Supplementary information

for

On-chip cavity-enhanced absorption spectroscopy using a white light-emitting diode and polymer mirrors

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Master fabrication

A 100 mm diameter glass wafer was immersed in fuming nitric acid for 2 minutes, followed by a thorough rinse in deionised water, acetone and finally isopropanol. The wafer was dehydrated overnight in an oven at 210 °C, before spinning with an adhesion promoter (Microchemicals GmbH, TI PRIME) at 3000 rpm with an acceleration of 5000 rpm/s for 30 seconds (Brewer Science, Cee 200 series). The wafer was baked on a hot plate for 2 minutes at 120 °C (SAWATEC, HP-401-Z), and then allowed to cool. Negative photoresist (Microchemicals GmbH, SU-8 3050) was then spun over the wafer at 3000 rpm with an acceleration of 300 rpm/s for 30 seconds. Following soft baking for 15 minutes at 95 °C, the wafer was exposed to a UV dose of 400 mJ cm⁻² (EVG, EVG620TB), with an acetate photo-mask used to define the channel design. The master was then baked at 65 °C for 1 minute, and 4 minutes at 95 °C, before development in SU-8 developer (Microposit EC solvent) for approximately 6 minutes.

PDMS Chip fabrication

Before coating with PDMS, the master was silanised for 30 minutes by placing in a desiccator under vacuum alongside a few drops of Trichloro(1H, 1H, 2H, 2H-perfluorooctyl)silane (Sigma-Aldrich, 448931-10G). The master was then baked at 80 °C for half an hour.

PDMS (Dow Corning, Sylgard 184) was prepared by mixing the pre-polymer and curing agent in a 10:1 mass ratio, and degassing in a desiccator under vacuum for 30 minutes.

Bench-top UV/vis spectrometer measurements

UV/vis spectra of six concentrations of thymol blue in the range $0.2 - 200 \mu$ M, dissolved in 50 mM Tris buffer (pH 9.0), were acquired using a bench-top UV/vis spectrometer (PerkinElmer, Lambda 650). For each concentration, three absorbance spectra were acquired. The average spectrum recorded for each concentration is presented in Fig. S 1.



Fig. S 1 UV/vis spectra of six different thymol blue concentrations acquired with a bench-top spectrometer, in a 1 cm cuvette.

The two absorbance peaks of the indicator dye lie at 435 nm (acidic peak) and 595 nm (basic peak). The absorbance per unit path length (α , in cm⁻¹) for these two peaks is presented in Fig. S 2.



Fig. S 2 Absorbance per unit path length versus thymol blue concentration, at 595 nm and 435 nm, acquired with a bench-top spectrometer, in a 1 cm cuvette. Three sigma error bars are included, determined from the acquisition of I_0 ten times.

The sensitivity of the bench-top UV/vis spectrometer can be assessed in two ways. Firstly, I_0 (Tris buffer) was recorded ten times. From these ten acquisitions, the uncertainty in the measurement was determined from three times the standard deviation (3 σ) to be $A_{min,s} = 1.63 \times 10^{-4}$ a. u. at 595 nm, and $A_{min,s} = 2.73 \times 10^{-4}$ a. u. at 435 nm. Secondly, the sensitivity can be determined from three times the uncertainty in the y-intercept of the plots shown in Fig. S 2. In this case, the measurement uncertainty was found to be $\alpha_{min,r} = 2.56 \times 10^{-2}$ cm⁻¹ at 595 nm, and $\alpha_{min,r} = 1.34 \times 10^{-2}$ cm⁻¹ at 435 nm. The absorption coefficient was determined from the gradient of the plots shown in Fig. S 2 to be $\varepsilon_{595 nm} = 13,600$ M⁻¹ cm⁻¹ ± 272 (3 σ uncertainty) and $\varepsilon_{435 nm} = 8,910$ M⁻¹ cm⁻¹ ± 142 (3 σ uncertainty).