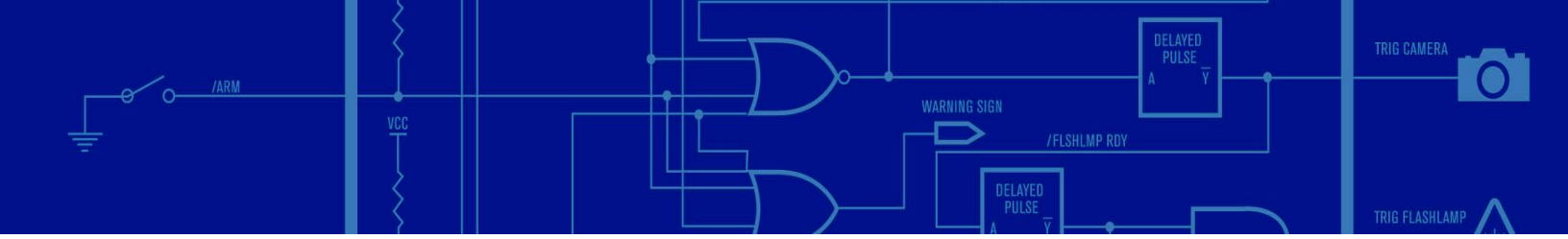

APPLYING VOLTAGE TO A CHANNEL IN A MICROFLUIDIC CHIP

Selecting and Preparing the Electrode

Platinum electrodes are commonly used to apply voltage to a fluidic channel. Although the approach is relatively simple, proper preparation of the electrode is very important to prevent field concentrations in the channels. Field concentrations can cause a multitude of problems, including bubble formation, cell lysing, localized heating, chemical reactions, and clogging of channels

Electrode Selection

Platinum is the standard and preferred material for high-voltage microfluidic electrodes.

Electrode size selection is often a cost vs performance tradeoff. Larger diameter electrodes help reduce the field concentrations. However, proper preparation of the electrode can eliminate most field concentration issues, reducing the need for a large electrode.

The electrodes sold by LabSmith are 23 gauge (0.584 mm dia) pure platinum wire. This size fits into the end of our high voltage cables, and is also stiff enough to be easy to form and retain in the desired shape. If you find that a larger electrode is necessary to eliminate field concentrations, a platinum-plated copper wire can be used to reduce cost. A microclip connector can be used to connect a larger or smaller electrode to the LabSmith high-voltage cables.

Preparing the Electrode

1. Cut a 1-2 cm length of electrode.
2. Twist the end of the electrode so it forms a circle that is approximately the inner diameter of your fluidic well.
3. Wrap the end of the wire back around the stem of the electrode, closing the circle. The end of the wire should be pressed against the stem, facing away from the current direction. *Note: this is very important; a sharp tip pointing in the direction of the current will create field concentration.*
4. Bend the circle so that it is perpendicular to the stem to complete the electrode, **Figure 1**.
5. Attach the electrode stem to a high voltage cable. If using the LabSmith cables, a microclip can be used to hold the electrodes, or a 23 gauge electrode (.584 mm) can be inserted directly in the end of the cable termination, as shown in **Figure 2**.
6. The electrode can now be placed in the fluidic well, with the bottom coil resting on the bottom surface of the well.

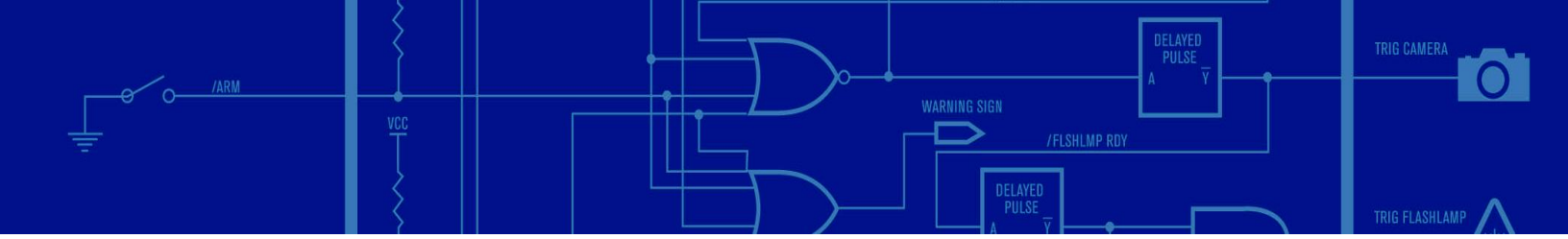

Figure 1. Platinum Electrode.

Figure 2. Platinum electrode inserted in LabSmith HVC high voltage cable termination.

Preparing the fluidic chip for electrodes

The electrode must be immersed in the fluid to transmit the applied voltage to the channel. Several options are available for creating the fluidic well.

Microfluidic chips typically have a ~1 mm open port at the channel termination, or have a built in connector, such as a luer lock, mini-luer or olive. The built in connectors are designed to connect directly to a syringe, tubing, or specialty made reservoir.

Figure 3 below shows an open-port chip, typically called a through-hole chip. The chip has a ~1mm diameter hole in the top plate for accessing the channel. LabSmith bonded port connectors (C360-400) are glued to the chip ports. The bonded port connector can be used to attach capillary tubing for a high-pressure, leak free connection, or, as shown in this case, it can be fitted with a chip reservoir (C360-400R). The electrode is then placed directly into the chip reservoir and the reservoir is filled with liquid.

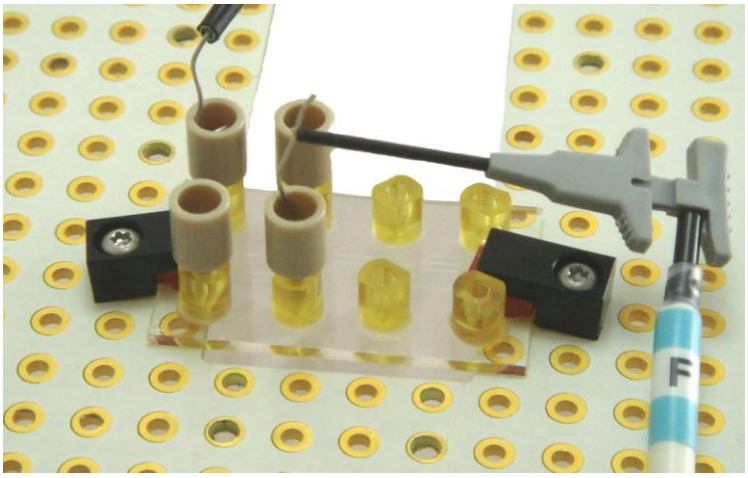

Figure 3. Placement of the electrode in reservoirs on a microfluidic chip using either a direct wire connection and a microclip connector to connect platinum wire electrodes to the high voltage cables plugged into the LabSmith HVS448 eight channel high voltage power supply.