

Protocol

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Fabrication of small apertures (diameter of 10~30um) on 25 um-thick Teflon using the micromanipulator MP-285 and commercial micro tips from Signatone.

Aim:

To fabricate an aperture on the Teflon, which is as small as possible using a micro tip to impale a 25 um-thick Teflon film.

Instrumentation:

The setup consists of a micromanipulator (Shutter Instrument Company MP-285), a microscope (Olympus IX51), a tip holder, a plastic film holder, and a tip. Micro tips are purchased from Signatone, which are 1 um diameter (SE-10T) and 3.5 um diameter (SE-20T).

Instructions:

The following steps take 3.5 um tips as an example. For 1 um tips, just replace 3.5 um tips with 1 um.

1. Take the 3.5 um tip holder, loose the screw, put the 3.5 um tip in the groove, and screw at the middle of the tip.
2. Turn on the micromanipulator, press the "MOVE" button on the panel, and push the "home" button on the Rotary Optical Encoder (ROE) which moves the head stage to the origin.
3. Mount the tip holder onto the head stage of micromanipulator, so that the tip is roughly 1 cm above the stage of microscope.
4. Use the three knobs on ROE to move the head stage for X, Y, and Z.
5. Observe through the eyepiece of the microscope using reflective mode, move the head stage carefully until you see the tip appear in field of view of microscope. Now, you have put the tip at the correct position.
6. Move the Z axis to the highest position.
7. Cut a rectangular Teflon film, whose dimension is 2.8 cm x 2.8 cm x 25 um.
8. Take the plastic film holder, loose the four screws, and put the Teflon film on it. The right-hand edge of Teflon is aligned with the right-hand side two screws, and the four corners are screwed to fix the Teflon film. The screws would drill four holes on Teflon, and it is normal. Try to make the Teflon film flat on the holder.
9. Put the film holder on the stage of the microscope.
10. Observe through the eyepiece of microscope, and make sure the image focuses on the Teflon film.

11. Move the tip approach the Teflon film, but don't touch the Teflon.
12. Push the "Coarse/Fine" button, now it is "Fine" mode.
13. Look into the eyepiece, and then slowly move the tip down to the Teflon film.
When the tip touches the Teflon, you would see a vibration of Teflon. When touching the Teflon, stop the tip going down.
14. Record the position of Z axis; this is the initial position.
15. Slowly move tip down a little bit, and refocus on the tip, it would like a grey spot.
16. Repeat step 15 until seeing a metal-shiny spot appear, which means the Teflon film has been penetrated, and the aperture size is around 10 μm .
17. If you want to make a larger aperture, you may go deeper a little.
18. After penetration, record the position of Z axis, and subtract the initial position and you get the distance going down. Next time, you can use the distance to reproduce the experiment.
19. Move the tip upward until it is 1cm above the Teflon film.
20. Remove the Teflon from the film holder.
21. Measure the aperture size using the microscope in Public Lab.
22. If the aperture is the size you want, trim the right edge of Teflon such that the two holes on the right hand side are removed.
23. Stick the Teflon in the chamber with silicone.