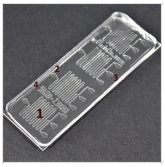

Dec 08, 2020

U-uF-SM1-2/3 Serpentine Mixing Chips User Manual

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1 Works for me dx.doi.org/10.17504/protocols.io.bqbemsje

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ABSTRACT

This is the user manual for U-uF-SM1-2/3 Serpentine Mixing Chips of uFluidic.com

EXTERNAL LINK

https://www.ufluidic.com/products/sm1-300um-z300-serpentine-mixing-microfluidic-chips

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EXTERNAL LINK

https://www.ufluidic.com/products/sm1-300um-z300-serpentine-mixing-microfluidic-chips

KEYWORDS

null, microfluidics, lab on a chip, PDMS

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SAFETY WARNINGS

All the chips, instruments and components are for RESEARCH PURPOSE ONLY and are not suitable or certified for medical or veterinary diagnostics or therapeutics.

For avoiding any damage to PDMS chips and the microchannels or glass, users must be aware of serious damage and even break it resulting in no further usage of chip. Use proper chemical liquids and temperature environment.

The microfluidic chips and all necessary accessories or chemicals must be used by researchers who have trained about working in laboratory conditions. Use the microfluidic chips and all necessary accessories or chemicals with suitable gloves and lab coats.

Applications of microfluidic chips are tested at Room Temperature. For higher and lower temperature conditions, it is possible to have same results but not guaranteed.

The chips are fabricated inside cleanroom conditions and UV-sterilized. Users can further sterilize them by autoclaving or gamma-radiation. After autoclaving, water vapour stays inside PDMS material but can be easily removed by 30 min incubation on hotplate or in dry incubator up to 99°C.

Please pay attention to fittings parts since they can be fragile. Also gently use the fittings and PDMS chips not to tear down.

Do not swallow or eat the microfluidic chips, small fitting parts or chemicals used for microfluidic applications.

ABSTRACT

This is the user manual for U-uF-SM1-2/3 Serpentine Mixing Chips of uFluidic.com

INTRODUCTION

1 This is a PDMS microchannel on microscope glass chip, UV sterilized, and packaged.
Serpentine mixing chips have multiple inlets and long channels for passive mixing of liquids by diffusion.
Main application areas are flow chemistry and organic synthesis.

ABOUT COMPANY

2 WE'RE A DESIGN AND FABRICATION CENTER FOR MICROFLUIDIC LAB-ON-A-CHIP DEVICES.

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NECESSARY EQUIPMENT

3

- Inverted or stereo microscope to view the devices, microchannels and inner sample

SuP: micro Syringe Pump
Syringe Pump
NBT **NBT#SuP**

- Syringe pumps to pump samples (at least 3 for single syringe capacity or 2 for dual syringe capacity)

Görcell: Smart Microscope
Microscope
NBT **NBT#Görcell**

- Syringes with luer or luer-lock tips to hold samples during pumping. (at least 1mL volume)
- Tubing to connect the syringes to chips (silicone or any flexible material with ID: 1mm-2mm is suggested)
- Fittings of syringe-to-tubing and tubing-to-chip to complete liquid flow path through chip (NBT original fittings at uFluidic.com are suggested)
- Cell strainers and filters to filter out any dirt, contamination or agglomerations Suggested: 25um or 40um cell strainer filter

QUICK START GUIDE

4 A. SET UP THE FLUIDIC SYSTEM

- Put the chip on microscope, 20x preferred

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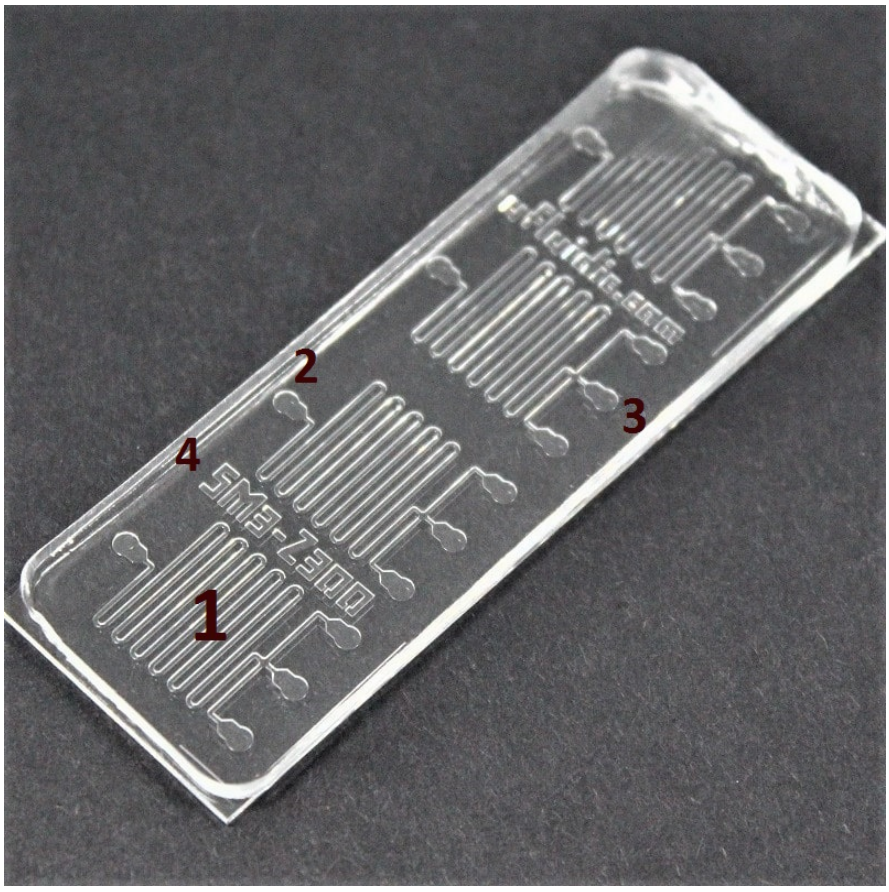
- Connect the tubings and fittings with syringe and syringe pump

B. ARRANGE the suitable liquid flow rate and PUMP the liquids

- Send the sterile distilled water first to fill the micro-channels
- Send, then, the sample at suitable pressure.

DESCRIPTION of DEVICES

5



1. The chip contains four devices of microchannels
2. Each channel has single outlet of product collection
3. SM1-2 device has two inlets for reactants. SM1-3 device has three inlets for reactants.
4. Here the code of chip is given.

6 Table-1: The properties of SM# series serpentine mixing microfluidic chips.

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A	B
Specification for	Info
Number of devices per Chip	4 devices
Material	PDMS bonded on microscopy glass
XY Size of Total Chip	25x73 mm2 of the chip on 26x76 mm2 of std microscopy glass
Z Height of Microchannels	300 micrometer
Z Height of PDMS chip	3.0-4.0 mm
The Width of the Channel	300 micrometer
The aspect ratio of channels (W/H)	1
Ports on Top or Edge	on Top
Number of Ports	3 ports for SM1#
	4 ports for SM1#
Pitch btw ports and edge-to-port	3 mm and 3.5 mm
Size and Shape of Ports	2 mm and Circle
Suitable Connector's Outer Diameter	2.0 - 2.5 mm
microChannel Geometry	Rectangular

EXPERIMENTAL PROTOCOL 1h

7 Open the package and 5m

- Take care of the chips.
- Remove the protection tape on top of chips
- Be sure it is good condition and there is not any breakage

8 Prepare fittings, tubing, and chemicals 5m

- 2 or 3 syringe and syringe-to-tubing fitting per device
- Enough amount of tubing with ID:1mm-2 mm
- 3 or 4 tubing-to-chip fitting for 2-3 for inlets and 1 for outlets
- Open reservoir fitting can be used for collection at outlet
- Plug fitting is not suggested

9 Fill syringe with suitable liquids 10m

- Fill one of the syringe with sterile distilled water
- Fill one of the syringes with your sample per device
- Do not leave any bubble inside syringe and tubing after filling

10 Connect syringes with tubing and fittings 10m

- Fill the liquid inside the connected liquid pathway
- Do not leave any bubble inside liquid pathway

11 Connect inlets with sample liquid tubing 5m

- Connect sample tubings to chip by the inlet ports
- Beware of air bubbles

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12 **Outlets** 1m

- Outlets can stay free for initial adjustments
- Beware of air bubbles

13 **Pumping velocity** 10m

- It is suggested to use 1-3 mL/min flow rate to obtain successful results.
- Higher flow rates may be needed for specific applications
- Very high flow rates may cause high pressure to breakage the bond between PDMS and glass.

14 **NO Closure on the outlets** 5m

- Do not close or plug any outlets which will disrupt the mixing and chemical reaction of the samples
- Use any suitable tubing to chip fitting for equal pressure affect on chip

15 **Which outlet?** 5m

- Observe the product liquid sample through outlets and find the outlets to be used for collection
- Connect fittings with tubing to the outlets for product liquid collection

16 **NO Closure on the inlets** 1m

- Never close the inlet port. The system does not work on backwards direction.

17 **Stable flow** 10m

- Wait for a few minutes to obtain stable flow and stable diffusion mixing or experimental product.
- Fine tune the flow rates for desired mixing efficiency regarding product properties.

18 **How to set the complete system** 10m

- The chips can be observed under inverted or stereo microscope
- The syringes and syringe pumps must be located higher vertically than the chips

19 **Collecting product in a tube** 5m

- Connect a tubing and a fitting of tubing-to-chip on the correct outlet ports.
- Place the other end of the tubing inside a suitable tube of 0.5 mL – 50 mL.

TROUBLESHOOTING

20 **Problem-1: Flow is not present**

Solution:
It takes time to push liquid sample in syringes, tubing and press air in microchannels. You may need to wait longer to stabilised flow inside channels. Please also check the conditions below;

- Any leakage from fittings and or the microchannels disrupt the proper flow of liquids, please be sure there is not any leakage from syringe, fittings, inlet ports, inside microchannels.
- Any clogging in channels also disrupt the proper flow, please check if all the microchannels are open and free of debris.
- Ensure the syringe back is acting and pump is working properly.
- Air bubbles in any part of the microchannels or tubing also disrupt the laminar flow and pressure stabilisation required for sorting. Please make sure there is not any air bubbles in the flow.

21 **Problem-2: Flow is not stable under syringe pump pressure**

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Solution:
In order to obtain stable, uniform, and laminar flow, whole the system must also be stable. Please check the conditions below;

- Tubing must stay stable and without vibration. The shorter the tubing the better results.
- The vertical level of syringe pumps must be at equal level or higher with the chip on microscope or table.
- The syringe pump or any other pumping actuator must be as low pulsation as possible. Higher the pulsation of pump, lower the uniformity of droplets.

22 **Problem-3: Particles or Cells are lost**

Solution:
This is an easy to solve common problem microfluidic experimentation. Please check the conditions below:

- Wetting the chips totally with sterile distilled water or PBS is necessary before starting the application. This makes the surface ready for your sample so no one sticks on the channel walls.
- Mix the tubing and syringes time to time to solve the precipitation of particles or cell inside syringes or tubing.

23 **Problem-4: Particles or Cells are not observable**

Solution
Under optimum conditions flow rate is equal between pump and microchannels but velocity of the flow is much higher inside channels due to contraction effect. Please check the conditions below;

- Observe the wider channels just before outlet ports to see the particle or cell separation. The wider the channel, slower the particles or cells.
- Use fluorescent beads with similar diameter with your target particles or cells so tracking the fluorescence is easier.
- Label the target particles or cells with fluorescent dyes for initial optimisation so tracking the fluorescence is easier.
- Use a high speed high fps camera with your microscope to be able to observe the sample ingredients.

24 **Problem-5: Clogging of channels with particles or dirt**

Solution:
The width of microchannels are given in the user manual. Please filter all the liquid samples previous to application by proper filters according to width of microchannels. If clogging occurs, under some conditions, inverted flow by pressure through outlets may clean the clogging.

25 **Problem-6: For any other problems regarding theSM#: Serpentine Mixing Microfluidics Chips or chemical compatibilities**

Solution
Please let us know by email or call via the contact details given above.

- For any problem the microchannels can be cleaned by distilled sterile water or ethanol at some level. For other PDMS compatible or non-compatible materials, please check our blog pages.
- The amount of protein in water-based sample, also, strongly influences the droplets. For example, Serum is strongly inhibitory and must be washed out completely.

GLOSSARY

26 **Lab-on-a-Chip:** Highly integrated microfluidic system providing laboratory functions.

Microfluidics: The science of manipulating and controlling fluids, usually in the range of microliters (10^6) to picolitres (10^12), in networks of channels with dimensions from tens to hundreds of micrometres.

Microfluidic Subsystem: Fluidic system may contain one or many MEMS components which are subsystems such as controlling, signalling, analysis, and/or modification elements, attached to a larger system or subsequent process.

Microfluidic Devices: Within each chip, the separate microchannels of microfluidic application with minimum 1 inlet and connected outlet.

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Biocompatibility: Refers to a special quality of some materials allowing them to come into contact biological materials without changing the materials' bioactivity.

Droplet Microfluidics: The science of manipulating and controlling immiscible liquids to form droplets in the range of nanoliters.

Inside Reservoir: A wider microchannel area relative to other channels of same microfluidic device to collect, analyse, or incubate specific droplets, cells, particles, or molecules.

Microreactor: A device in which chemical reactions take place in a confinement with a typical lateral and/or vertical dimensions below 1 mm.

Fittings Accessories: parts related to microfluidic chips to connect tubing to chips and syringes for flowing samples through.

Single Layer Droplets: This is single cover or single capsule of droplets such as water-in-oil (w/o) or oil-in-water (o/w). For multi-layer droplets, multiple layers of phases are needed such as water-in-oil-in-water (w/o/w).

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