Electronic Supplementary Material

Design and Construction of an Open Source-Based Photometer and its Applications in Flow Chemistry

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1. Schematics of the photometer

1.1. General schematic overview

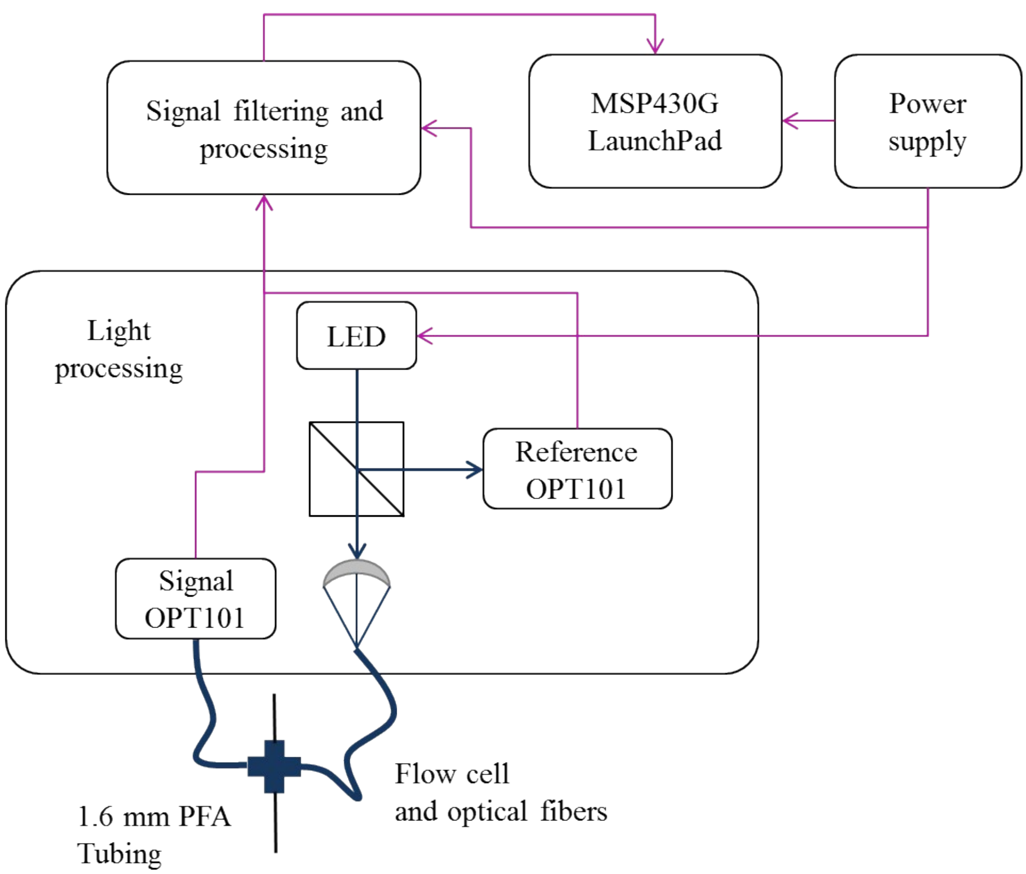

Figure S1. General schematic view of the photometer

1.2. Power supply

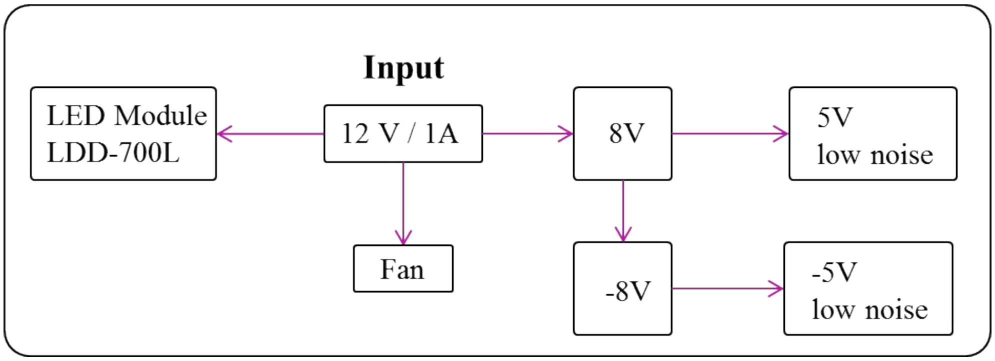

Figure S2. Power supply board

1.3. Filters and amplifiers

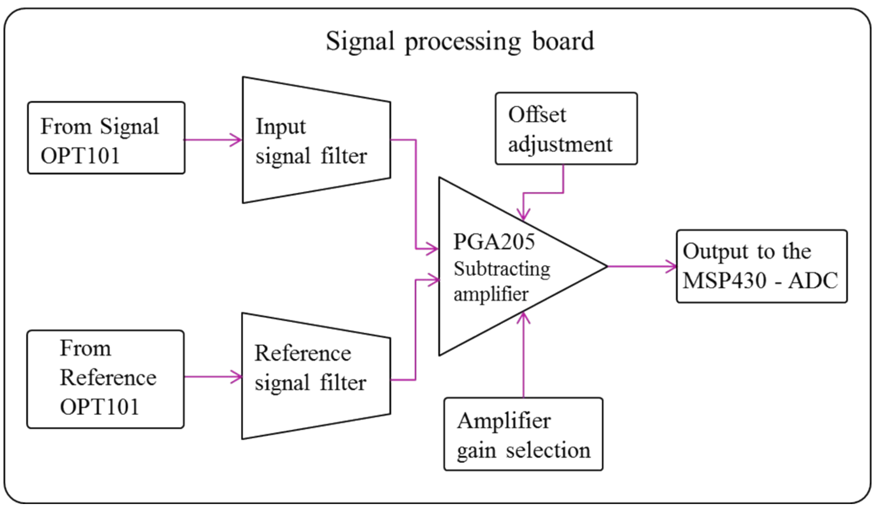

Figure S3. Signal processing board containing input filters and subtracting amplifier

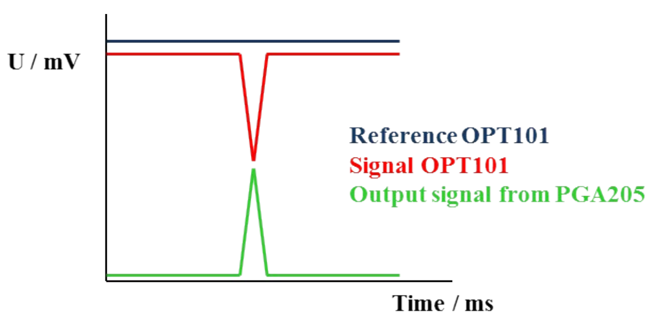

Figure S4. Subtracting mode of action of the amplifier

1.4. Detectors

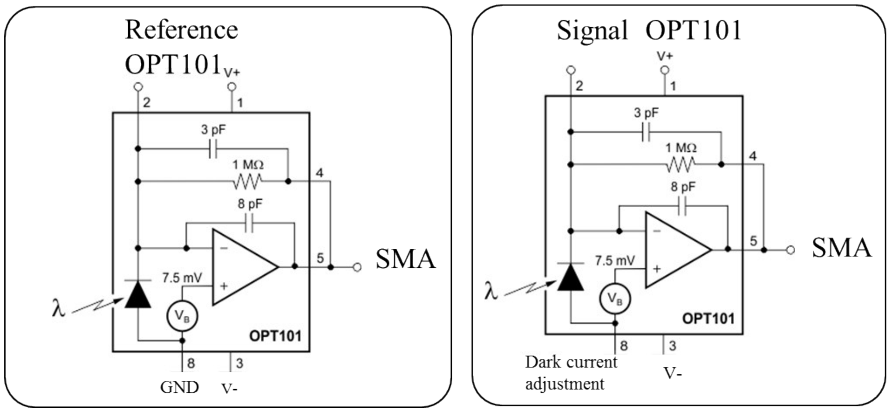

Figure S5. Reference Detector and Signal detector schematics

2. Emission spectra of used LEDs

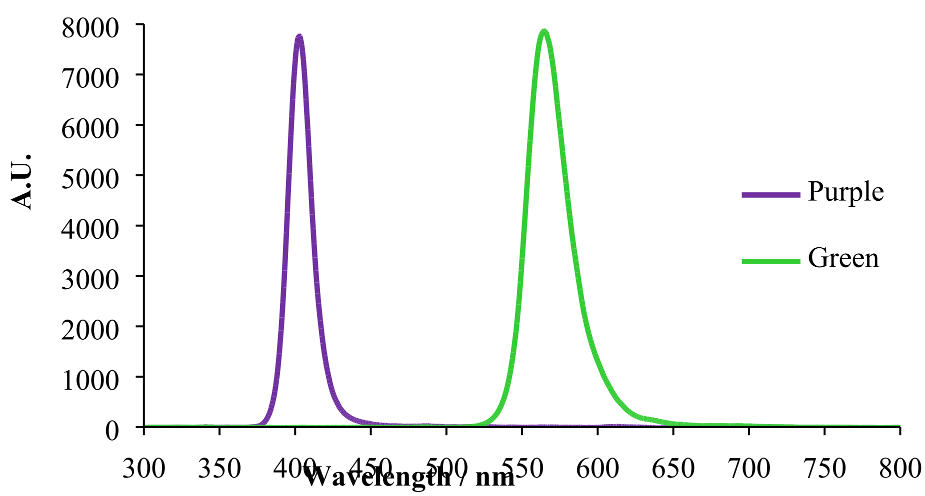

Figure S6. Emission spectra of 1W purple LED, and
green LED used in the experiments, measured with AvaSpec system (Avantes, Netherland)

3. Bill of materials

Table S1. Partially estimated bill of materials used for construction of the photometer

Manufacturer	Part number / description	Qty	Price / pcs ($)	Price ($)
Texas Instruments	MSP-EXP430G2 LaunchPad	1	9,99	9,99
Texas Instruments	OPT101	2	7,46	14,92
Texas Instruments	PGA205	1	17,51	17,51
Texas Instruments	TLV2141	4	1,76	7,04

Texas Instruments	REF200	2	8,42	16,84
Texas Instruments	TPS78101DDCR	4	0,83	3,32
Texas Instruments	TPS72301	2	2,63	5,26
Texas Instruments	OPA177GS	2	2,97	5,94
Mean Well	LDD-700L	1	4,95	4,95
Vishay-Dale	1206, Mini-melf precision resistors 0.1% 25 ppm	7	0,26	1,82
Vishay-Dale	1206, Mini-melf resistors 1.0% 50ppm	29	0,03	0,87
Kemet or AVX	1206 and 0805 precision capacitors 10%	50	0,05	2,50
Generic	Connectors, cables, PCB plates, supporting parts			65
Generic	Optical cable and lens		50	50
Thor labs	10 mm 50:50 beam splitter cube	1	154,02	154,02
			Total	**359,98**

4. Overlap of rose bangal dye and green LED

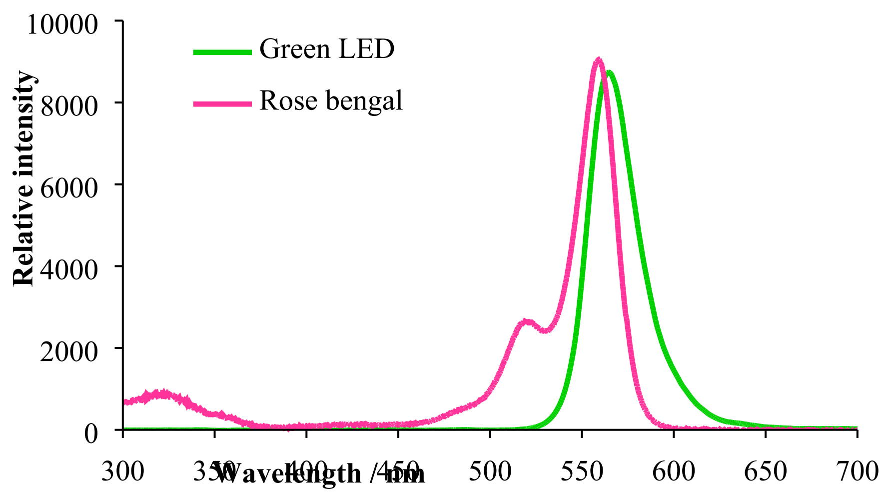

Figure S7. Absorption spectra of Rose bangal dye solution from PhotochemCAD software ref [S1], and emission spectra of green LED with ʎmax = 565 nm used in experiments.

5. Experimental setups for the pulse and step experiments

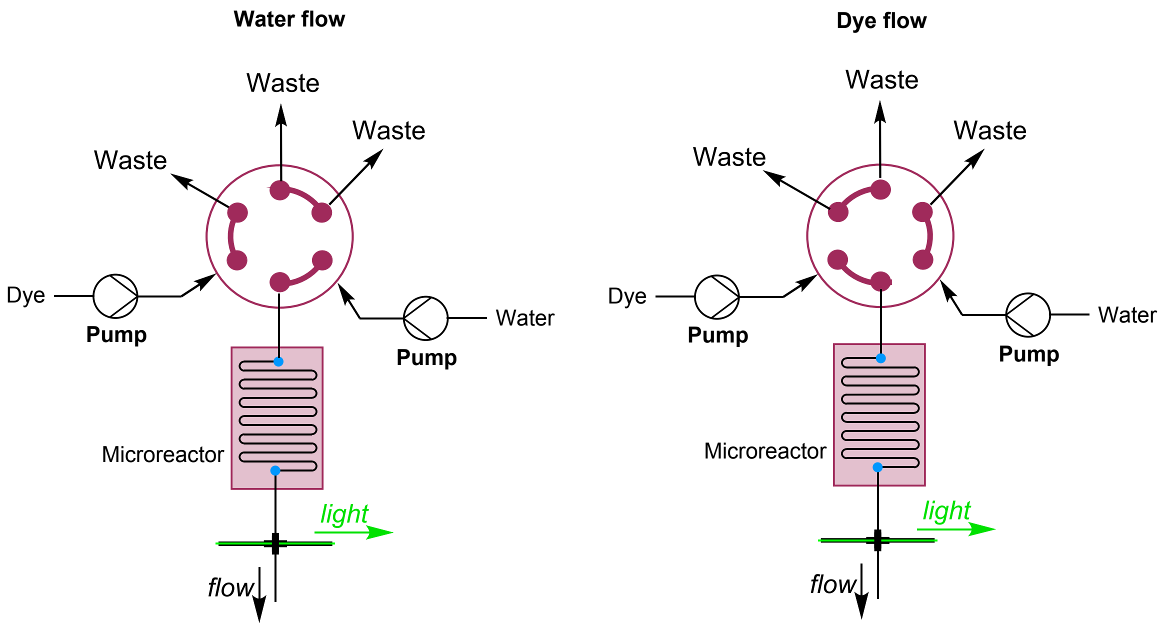

Figure S8. Setup for the step experiment

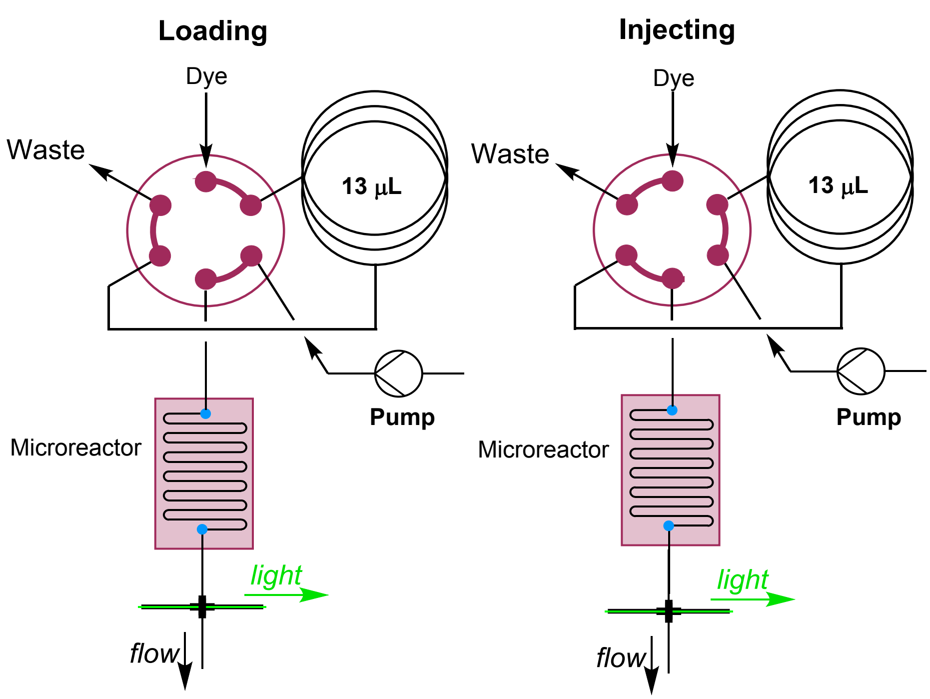

Figure S9. Setup for the pulse experiment

6. Schematics and pictures of used micromixers/microreactors

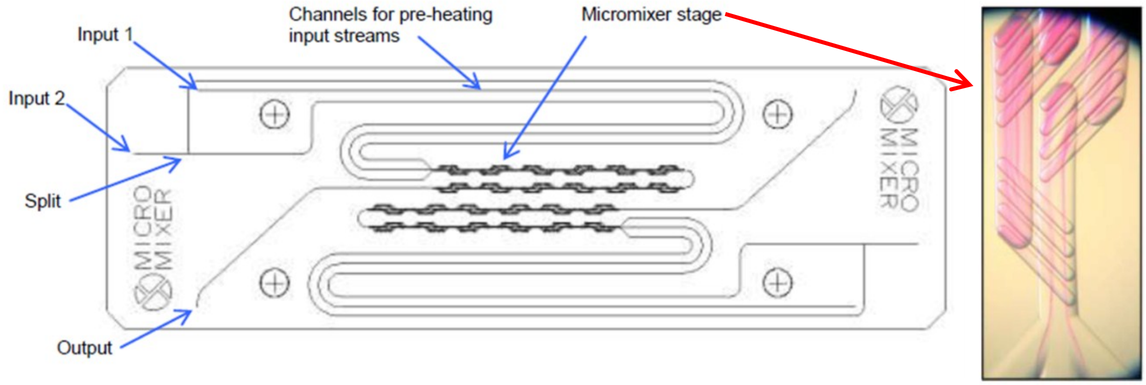

Figure S10. Asia 26 μL micromixer chip

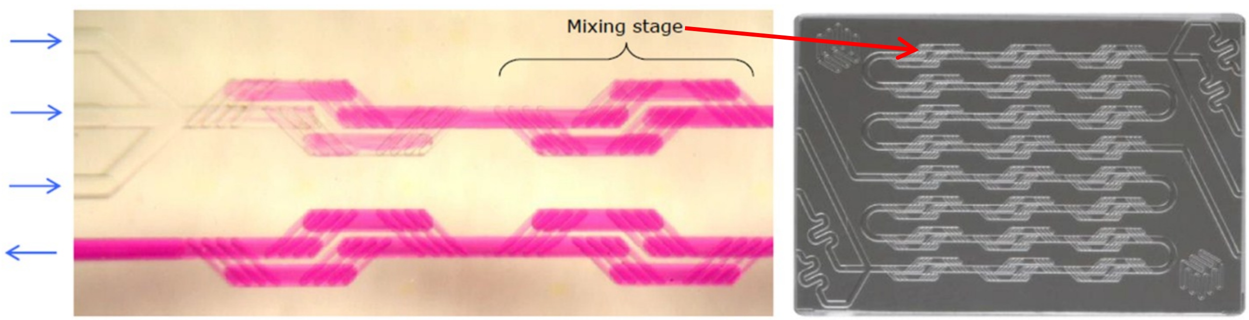

Figure S11. Dolomite 4.6 μL micromixer chip

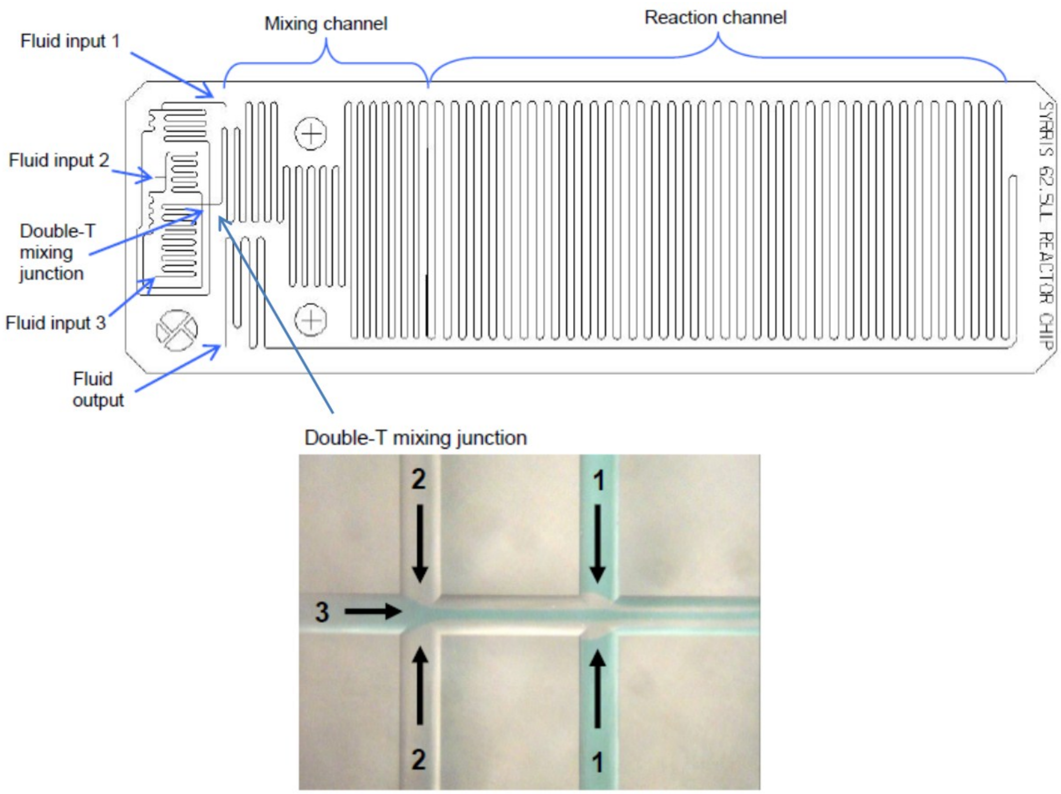

Figure S12. Syrris 250μL glass microreactor

Figure S13. Uniqsis 1.8 mL glass microreactor

Figure S14. PFA tube

7. F and E curves for tested micromixers using step experiments

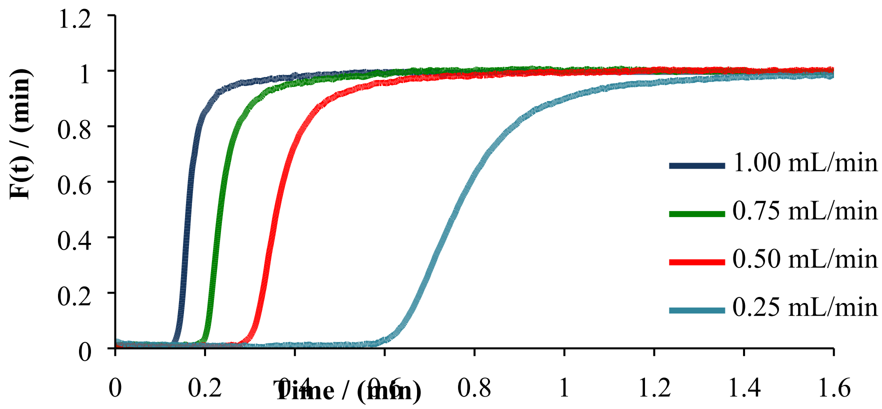

Figure S15. F curve calculated for the Asia 26 μL micromixer chip

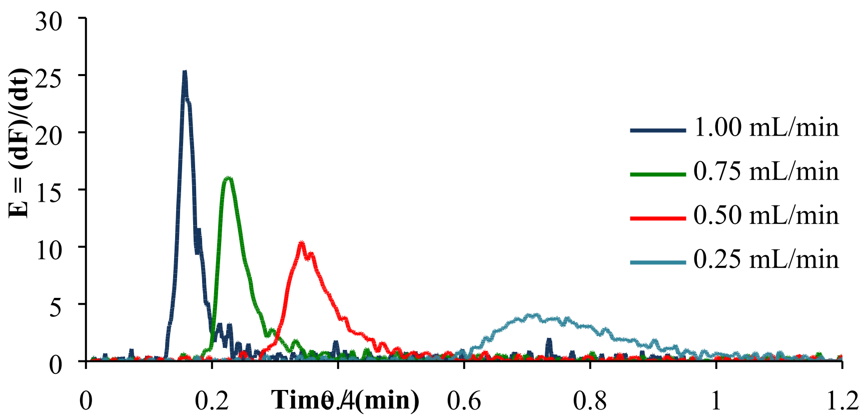

Figure S16. E curve calculated for the Asia 26 μL micromixer chip

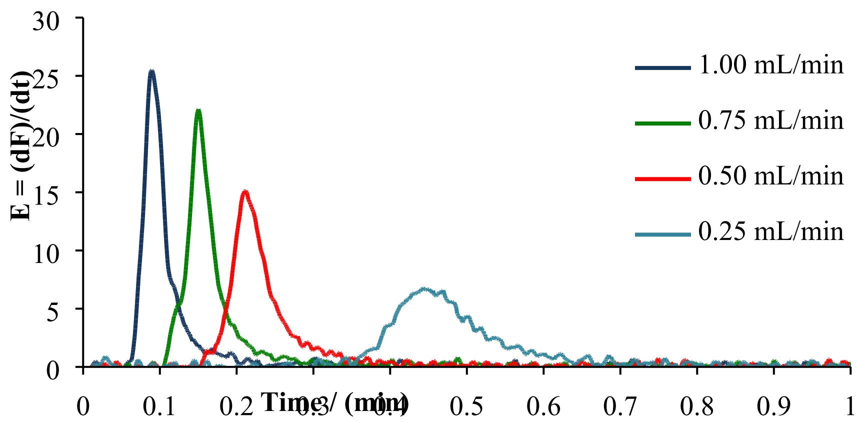

Figure S17. E curve calculated for the Dolomite 4.6 μL micromixer chip

8. F and E curves for tested microreactors using pulse experiments

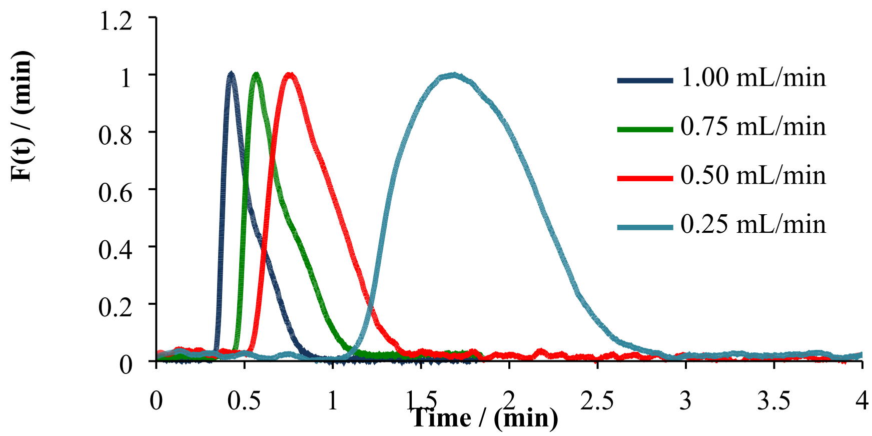

Figure 18. F curve calculated for the Syrris (250μL glass microreactor) from pulse experiment.

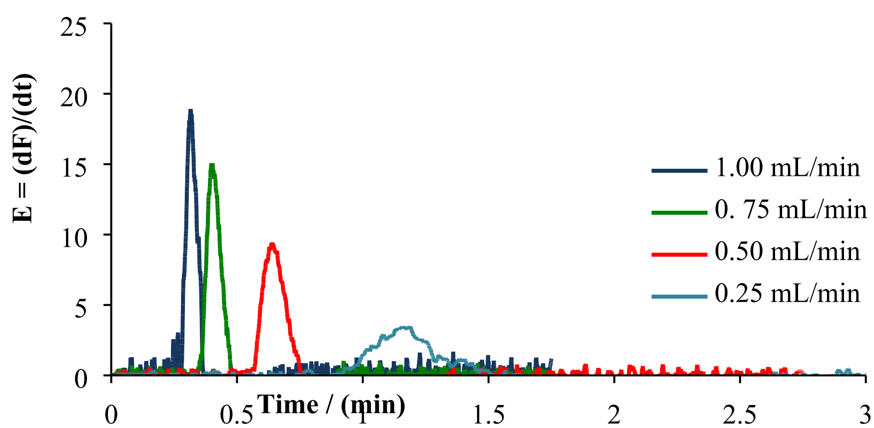

Figure S19. E curve calculated for the Syrris (250μL glass microreactor)

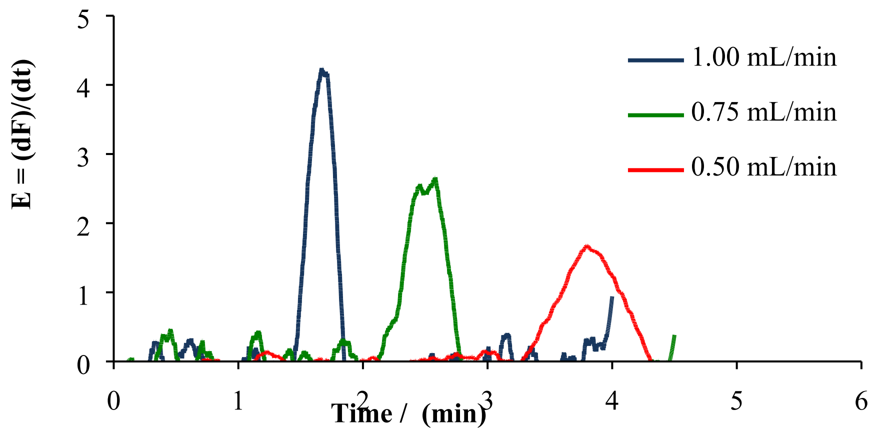

Figure S20. E curve calculated for the Uniqsis (1.8 mL glass microreactor)

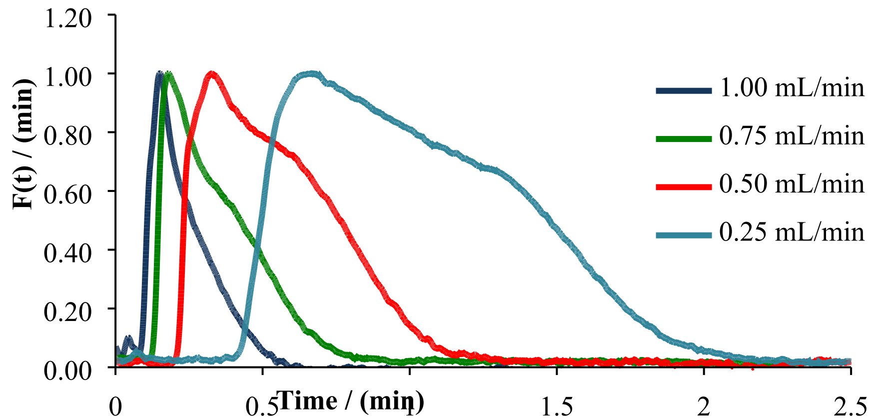

Figure S21. F curve calculated for the PFA tube (ID 0.8 mm, 250µL at 50 cm distance)

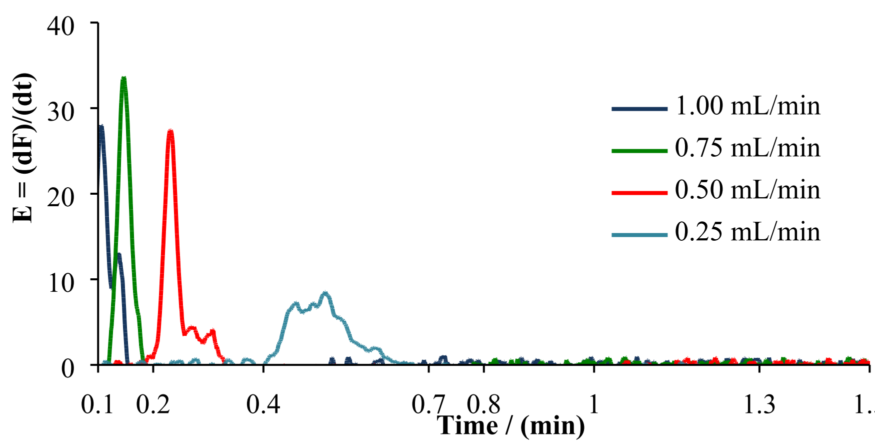

Figure S22. E curve calculated for the PFA tube (OD 1.6 mm, 250µL at 50 cm distance)

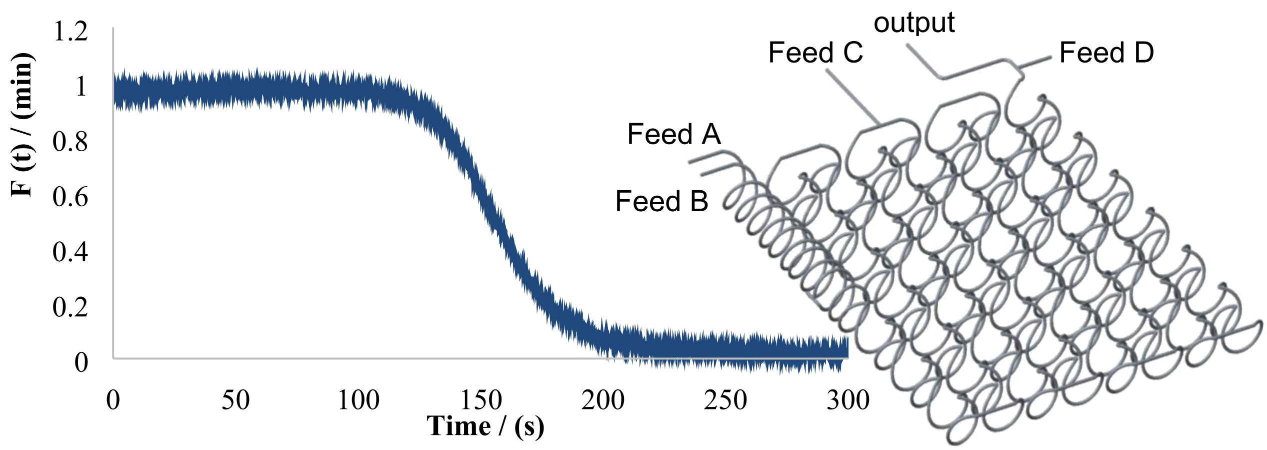

Figure S23. Step experiment for the 3D printed reactor (ca. 1.9 mL internal volume) with Rose Bengal (left). The CAD drawing of the reactor is shown on the right. Further details are provided in ref. [S2].

9. Hydrolysis of p-NFA

9.1. Experimental setup for biphasic hydrolysis and calibration graph

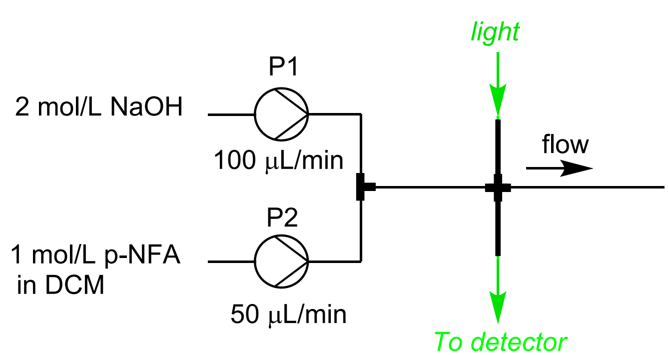

Figure S24. Schematics of experimental setup for hydrolysis

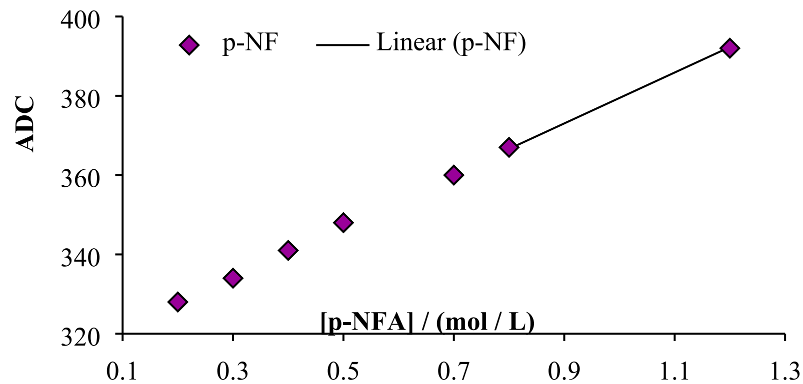

Figure S25. Calibration diagram for the p-NF, the y-axis is the ADC value output, which is then converted to the concentration.

9.2. Concentration of p-NF as the function of residence time, diagram.

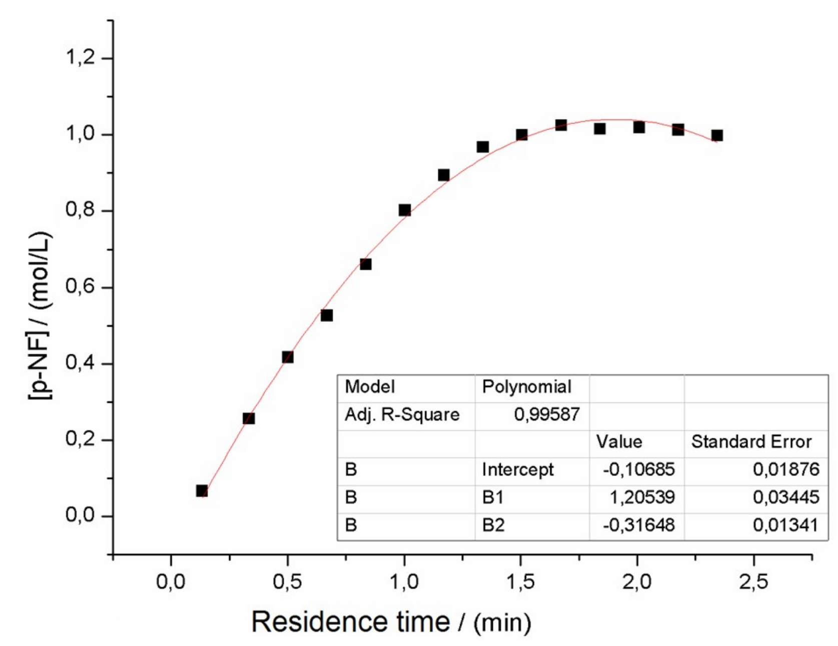

Figure S26. Concentration of p-NF as the function of residence time with fitted line

9.3. Ln [p-NFA] vs residence time, diagram.

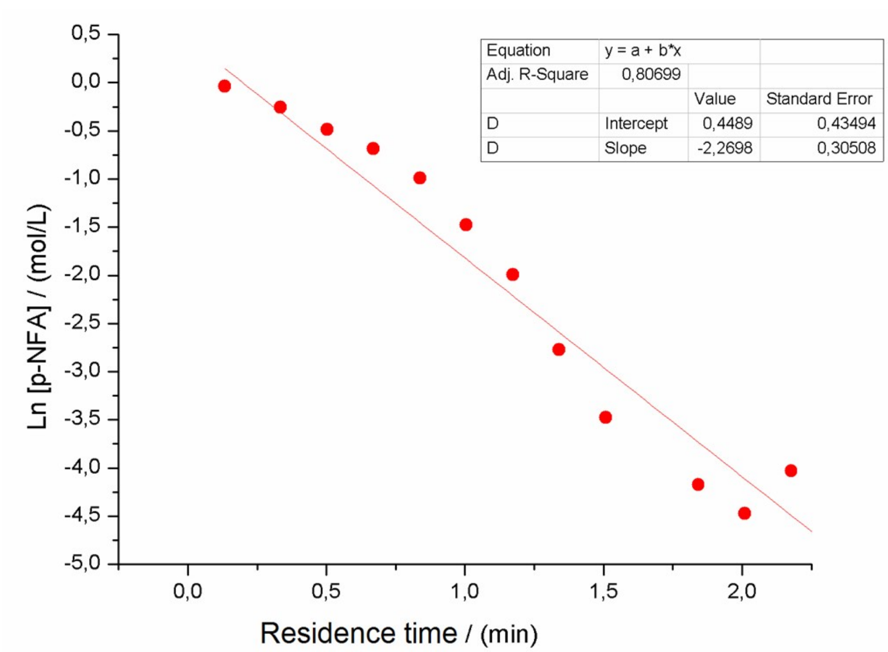

Figure S27. Calculated Ln [p-NFA] vs residence time, some points show a large deviation caused by taking Ln of the value with superimposed signal noise as the consequence of the segmented flow regime.

9.4 Segment lengths measurements and calculations

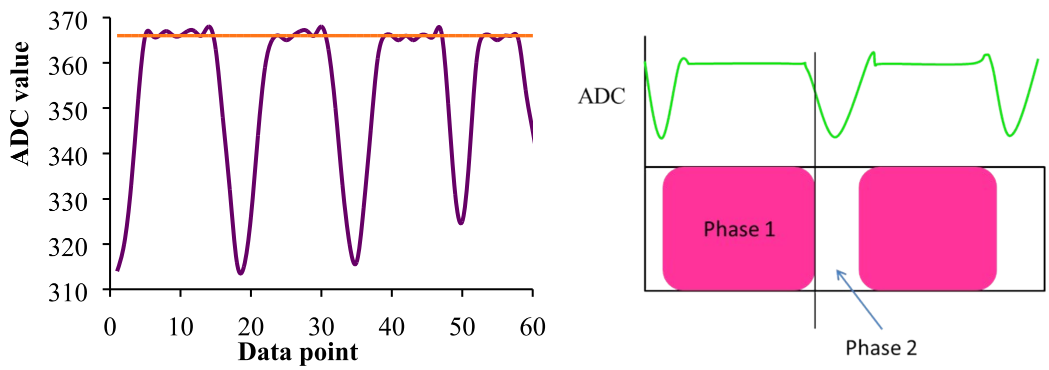

Figure S28. a) Highlighted first 55 points from data in Figure 6b. b) Schematic representation of light scattering at the phase boundary.

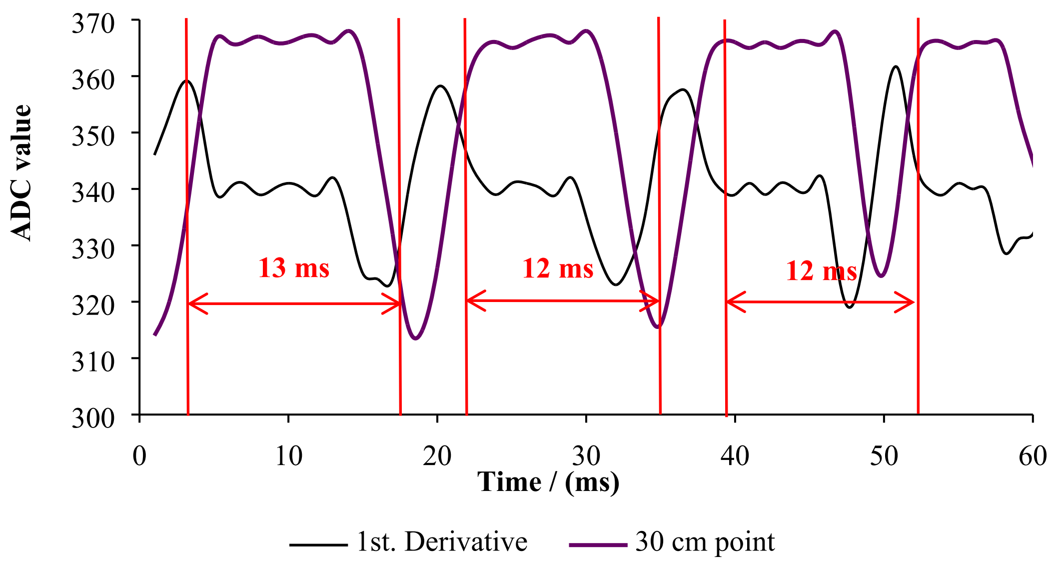

Figure S29. Example of measuring the time/length of segments (the average was 12.3 ms; since the resolution is 1 ms the average comes down to 12 ms).

10. References

S2: https://omlc.org/spectra/PhotochemCAD/index.html

S2: B. Gutmann, M. Köckinger, G. Glotz, T. Ciaglia, E. Slama, M. Zadravec, S. Pfanner, M. C. Maier, H. Gruber-Wölfler and C. O. Kappe, *React. Chem. Eng.*, 2017, **2**, 919-927.