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Fast Production of Microfluidic Devices by CO2 Laser Engraving of Wax-Coated Glass Slides

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Fast Production of Microfluidic Devices by CO_2 Laser Engraving of Wax-Coated Glass Slides

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Introduction

Glass is one of the most convenient materials for the development of microfluidic devices. However, most of the fabrication protocols, require long processing times and expensive facilities. Polymeric materials have been extensively used due the fast and low-cost production methods. Ablation by CO_2 laser has been used to prototype on polymeric materials, but is difficult to extend to glass devices, because the local heating causes surface cracking. We herein describe a simple procedure to produce microfluidic devices for capillary electrophoresis from microscope glass slides.

Experimental section

The channels and reservoirs were fabricated on standard soda-lime glass microscope slides coated with paraffin wax before ablation. Firstly, some wax was melted at 60°C and a thin and uniform layer was deposited on the top and bottom faces of the slides (0.40g and 0.20g respectively). All ablations were carried out with a commercial CO_2 laser engraver. The channels were ablated using 80% of the laser's power and 10% of laser's carriage speed while the reservoirs were cut by repeatedly scanning (5x) the area on 100% of power and 2% speed

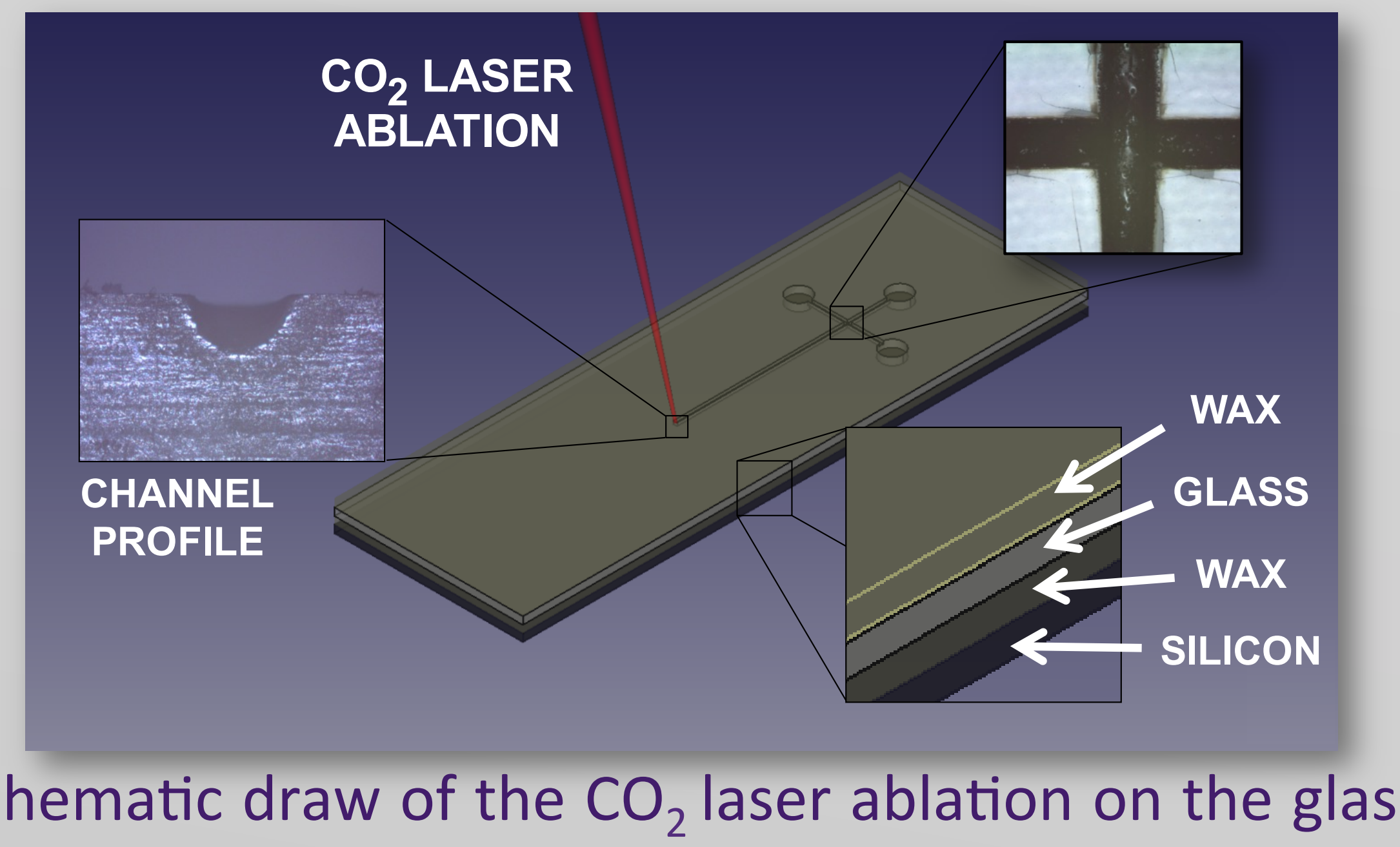

Figure 1: Schematic draw of the CO_2 laser ablation on the glass slide. The inserts are cross channel and profile of the obtained channel.

Results

Microscope images of the channels produced by this methodology are shown in the Figure 2. Also a comparison of the channels obtained without (A and C) and with (B and D) the wax layer is presented. The 3D image of a cross channel and the channel's perfilometry (E) and a picture of the cross channels and reservoirs of 3mm diameter (F) produced are also showed.

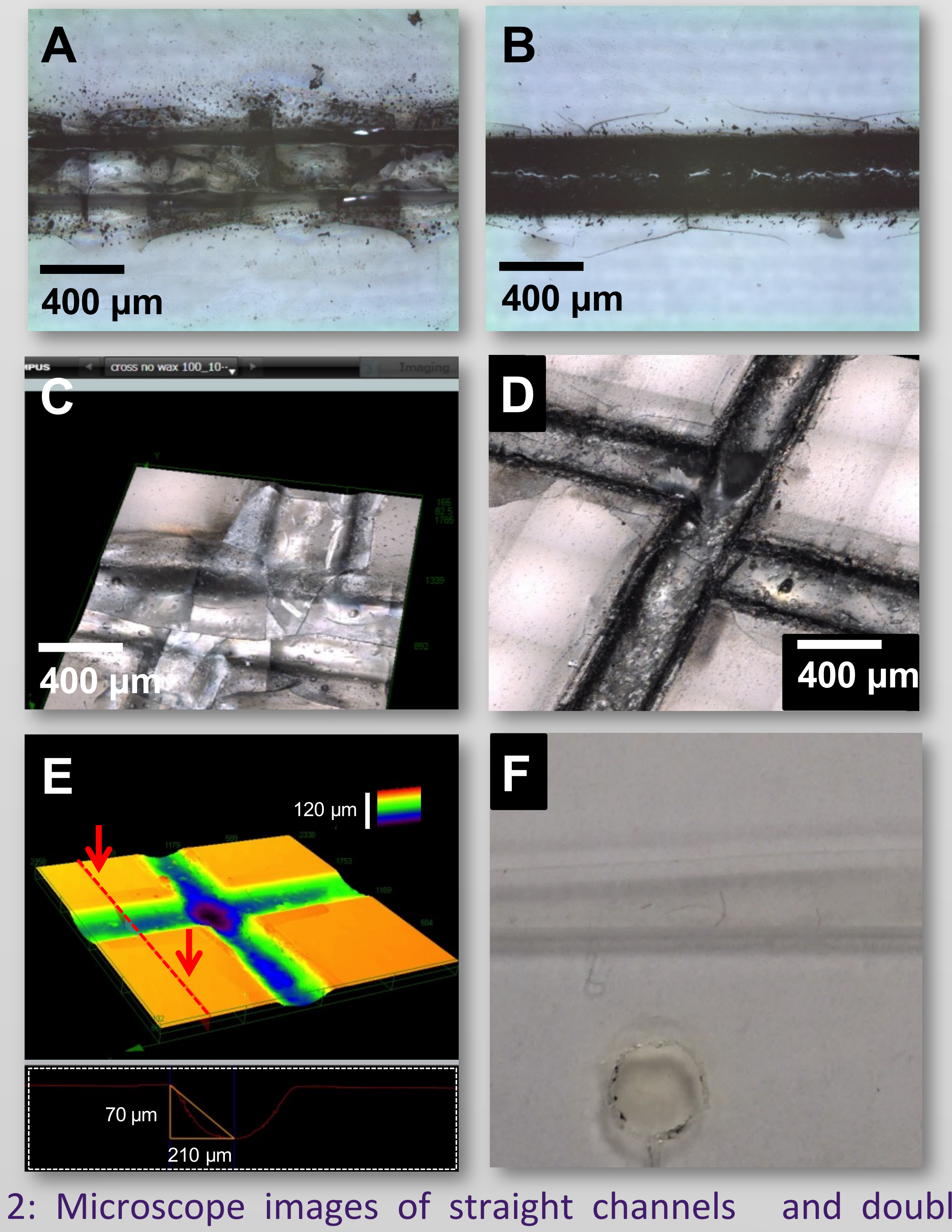

Figure 2: Microscope images of straight channels and double-T channels made on glass microdevices without (A and C) and with (B and D) a layer of wax. 3D Microscope image of cross channel (E) (insert of the channel profilometry showing the semicircular shape and dimensions). The objective lens used was 20x. Close up of the sample/buffer reservoirs (F).

As shown in the Figure 3A, the increase of laser's power intensity yielded significant increase in the channels' depth and width, while an increase in the dimensions of the channels was obtained by a reduction in the ablation speed (B) (actually, one over speed).

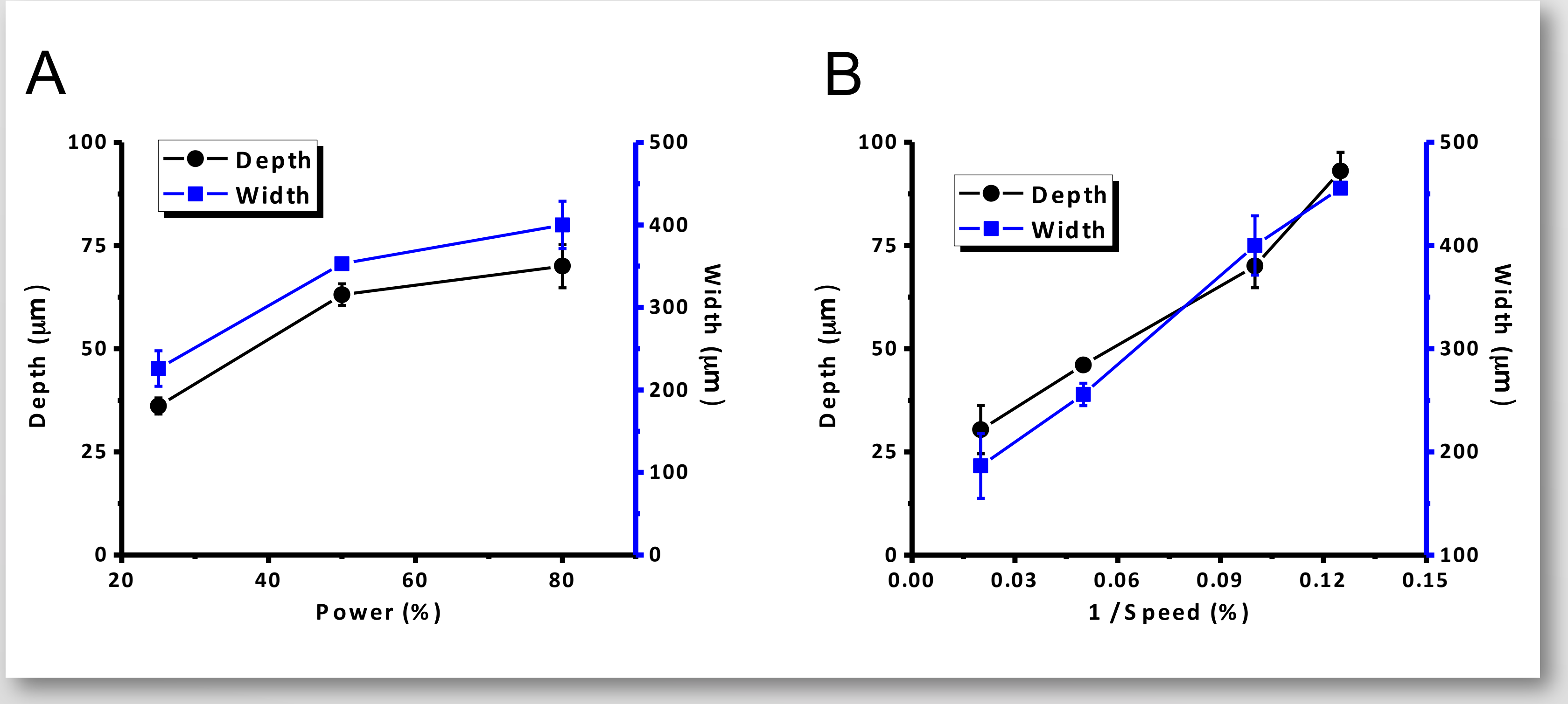

Figure 3: Dependence of the engraved channels' dimensions as a function of the laser's power (A, speed set at 10 %) and speed (B, power set at 80 %).

Conclusions

The obtained channels have a semicircular shape and the dimensions can be controlled by the laser's power and speed. Although the produced channels do not display better aspect ratios than those produced by photolithography, they are comparable to those produced by ablation of polymeric substrates, with the additional advantages of lower costs, lower preparation time, and no harsh chemical etching conditions.

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