Supporting information to:

OPTIMISATION SYNTHESIS AND BIOSENSING PERFORMANCE OF AN ACRYLATE-BASED HYDROGEL AS AN OPTICAL WAVEGUIDING SENSING FILM

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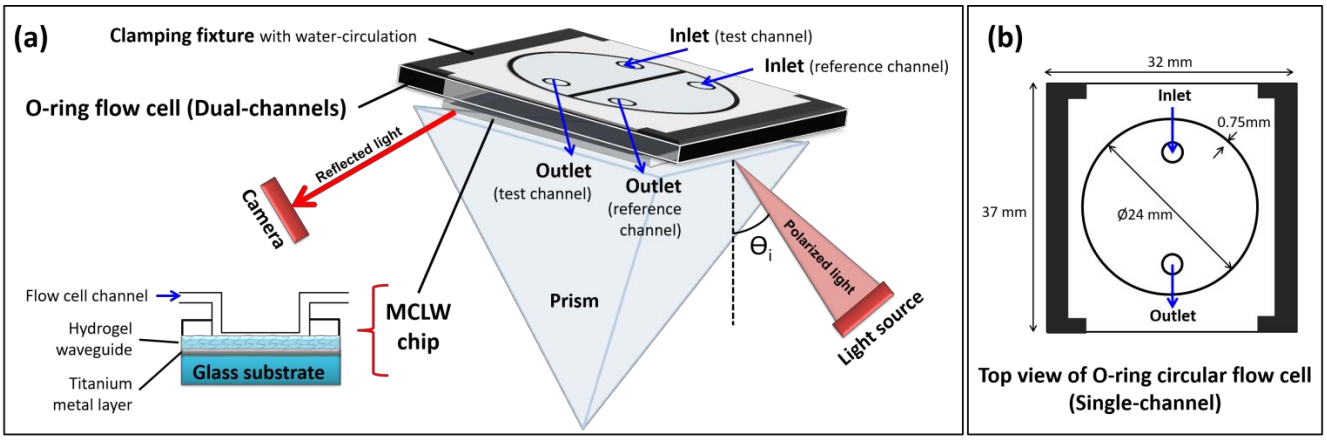


Figure S1: (a) System design for characterisation of MCLW chips with hydrogel as a sensing layer (in which angle of incidence, Θ_i was scanned) using dual-channel flow cell. (b) Top view of single-channel flow cell system.

Figure S1 shows the system design used to probe the metal clad-leaky waveguide chip. For the fabrication of the metal clad-leaky waveguide (MCLW) chip, the chip was made up using a Ti-coated microscope slide. In order to ensure that the Ti-coated slide does not damage during the cutting process, another Ti-coated slide was used to cover up the side of the coated layer. The edge of the slide was used as a ruler to mark the cutting line during the cutting process. Here, the right technique to handle the cutting process must be performed includes not to force the middle part of the glass, only apply pressure at the cutting line and cut using a diamond cutter. This includes firmly engraving the cutting point on the top and bottom edges of the slide once and later pressing hard to break the slide. After the cutting process, the slide was cleaned properly and the slide chosen to be subsequently used must be free from any damage and having the right dimensions of the chip.

The plate used to make a flow cell was 37 mm by 32 mm with either a single circular cavity or two parallel elongated cavities of 0.75 mm deep and 0.5 mm deep by 1 mm wide grooves to mount an O-rings for sealing (see Figure S1). The inlet and outlet ports were constructed using ferrules (Part No. 211-4252, RS Components Ltd, Corby, UK) and attached to the back of the flow cell using epoxy adhesive. These inlet and outlet ports were placed diametrically opposite to each other along the centre of the chip so that the waveguide intensities from both channels were identical.

The dual-channel design (see Figure S1, (b)) was used to characterise the waveguide behaviour, by evaluating surface functionalisation and analyte detection. In addition, the dual-channel flow cell enabled the two separate target analytes to be examined simultaneously within the optical set-up without interacting with each other. The flow cell (single-channel or dual-channel) was clamped gently against the sensor chip and prism, and the ferrules were linked to a peristaltic pump (MINIPULS-3, MP4, Gilson) by attaching PVC peristaltic tube (internal diameter of ca. 15 mm).

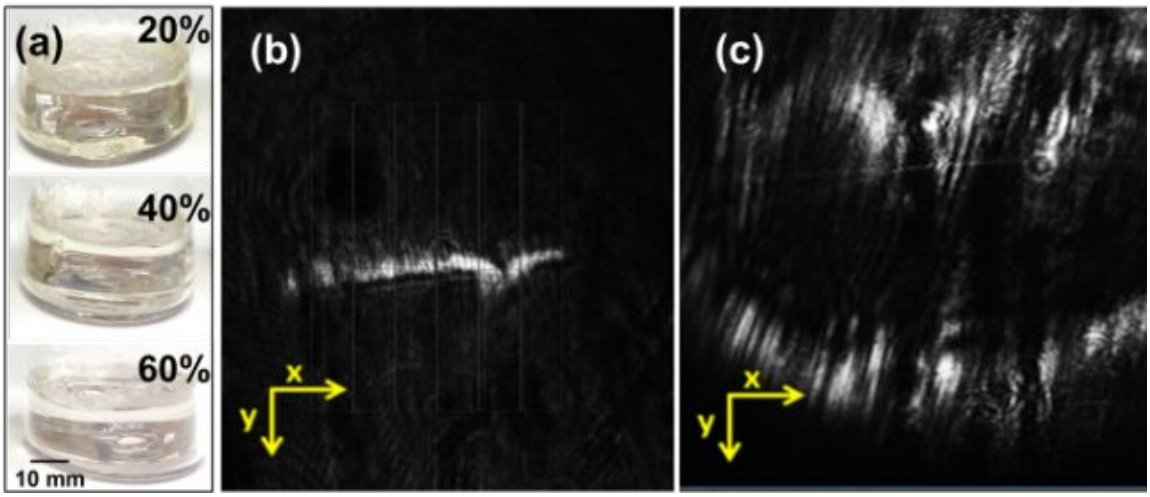
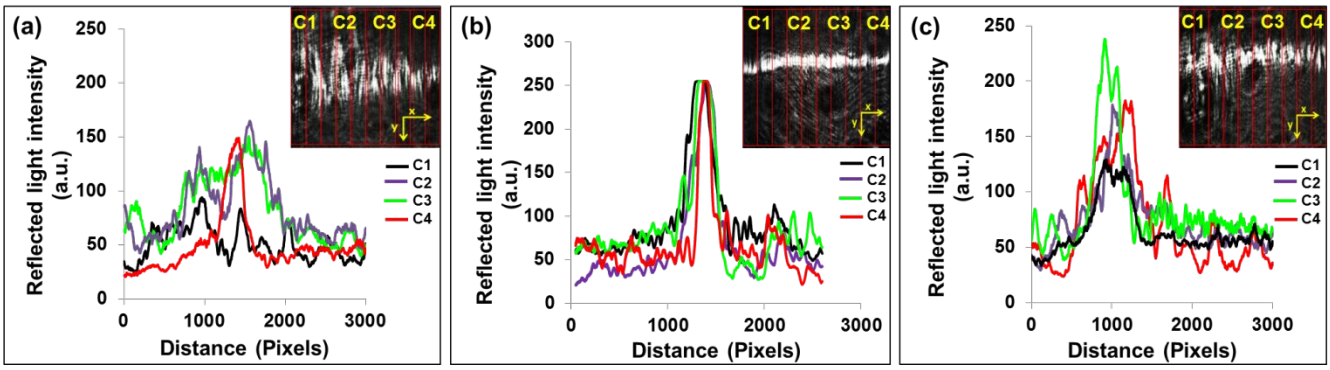


Figure S2: (a) Photographs of hydrogel for 20%, 40% and 60% v/v of PEGMEA-PEGDA at a composition ratio of 4:1 of PEGMEA to PEGDA. The waveguide image of the reflected light signal on camera for (b) 40% v/v and (c) 60% v/v of PEGMEA-PEGDA; respectively.



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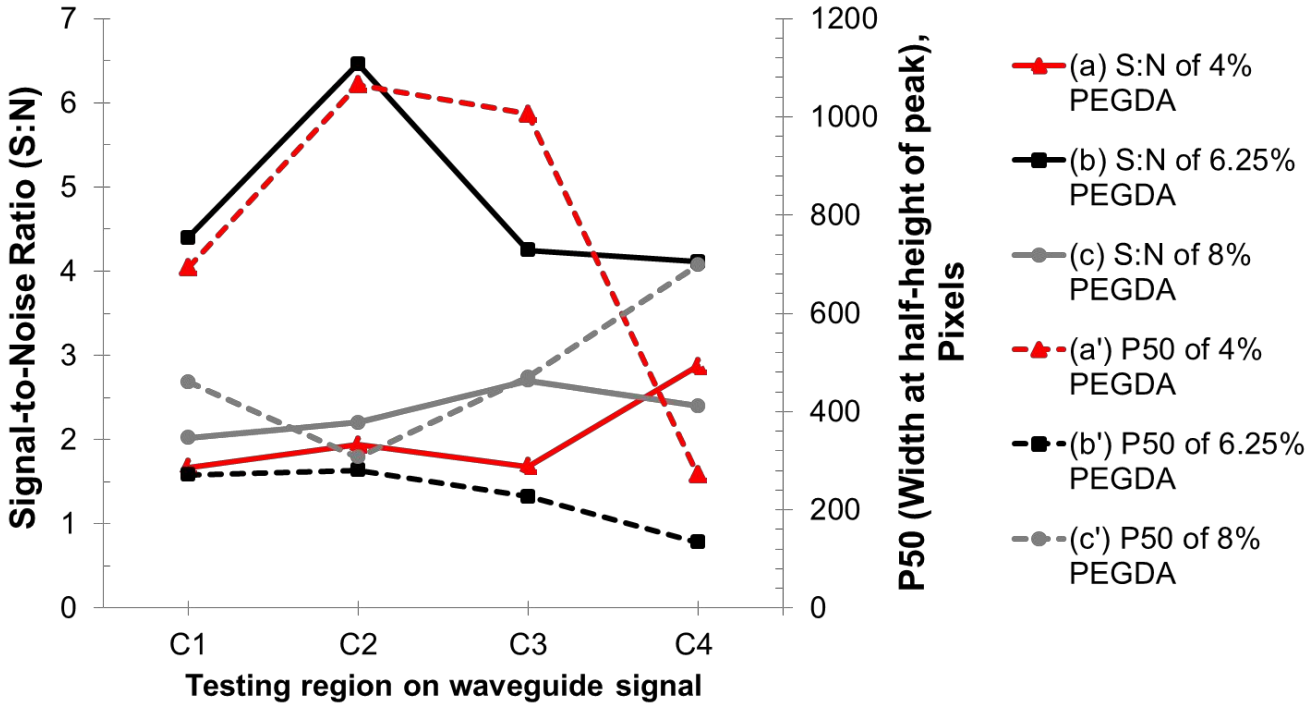

Figure S4: Graphical display of signal-to-noise ratio (*S:N*; straight line) and peak width at half-height (*P50*; dashed line) calculated from the waveguide profile in Figure 3.

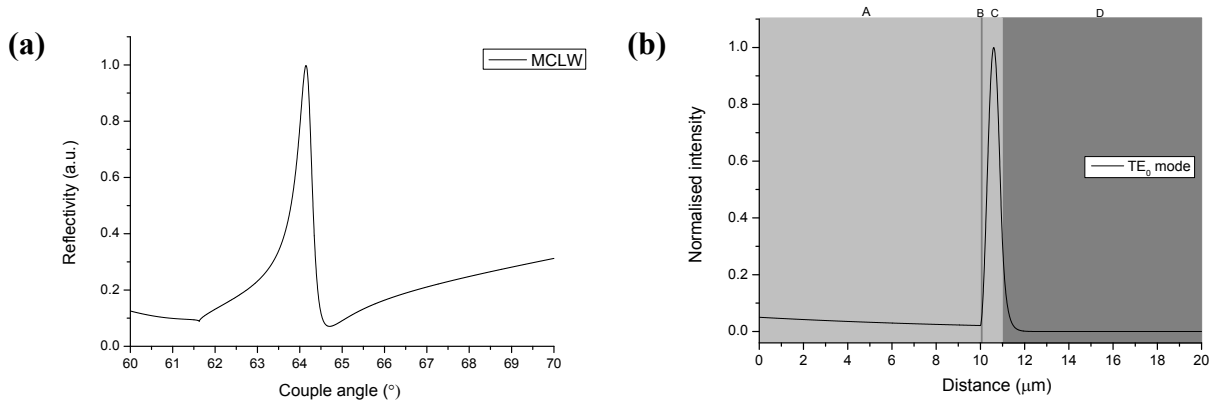

Figure S5: (a) Reflectivity plots versus coupling angle for single-mode MCLW and (b) Mode profiles for the TE_0 of the single-mode MCLW device. Layer A: glass substrate (*n*=1.515), B: Ti, C: acrylate hydrogel (*n*=1.392) and D: water (*n*=1.3333).

Clarification on the different pattern of a signal shown in Figure 2, 3 and 4:

For a leaky waveguide sensor, the signal is generated based on the position of the waveguide signal which relies on the reflection light from the sample. For the situation in Figure 2, the signal was unstable as the hydrogel itself not covalently bonded to the chip, thus indicated that a surface modification on the glass slide was needed. Figure 3 shows the signal generated after silanization on the slide was implemented showing that the signal was steady and stable throughout the detection. In contrast, the signal generated in Figure 4 was diagonally in the pattern line due to the noise that was resulted due to software misalignment. Due to the presence of the noise, the result of Figure 4 was analysed using the differential angle between the test line and reference line instead of direct reading from the test line. This result of Figure 4 is valid as long as it is read via the differential angle and not direct reading from the test line.