In-situ photo-patterning of pressure-resistant hydrogel membranes with controlled permeabilities in PEGDA microfluidic channels

J.DECOCK[a], C.KEITA[a], M.SCHLENK[b], J.B. SALMON*[a]

[a]*CNRS, Solvay, LOF, UMR 5258, Univ. Bordeaux, F-33600 Pessac, France.; E-mail: jean-baptiste.salmon-exterieur@solvay.com*

[b]*Physical Chemistry I, University of Bayreuth, D-95440 Bayreuth, Germany*

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1. Introduction

We report the fabrication of highly permeable membranes in poly(ethylene glycol) diacrylate (PEGDA) channels, for investigating ultra-filtration, at the microfluidic scale. More precisely, we use a maskless UV projection setup to photo-pattern PEG-based hydrogel membranes on large scale (mm–cm), and with a spatial resolution of a few microns. We show that these membranes can withstand trans-membrane pressure drops up to 7 bar without any leakages, thanks to the strong anchoring of the hydrogel with the channel walls. We also report in-situ measurements of the Darcy permeability of these membranes, as a function of the deposited energy during the photo-polymerization, and the formulation composition. We show that the use of PEG chains as porogens, as proposed in [1], increases significantly the porosity of the hydrogels, while maintaining strong mechanical stability of the membranes. We finally illustrate the opportunities offered by this technique, by investigating frontal filtration of colloidal dispersions in a straight microfluidic channel [2].

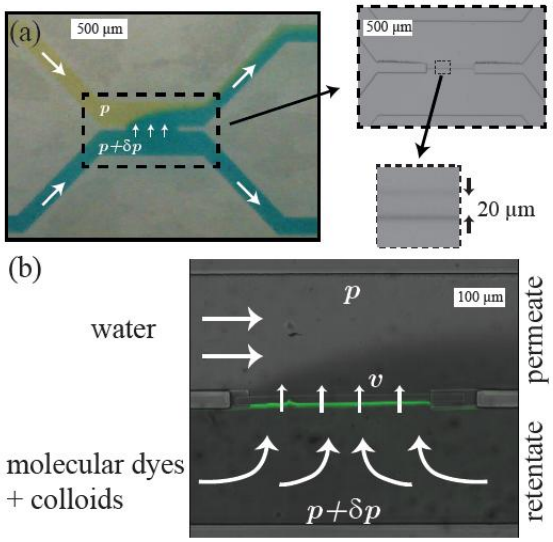

Figure: (a) Flow pattern of aqueous dyes: the trans-membrane pressure drop δP drives a flow through the membrane of width w_m = 20 µm, see the insets for bright field images. (b) Superimposed fluorescence and bright field images showing the frontal filtration of a fluorescent colloidal dispersion containing also molecular dyes (δP = 2 bar, membrane width w_m = 20 µm). The tracers (diameter 20nm) accumulate on the permeable membrane, but molecular dyes flow through it, as evidenced by the coflow in the permeate channel.

References

[1] Lee et al., Biomacromolecules, 2010, 11, 3316

[2] Decock et al., to appear in Lab on a Chip, 2018