Assembly of the uFluidic Magnetic Cell Counting Device

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A. Description

The goal of this procedure is to form a channel in a block of PDMS with a coil of wire wrapped tightly around it.

B. Materials

- 3D printed mold
- Hot plate
- Scale or Balance
- Scalpel
- Tweezers
- Dissecting Microscope
- Hand Mixer
- Needle Nose Pliers
- Dow Sylgard 184 Silicone Encapsulant (PDMS)
- Optical fibre
- 44 or 46 AWG enameled copper wire
- 50mL Centrifuge Tube
- Electrical Tape

C. Preparation of the optical fibre

1) Suspend the optical fibre horizonatally under the viewing area of the microscope. The optical fibre should be positioned such that there is room above and below it to wrap the copper wire.
2) Cut a piece of copper wire about 40cm long, and tape one end directly below the optical fibre.
3) Using the taped end to provide a small amount of tension, begin wrapping the wire around the optical fibre.
4) Keep wrapping the wire until around 20 turns are on the optical fibre. Tweezers may help to keep the coils neat and bunched tightly.
5) Thread the optical fibre into the mold, by first threading one end, then the other into the holes from the inside of the mold to the outside.
6) Place the mold onto a piece of plastic, foil, or a petri dish to catch any PDMS spills.

D. Preparation of the PDMS

Notes: PDMS is oily and sticky. Do this on a disposable surface such as newspaper and wear gloves.

1) Prepare a 50mL centrifuge tube so it can be held upright on the scale or balance.
2) Weigh out around 10g of PDMS compound 1 (The larger one) into the tube. The exact amount isn't important, but the ratio between the two parts is.
3) Weigh out 1/10 of the amount weighed out in step 2 of the PDMS crosslinker (the small bottle) into the test tube.
4) Mix thoroughly using a stir stick. Don't worry about creating bubbles as they will be removed shortly.

E. De-gassing the PDMS (Vacuum Method)

1) Pour the PDMS mixture into the mold. Make sure to cover the coil and optical fibre.
2) Place the mold into a vacuum chamber, making sure to place something under the mold to catch any leaks.
3) Pull a vacuum on the chamber for 15-30 minutes to remove any bubbles

F. De-gassing the PDMS (Cheap Method)

This method does not work as well as the vacuum pump method as it does not remove any dissolved gasses in the PDMS. It does however do a remarkable job of removing the bubbles introduced by mixing. It also works best with a tube that is about halfway full, as a less full tube makes the mixer vibrate excessively.

1) Seal and weigh the test tube containing the PDMS. It is recommended to do this in a weigh boat to keep the balance clean.
2) Prepare another 50mL test tube and fill it with enough water to weigh approximately as much as the tube of PDMS.
3) Remove both beaters from the hand mixer and set one aside.
4) Securely Tape both test tubes on opposite sides of the other beater. It is recommended to tape both the top and bottom of the test tubes.
5) Insert the beater into the mixer, and turn the mixer on low.
6) If the assembly seems stable, increase the mixer speed to medium-high and spin for 2-3 minutes
7) Stop the mixer and carefully remove the PDMS tube. The tube should contain no bubbles.
8) Very carefully pour the PDMS into the mold. The best way to do this is to hold the tube very close to the surface and pour extremely slowly. Failure to do this will result in bubbles forming in the mold.

G. Curing the PDMS

1) Place the mold on a piece of aluminum foil on top of a hot plate. Glass is not recommended as the PDMS sticks well to glass.

2) If the mold is made from plastic, turn the hot plate on low, and let the PDMS cure for 2-4 hours. Take care not to go very far over the glass transition temperature of the plastic, in our case PLA (60° C).
3) If the mold is made from metal or high temperature plastic (melting point $>150^\circ$C), turn the hot plate to high/150°C and cure for 15 minutes

H. De-Molding

1) Remove the mold from the hot plate. Do not let it cool.
2) Take a pair of needle nose pliers and wrap electrical tape around the jaws
3) Using the wrapped needle nose pliers, carefully grip the glass fibre and slowly pull it through the block of PDMS.
4) If the fibre breaks, use the other end or any remaining fibre to attempt to pull it out. If no more fibre is available to pull on, or the coil is pulled along with the fibre, throw out the PDMS and try again.
5) Let the mold cool.
6) Using a scalpel, carefully cut the PDMS away from the sides of the mold. Take care not to cut or damage the copper wire.
7) Carefully peel the PDMS from the mold, taking care not to tear the gel.