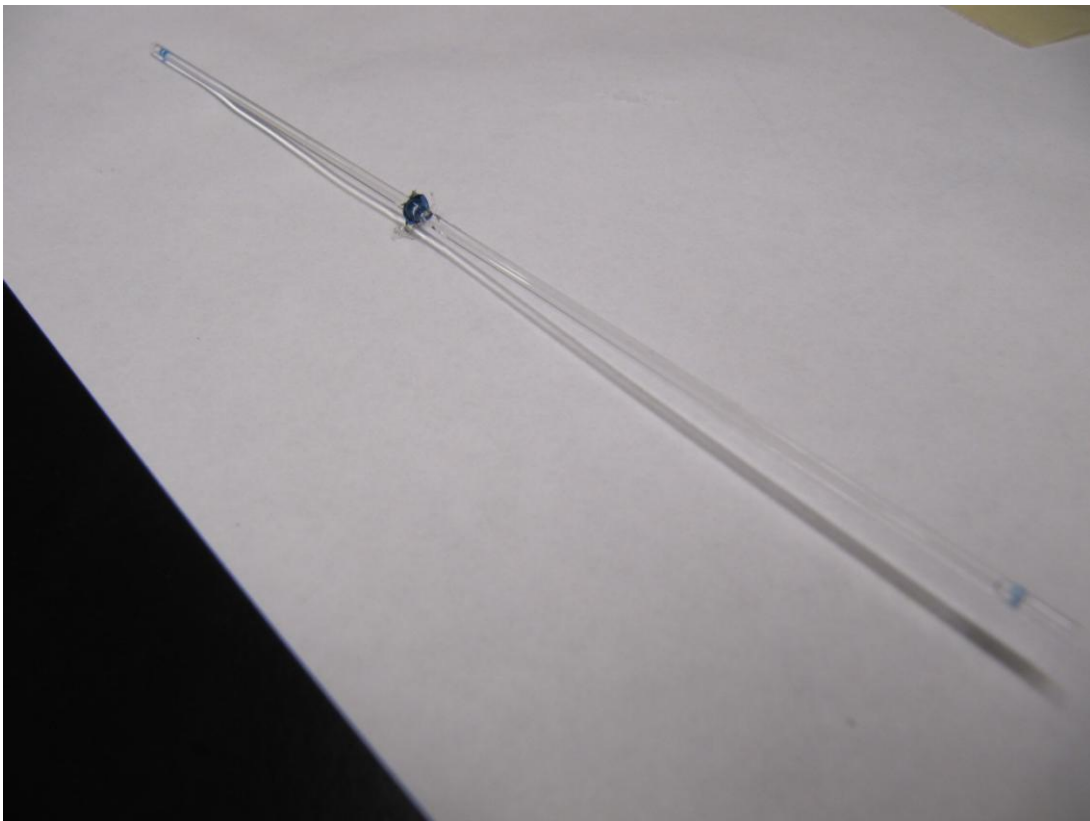


15. To make sure that the membrane is still intact, hold the device vertically, membrane-side down. If water leaks out through the chip, the membrane is broken.

16. Place the device back into the bottom of the pipette puller, chip up. Place another capillary tube in the top of the pipette puller. Lower the pipette onto the chip with some pressure. Follow the same gluing procedure (steps 7-8) to glue the second pipette on.



17. Cut off about half of each pipette to decrease the total volume of the device. Fill both sides with a salt solution (0.1M KCl) using the syringe pump. To prevent air bubbles, fill both capillaries through the same end, passing water through the membrane.



18. You can now insert electrodes in each end and begin electroosmosis.