Electronic Supplementary Material (ESI) for Lab on a Chip.

Supplementary Information

Microalgae on display: A microfluidic pixel-based irradiance assay for photosynthetic growth

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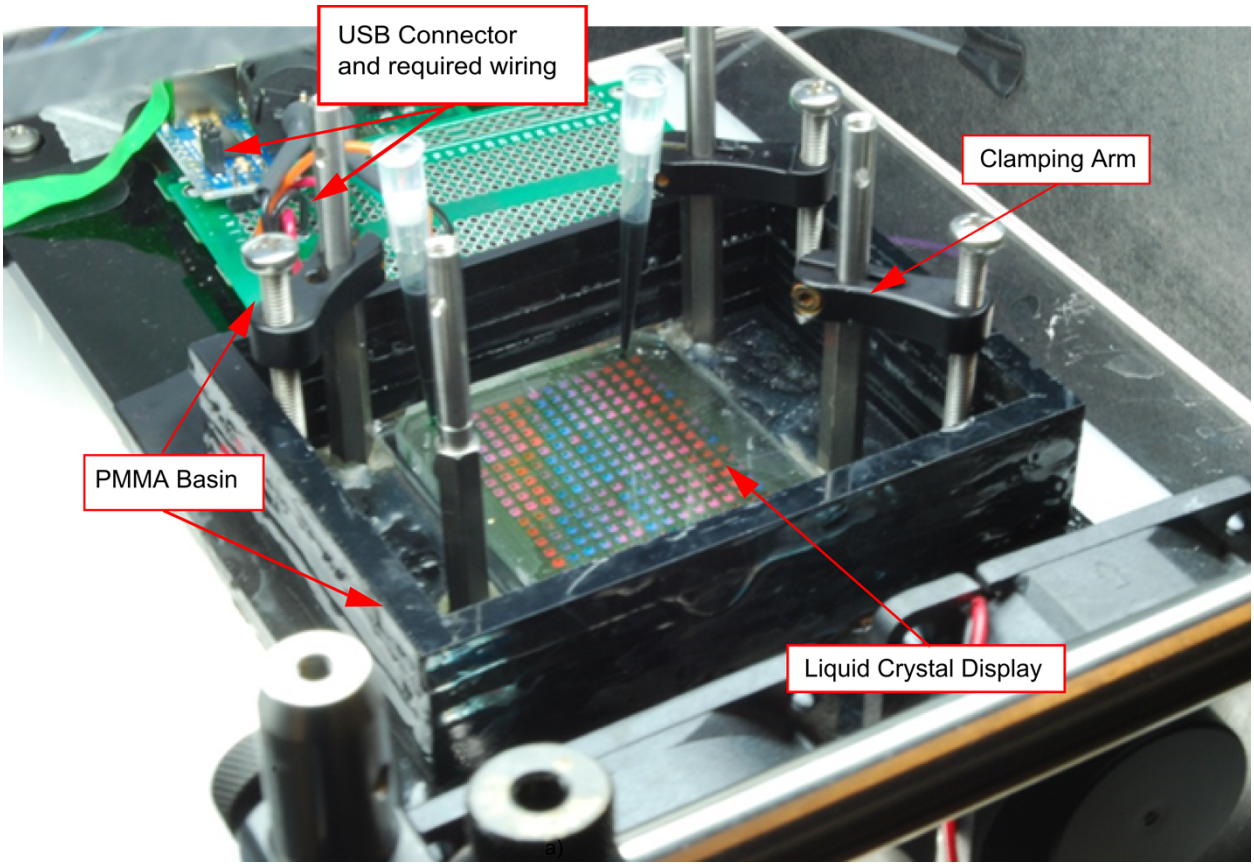

Fig. S1 Experimental setup for microfluidic pixel-based irradiance platform. A transparent PDMS chip filled with dye is used here for clarity (all chips used in experiments are opaque).

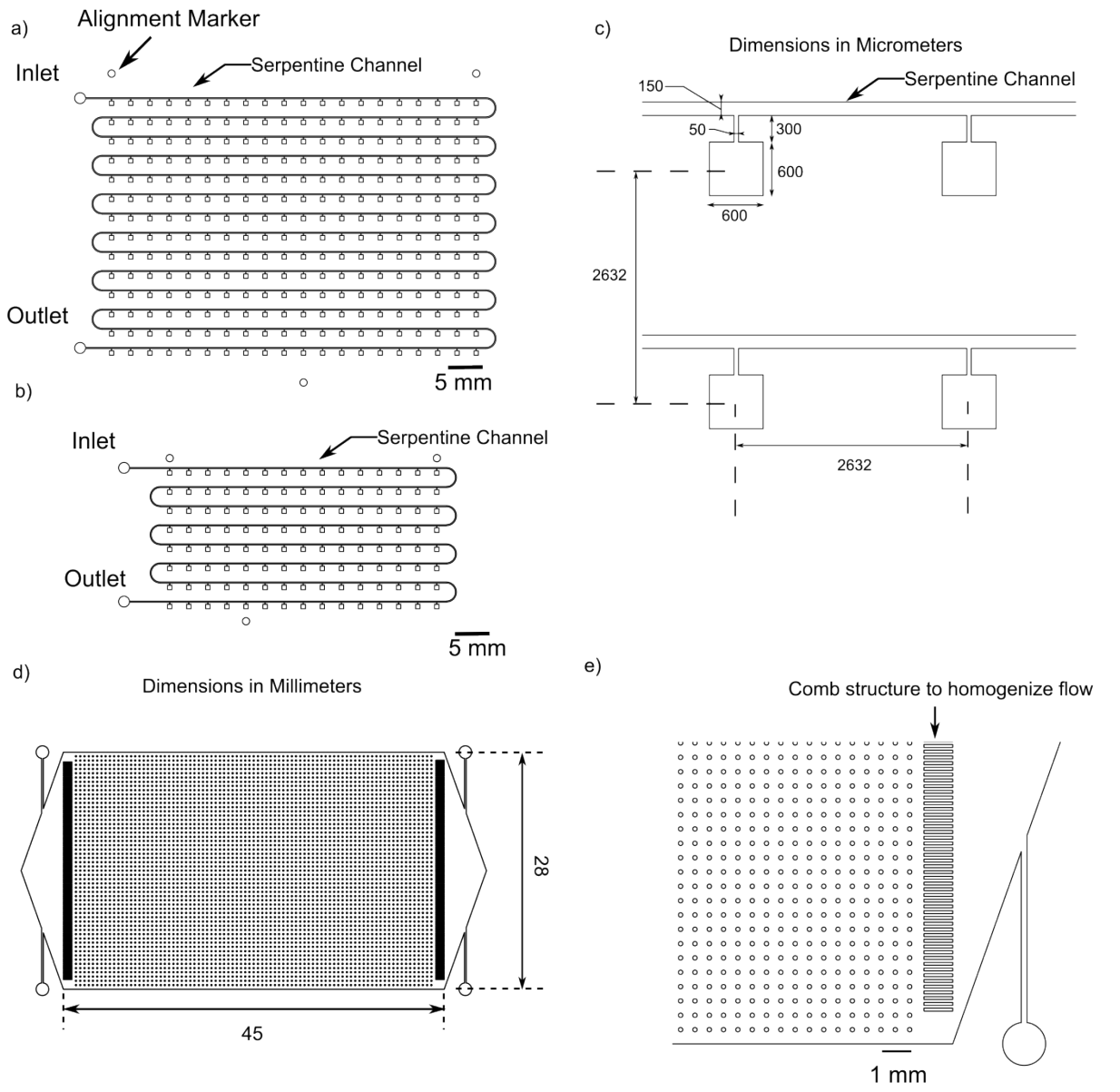

Fig. S2 Detailed schematics of microfluidic chips used in this work. a) Large format 14 x 20 microreactor array. b) Small format 8 x 15 microreactor array. Both microreactor style chips have three alignment markers. c) Key dimensions of microreactors used for array designs. d) Post array chip, used to produce the University of Toronto crest replica. e) Enlarged view of post array chip, showing a comb structure used to homogenize flow and aid in uniform cell seeding.

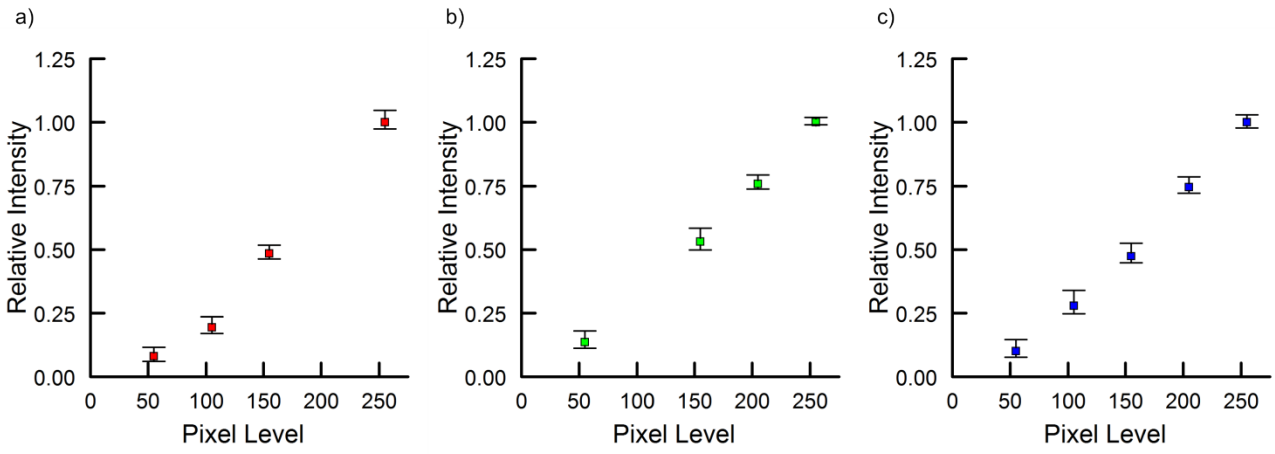

Fig. S3 Temporal uniformity of irradiance within an area of a microreactor corresponding to the size of a pixel for different pixel levels of (a) red, (b) green or (c) blue. The error bars represent min-max values of the 60Hz light signal.

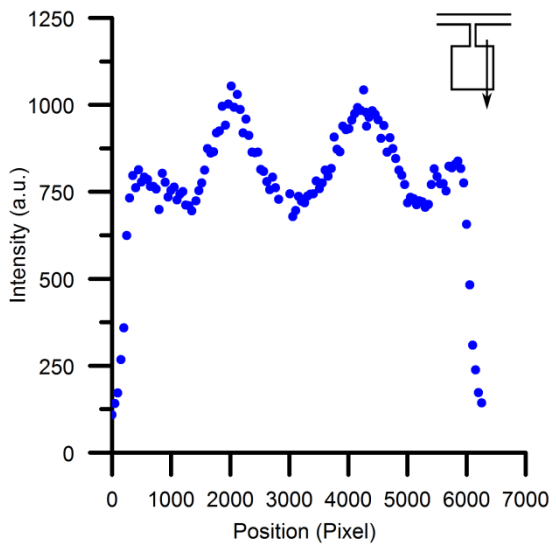

Fig. S4 Spatial uniformity of irradiance across a microreactor. Intensity within the microreactor is plotted as a function of position, where the positive direction in the plot corresponds to downwards along the microreactor, as shown in the inset. Lighting conditions correspond to a blue pixel level of 255, with red and green at a level of 0. The plot is obtained by combining intensity measurements from 8 images spanning the height of the microreactor. The standard deviation between the 1000 and 5000 pixel positions is 12% of the mean.

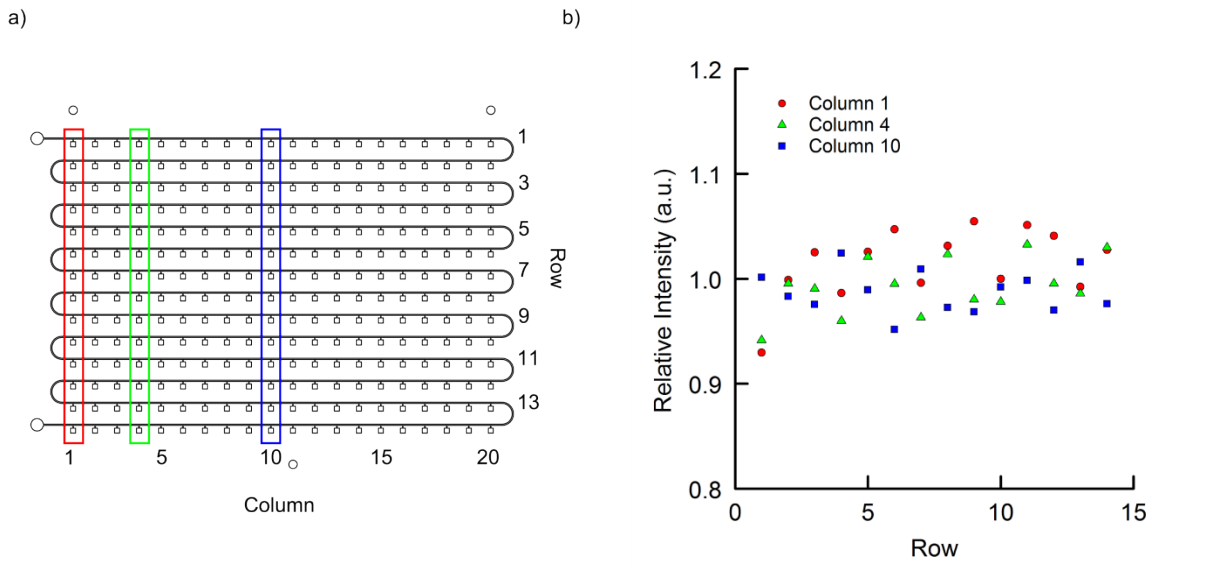

Fig. S5 Spatial uniformity of irradiance across the large format 14 x 20 microreactor array. a) The 14 x 20 microreactor array, with row and column numbering. b) Relative intensity along columns 1, 4 and 10.

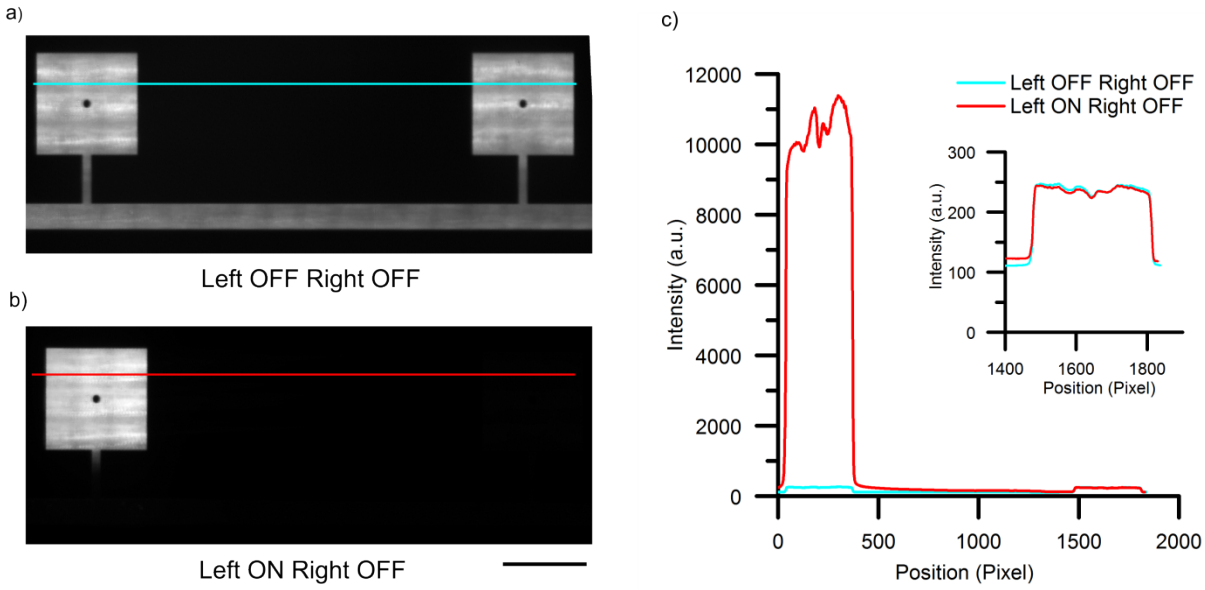

Fig. S6 Light Leakage between adjacent microreactors, characterised by placing a photomask against the LCD. a) Microscope image of two adjacent microreactors both set to and RGB value of (0,0,0). b) Microscope image of two adjacent microreactors, where the left reactor is set to (255,255,255) and the right reactor is set to (0,0,0). c) Intensity plot corresponding to a) and b), the inset highlights the intensity in the reactor kept at (0,0,0) for both cases.

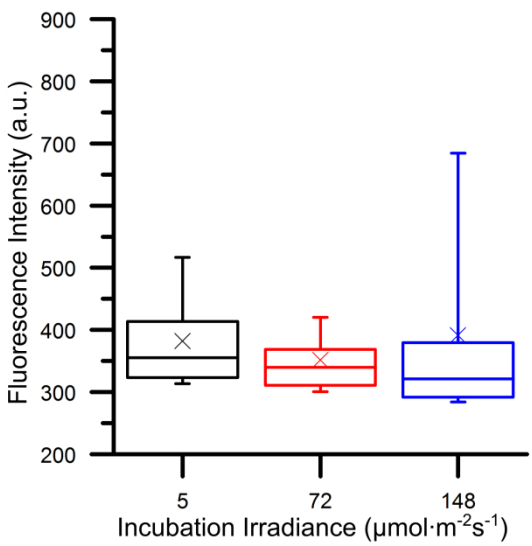

Fig. S7 Fluorescence signal measured across microalgal cells after two days growth, for three different incubation irradiance intensities, presented as a box and whisker plot. Fluorescence intensity was measured across the width of 25-35 microalgal cells for each irradiance. The box encompasses data from the 25th to 75th percentile and the whiskers capture the 10th and 90th percentiles. The average value is denoted by an X. Measured fluorescence intensity does not change significantly based on incubation irradiance conditions.

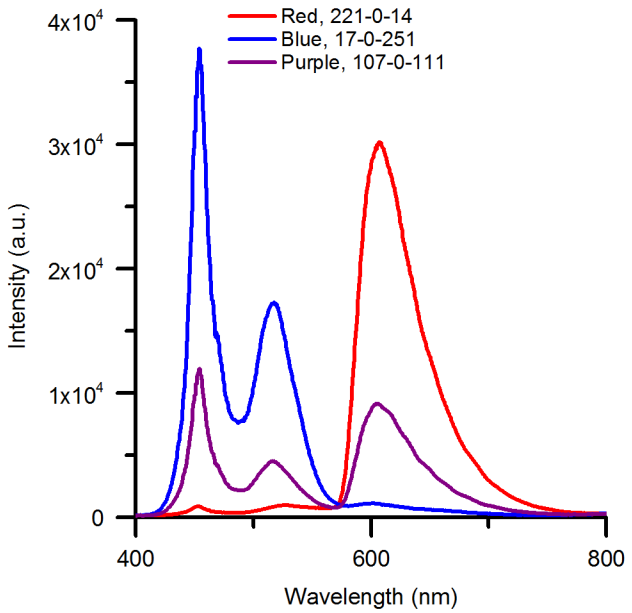

Fig. S8 Sample irradiance spectra of LCD screen operating under red, blue and purple settings. Corresponding RGB values are indicated in the legend.