Flow Cell Development Kit

Tangential and transmembrane flow cell assembly

Product Nos. GASKET-CS

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INSTRUCTIONS FOR USE

Provided Kit Materials

- Pre-Cut PDMS Gasket Set (suitable for 10 devices)
- 18Ga ½" Stainless Steel Luer Lock straight Needles (2)
- 18Ga ½" Stainless Steel Luer Lock ninety degree Needles (2)
- #1 22 x 22 mm cover slips (10)

Figure 1 (A) Gasket bag components and (**B**) internal component bags

Required Equipment & Supplies

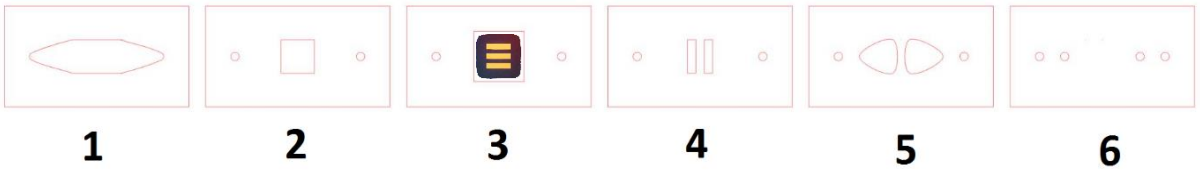
Equipment

- UV Ozone generator or Oxygen Plasma Oven
- Hot Plate or gravity oven

Supplies

- Tweezers suitable for membrane manipulation (SiMPore K6TWZR, or equivalent)
- User-supplied tubing or fluidic interface(s)
- Petri dish, glass slide, or other clean **substrate** on which to assemble devices
- Alcohol wipes or KimWipe saturated with an alcohol solution
- Absolute Alcohol (such as IPA or Ethanol)
- Wetting Media (lab prepared)
- Gloves and other suitable PPE

Gasket Stack Layout



Layer #	Material
1-5	250 µm platinum cured PDMS
6	800 µm platinum cured PDMS
Chip (within layer 3)	300 µm SiN/Si membrane chip

Figure 2. Gasket stack order of assembly

INSTRUCTIONS

Please read all **instructions** before proceeding. Refer to the gasket stack diagram above which details the order of assembly. If unfamiliar with assembling microfluidic devices from PDMS, refer to the Tips & Troubleshooting section for more guidance.

Device Assembly

1. Working on a clean, particle-free work surface, remove the PDMS gaskets and cover slips from the supplied bags.
2. Clean the glass cover slip with an alcohol wipe, allow to air dry, and place on the **substrate.**
3. Using tweezers transfer the lower channel layer (1) to the substrate and transfer to a UV ozone or O2 Plasma source, then surface activate as per tool specifications.

   NOTE: Reference Figure 1 (above) for gasket layer number and order of assembly.
4. Carefully transfer the now surface activated Lower Channel Layer (1) to the cover slip, aligning the two to ensure an even fit.
5. Repeat the above process (steps 3 - 4) for adhering the Membrane Interface Layer (2) onto the Lower Channel Layer (1).
6. Continue the layer addition process as above to secure the Membrane Housing Layer (3) to the Interface Layer (2)
7. Retrieve a 5.4 mm x 5.4 mm SiMPore membrane chip and surface activate the lower assembled layers and chip as before

   NOTE: When manipulating the membrane chips, ensure the membrane-side of the chip remains **up** at all times to prevent membrane damage. Reference Figure 3 below.

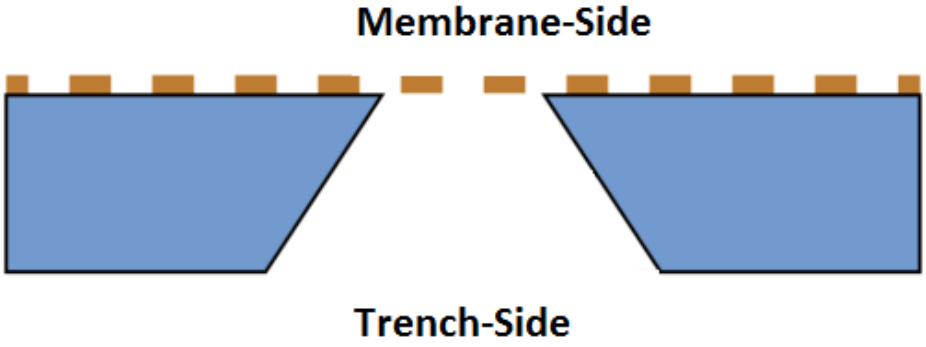


Figure 3. Membrane chip organization. SiMPore membranes are deposited across the surface of a silicon wafer support material. Access to the membrane is achieve by etching trenches through the silicon wafer support, yielding the cross sectional geometry shown above.

8. Install the now surface activated membrane chip into the lower channel assembly such that the **membrane** side is **down** and the long axis of the **trench** are parallel to the long axis of the gasket layers.

   NOTE: Incorrect placement or orientation of the membrane chip will prevent proper device function, and likely will result in membrane failure

9. Retrieve and surface activate the upper Membrane Interface Layer (4) and surface activate with the membrane assembly, then assemble as shown in Figure 2.

10. Surface activate the Upper Channel Layer (5) and surface activate with the membrane assembly, then assemble as shown in Figure 2.

11. Finally, retrieve an Interface Layer (6) and surface activate with the membrane assembly, then assemble as shown in Figure 2.

    NOTE: The interface layer is 800 microns in total thickness and must be well-aligned to ensure an open fluid path through the device.

12. Once fully assembled, cure the device for at least 60 minutes at 80ºC

Using the Device

1. After curing, use the provided 18Ga needles to develop fluid interfaces to the device.

   - Slowly with even pressure insert the needle through the port within the interface layer. Some resistance is expected.
   - Ensure proper placement by visual examination of the device from the side and top such that the steel needle does not embed into the bottom of the channel layer.
   - Repeat the above process for the remaining three needles.

2. Once ported, connect tubing assemblies (user supplied) to the Luer lock ports and prime using a wetting solution (particle free (0.2 µm filtered) dilute IPA or other hygroscopic solution) by slow injection from a syringe. If resistance is

experienced during priming, slowly withdraw the needle(s) to enable fluid flow through each flow channel.

NOTE: If significant transmembrane flow is observed, discontinue flow and examine the outlet channel and port for closures.

3. Continue priming with wetting solution until the entire flow path is purged of air.

   NOTE: Small bubbles encapsulated within the device may be dislodged by gentle tapping. Alternatively, slowly withdrawing the solution front through the device will cause small bubbles to pop against the retreating solution-air interface.

4. Once fully wetted, exchange the wetting solution with the desired media (experiment specific) with sufficient volume to ensure displacement of all residual wetting solution

5. As a general rule, avoid experimental parameters that exceed the following to ensure device and membrane integrity is not compromised

Parameter	Value
Flow Rate	<5 mL/min
Membrane ΔP	< 68 kPa
Device ΔP	< 55 kPa
Media Composition	Aqueous solutions, solvents compatible with PDMS. De-gassed and particle-free

TIPS AND TROUBLESHOOTING

- **Inspection:** Prior to assembling device layers, carefully inspect the gaskets for debris, which may include PDMS cuttings or plugs (particularly in fluid ports or other small feature).
- **Cleanliness:** It is of critical importance to maintain the cleanliness of the PDMS surface to ensure proper bonding between gasket layers. If dust, debris, or other visible debris is present, attempt to remove via tweezers or compressed nitrogen gas. If accidental contact is made with an ungloved hand the PDMS gasket must be thoroughly cleaned with IPA or other solvent to remove any surface oil.
- **Surface Activation:** Surface activation of PDMS should be performed via UV Ozone or PDMS. As tool settings and operating parameters vary, development of an optimized recipe for complete surface activation is left to the user. Once surface activated the PDMS should be bonded as quickly as possible, within five minutes for optimal bonding results.
- **Proper Sealing:** Good bonding between the two PDMS layers is critical to ensure device performance. Debris or bubbles between the layers may cause device failure. Once bonded, no movement between the layers is advised (e.g. replacement during alignment), as the bond strength is greatly diminished with repeated contact. If misplacement occurs, repeat the surface activation before bonding again.

- **Curing:** Once fully assemble, the device must be heat-cured before use to improve the integrity of the bonded layers. Bake the assembled device on a hot plate or more ideally a gravity oven, for at least 60 minutes at 80ºC. Bake times will vary depending on the tool used.
- **Device Priming**: Once cured and the needles inserted, the device layer and membrane may be initially hydrophobic due to off-gassing during the cure. A hygroscopic solution, ideally dilute alcohol or glycerol in MilliQ water may be used to fully wet the channels and membrane before use. Rinse the device fully with the desired contact media before experimentation.
- **Using the Device:** Adhere to the recommended values provided above in *Using the Device,* Step 5. Caking or fouling may occur of particle or biofouling agent density is too high leading to device pressure increase and membrane or device failure. Device service life has not been fully tested and varies depending on assembly quality and use case(s), but generally is suitable for at least 72 hours of continuous use with diligent care. Refer to Figure 4 below for a flow path diagram and picture of a represented device after assembly.

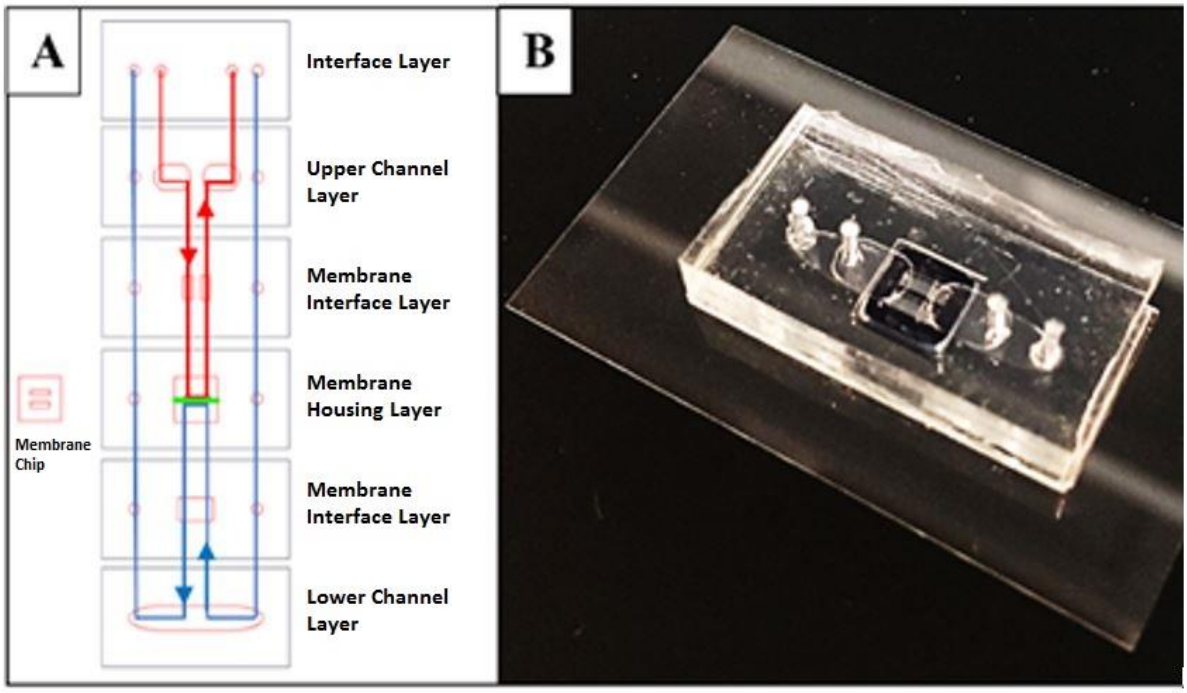


Figure 4 (**A**) Assembled gasket geometry stack and direction of flow for the upper (red) and lower (blue) channels. (**B**) A representative image of a fully assembled flow cell containing a membrane chip

PHYSICAL PROPERTIES

Property	Value
Membrane Composition:	Silicon Nitride (SiN)
Membrane Surface Area	1.4 mm^2 (single slot), 6.3 mm^2 (three slot)
Minimum Working Length	750 µm
Membrane Thickness:	100 nm (NPN) / 400 nm (SiN)
Pore Size Cut-Off:	varies
Porosity:	varies
Surface Charge:	Neutral to slightly negative
Wetted Components Material(s):	PDMS, Si, SiN, SS

SPECIFICATIONS

Sterilization

Flow Cell devices may be sterilized via Ethylene Oxide, Hydrogen Peroxide Gas, 70% IPA immersion, or gamma, UV, and E-Beam irradiation after removing from the plastic bag. **Do Not** Sterilize via steam autoclave as device damage may occur.

Chemical Stability

Devices are incompatible with strong bases, as membrane degradation may occur. Avoid long exposure durations to solvents, as this may compromise device integrity. Do not apply solvents, acids, bases, organics, or other compounds that are incompatible with the stated device components.

Device Storage

Store in a clean and dry environment. Prolonged exposure to UV can degrade the PDMS bonding, leading to poor layer adhesion and shortened service life.

STANDARD WARRANTY

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