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Supporting Information for *In-situ photo-patterning of pressure-resistant hydrogel membranes with controlled permeabilities in PEGDA microfluidic channels*†

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UV illumination field

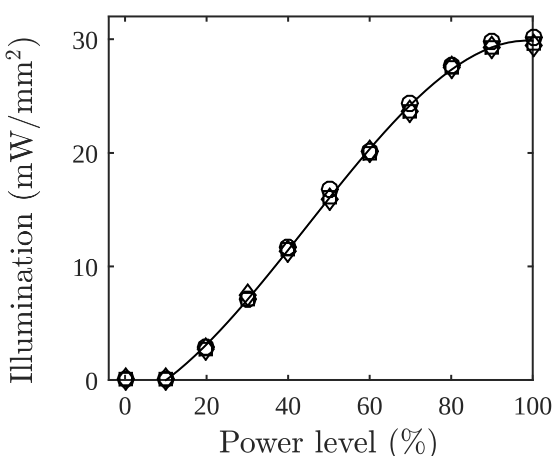

Fig. 1 UV illumination measured through a glass slide for rectangular patterns generated by the Primo setup, as a function of the power level of the laser (software units). Pattern areas: ∘: 270×110 μm^2, □: 385×220 μm^2, ⋄: 450×270 μm^2. The continuous line is a guideline.

Movies

Movie S1 – Fabrication of a hydrogel membrane (width $w_m = 25$ μm) using the Primo photo-patterning setup (real time). The red (resp. green) drawing is the pattern before (resp. after) photo-polymerization, and which is used to align existing micro-structures with the photo-patterned hydrogel.

Movie S2 – Illustration of the permeability measurements. A ramp of imposed trans-membrane pressure drops (see the displayed value) affects the coflow in the filtrate channel. Some fluorescent nanoparticles (500 nm in diameter) in the retentate channel accumulate on the membrane due to the trans-membrane flow. Membrane width $w_m = 20$ μm.

Movie S3 – Accumulation of fluorescent nanoparticles (500 nm in diameter) on the membrane for a trans-membrane pressure drop of $\delta p = 1.7$ bar (real time). Membrane width $w_m = 20$ μm.

Movie S4 – Accumulation of small fluorescent nanoparticles (20 nm in diameter) on the membrane for a trans-membrane pressure drop $\delta p = 200$ mbar applied at $t \simeq 6$ s. The accumulated nanoparticles are then re-dispersed by a negative $\delta p = -500$ mbar imposed at $t \simeq 26$ s. Larger fluorescent nanoparticles (500 nm in diameter) in the filtrate channel help to evidence the flow. Membrane width $w_m = 25$ μm.

Movie S5 – Frontal filtration at $p_c = 6$ bar of a colloidal dispersion, see text for details. Membrane width $w_m = 35$ μm.

Relation between δ/w and Q_m/Q

The velocity profile in a straight microchannel with a rectangular cross-section $h \times w$ is given by[?] :

$$v(x,y) = \frac{\Delta p}{\eta L}\frac{4h^2}{\pi^3}\sum_{n=1,3,5,\ldots}^{\infty}\frac{1}{n^3}\left(1-\frac{\cosh(n\pi x/h)}{\cosh(n\pi w/2h)}\right)\sin(n\pi y/h)\,, \quad (1)$$

where L is the channel length, Δp the pressure drop, and η the viscosity of the liquid. In the above relation, $-w/2 \leq x \leq w/2$ and $0 \leq y \leq h$. The flow rates Q and Q_m are given by

$$Q = \int_0^h \mathrm{d}y \int_{-w/2}^{-w/2+\delta} \mathrm{d}x v(x,y)\,, \quad (2)$$

$$Q_m = \int_0^h \mathrm{d}y \int_{-w/2+\delta}^{w/2} \mathrm{d}x v(x,y)\,, \quad (3)$$

and the ratio Q_m/Q can be easily calculated numerically for a given value δ/w.

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Fig. 2 shows Q_m/Q vs. δ/w for the experimental aspect ratio investigated in the present work, $h = 14\ \mu$m, $w = 165\ \mu$m. The

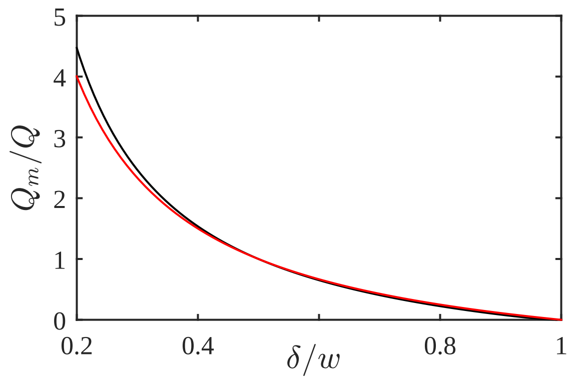

Fig. 2 Ratio Q_m/Q vs. δ/w for a channel rectangular cross-section $h \times w = 14 \times 165\ \mu$m^2 (black). The red line corresponds to the assumption $h \ll w$ given by eqn (4).

ratio of flow rates is computed from the measured δ/w using this curve. Note that for very thin microfluidic channels, i.e. $h \ll w$, both ratios are related by

$$\frac{\delta}{w} = \frac{Q}{Q + Q_m}\,, \tag{4}$$

and this limiting case is shown for comparison in Fig. 2.

Table

Process parameters together with measured widths w_m and permeabilities κ for the datasets displayed in Figs. 6b and 7:

I (mW/mm)^2	τ_{exp} (ms)	E (mJ/mm^2)	φ_p (%)	$10^{17} \times \kappa$ (m^2)	w_m (μm)
20.0	300	6	10	$\simeq 0$	15
20.0	300	6	15	$\simeq 0$	15
20.0	300	6	20	0.29	15
20.0	300	6	25	2.23	20
20.0	300	6	25	2.16	15
20.0	300	6	25	2.15	23
20.0	300	6	30	7.60	23
20.0	300	6	35	14.08	28
20.0	300	6	40	n/a	no membrane
20.0	100	2	25	8.51	27
11.5	300	3.45	25	6.37	22
20.0	200	4	25	6.17	23
11.5	400	4.56	25	3.30	27
11.5	400	4.56	25	3.28	22
11.5	400	4.56	25	3.24	14
11.5	500	5.75	25	2.45	22
20.0	300	6	25	2.21	15
20.0	300	6	25	2.23	20
20.0	300	6	25	2.15	23
11.5	600	6.9	25	1.25	15
11.5	600	6.9	25	0.87	15

References

N. A. Mortensen, F. Okkels and H. Bruus, *Phys. Rev. E*, 2005, **71**, 057301.