Low-Cost Microfluidic channel Fabrication for lab-on-a-chip application using optimized SU-8 soft lithography

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Abstract

The study and optimization of epoxy-based negative photoresist (SU-8) microstructures through a low-cost process and without the need for cleanroom facility will be presented in this work. It will be demonstrated that the Ultraviolet Rays (UV) exposure equipment, commonly used in the UV glue curing industry, can replace the more expensive and less available equipment. Moreover, high transparency masks, printed in a photomask, will be used, instead of expensive chromium masks. The fabrication of well-defined SU-8 microchannels with high aspect ratios are hoped to be successfully demonstrated with those facilities. In addition, fluid flow through the micro-channels fabricated using SU-8 soft lithography will be tested and characterized using MicroPIV, Particle Image Velocimetry.

Introduction

Microtechnology and microfluidic systems are areas whose growth has soared exponentially over the past few years. Offering reduced reagent consumption, high throughput, and unprecedented automation, these “lab on a chip” systems are often seen as preferable, especially because of their size, which makes them suitable for mobile field laboratories. Their highly reduced consumption of samples and reagents, system cost, size, power, and remarkably fast analysis time has proved it preferable while working on rapid on-site issues. MEMS (Microelectromechanical systems) and LOC (Lab on a chip) evolution using soft lithography have proved very useful, but often require the use of expensive, industrial equipment, a change of which is seen in this experiment.

Objectives/Hypothesis

In this study, the primary objective is to build a microchannel for Lab on a Chip application utilizing low cost and available equipment.

Methodology

change in some steps such as not using piranha solution while preparing the substrate, less expensive UV light source, no cleanroom, and high transparency masks. Micro PIV will also be used to check microchannel particle flow for optimal function.

Results

The fabrication of a microchannel was produced in this experiment, its flow being tested through Micro-PIV for successfulness.

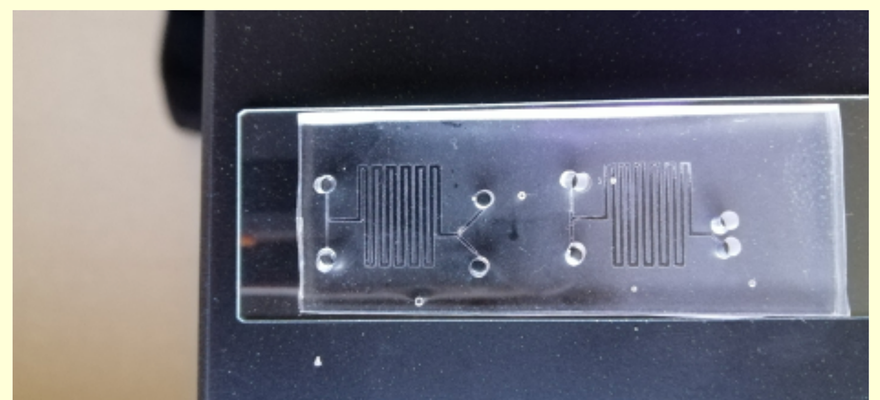

Figure 1. fabricated Microchannel

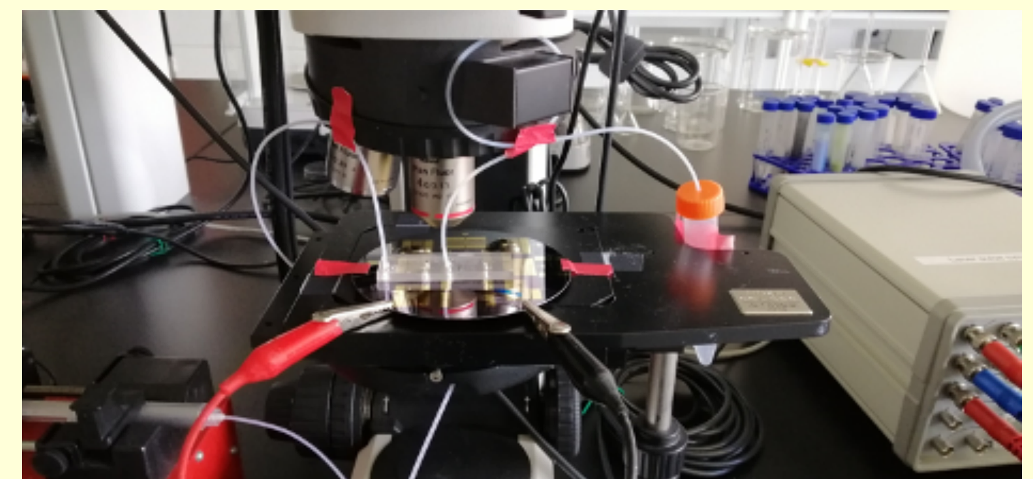

Figure 2. In this figure liquid was pumped through the microchannel using a syringe pump.

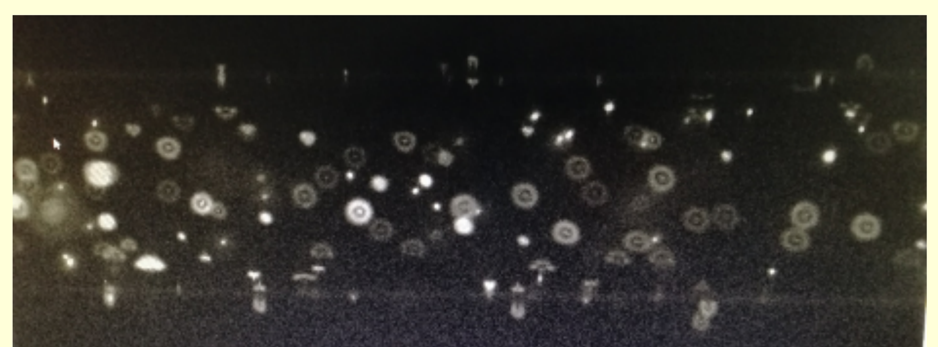

Figure 3. Fluorescent particles flow inside the microchannel. (zoom view).

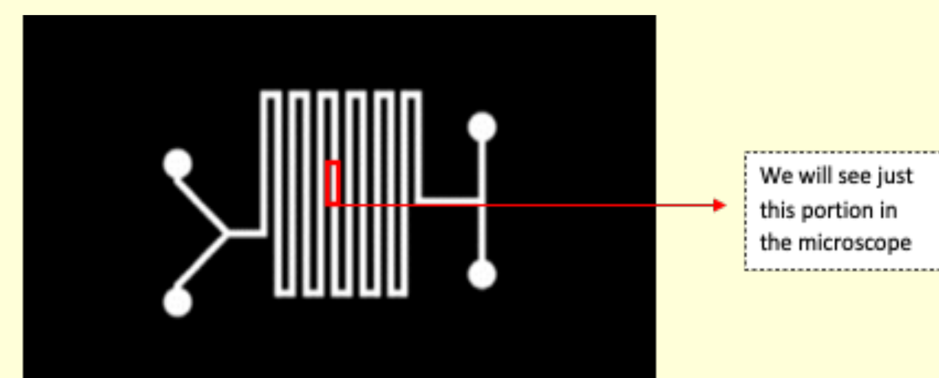

Figure 4. Microchannel section examined, results are emphasized on this portion.

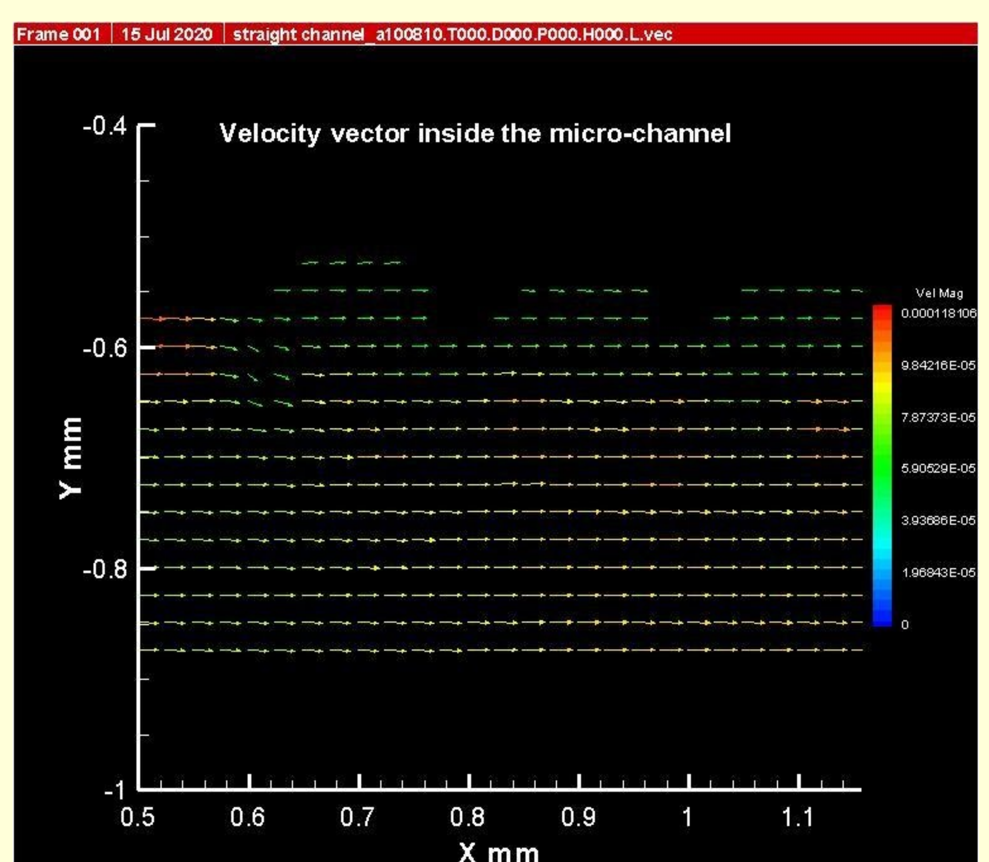

Figure 5A. The colored vectors represent the velocity vectors of fluorescent particles’ velocity vector at a straight point.

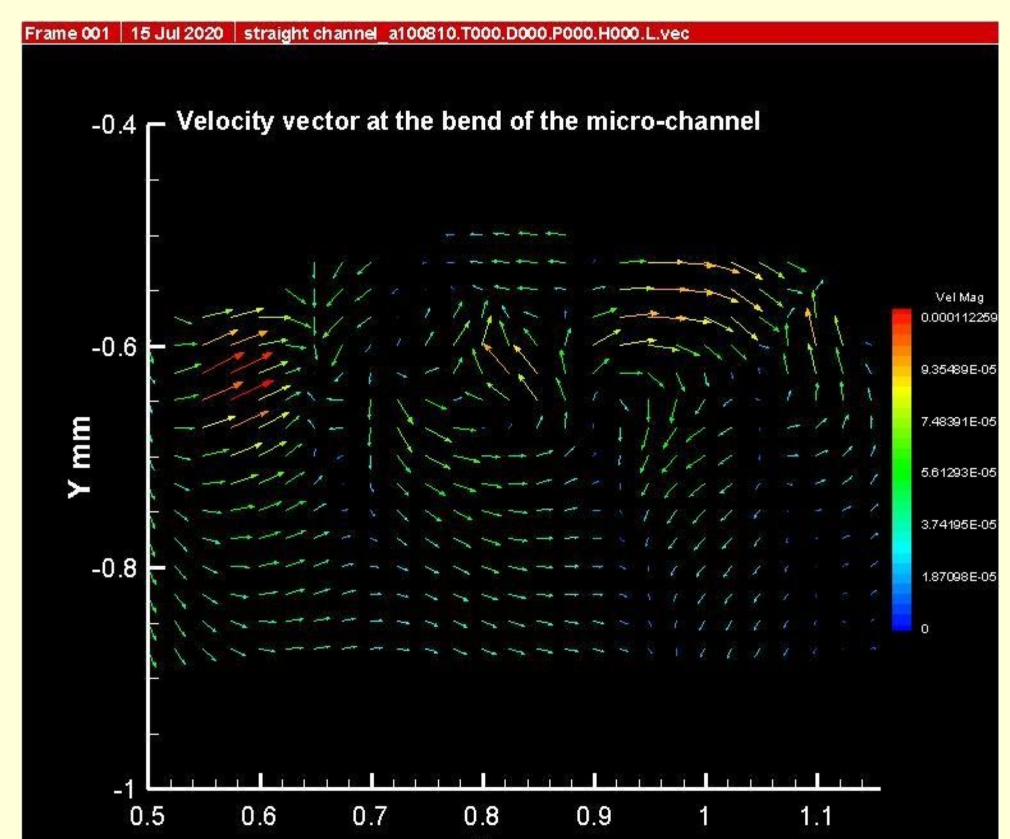

Figure 5B. This figure represents the velocity vectors at the channel bend. There is some vortex due to rough surface and channel bend

Discussion

To show microchannel functionality, Micro PIV was used to test channel operation, proving no irregularities or blockers inside the channel. Micro PIV is a tool used to measure the velocity profile across a plane in a microfluidic device. It utilizes a volume illumination technique where the light source and the view field are introduced through the same optics. The fluid velocity in this microchannel was measured by the displacement of small tracer particles added to the channel’s fluid which was pumped into the microchannel using a syringe pump as seen in figure2. The images of these particles are shown in small sub areas, shown in figure4, taken after the flow field was illuminated by a laser, resulting in light being emitted from the particles. This allowed the recording of the fluorescent particles seen in figure 3 and proved the directionality of the particles. The graphs on figure 5A shows the direction, right, of these particles on a straight section of the microchannel, whereas figure 5B shows a vortex caused by the particles bending on one of the microchannel edges.

Conclusion

In this study the fabrication of a microchannel under cheaper, more affordable equipment was applied to optimize production of microfluidic structures. Micro PIV was used to determine optimal functionality of the microchannel and secure its smooth operation. In the future, this information will be used to successfully fabricate new medical and fast acting technology.

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