Supporting information

Controlling explosive and highly energetic reactions: scaling up the liquid-phase aerobic oxidation of alcohols and aldehydes in flow

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1. Description of the experimental setup

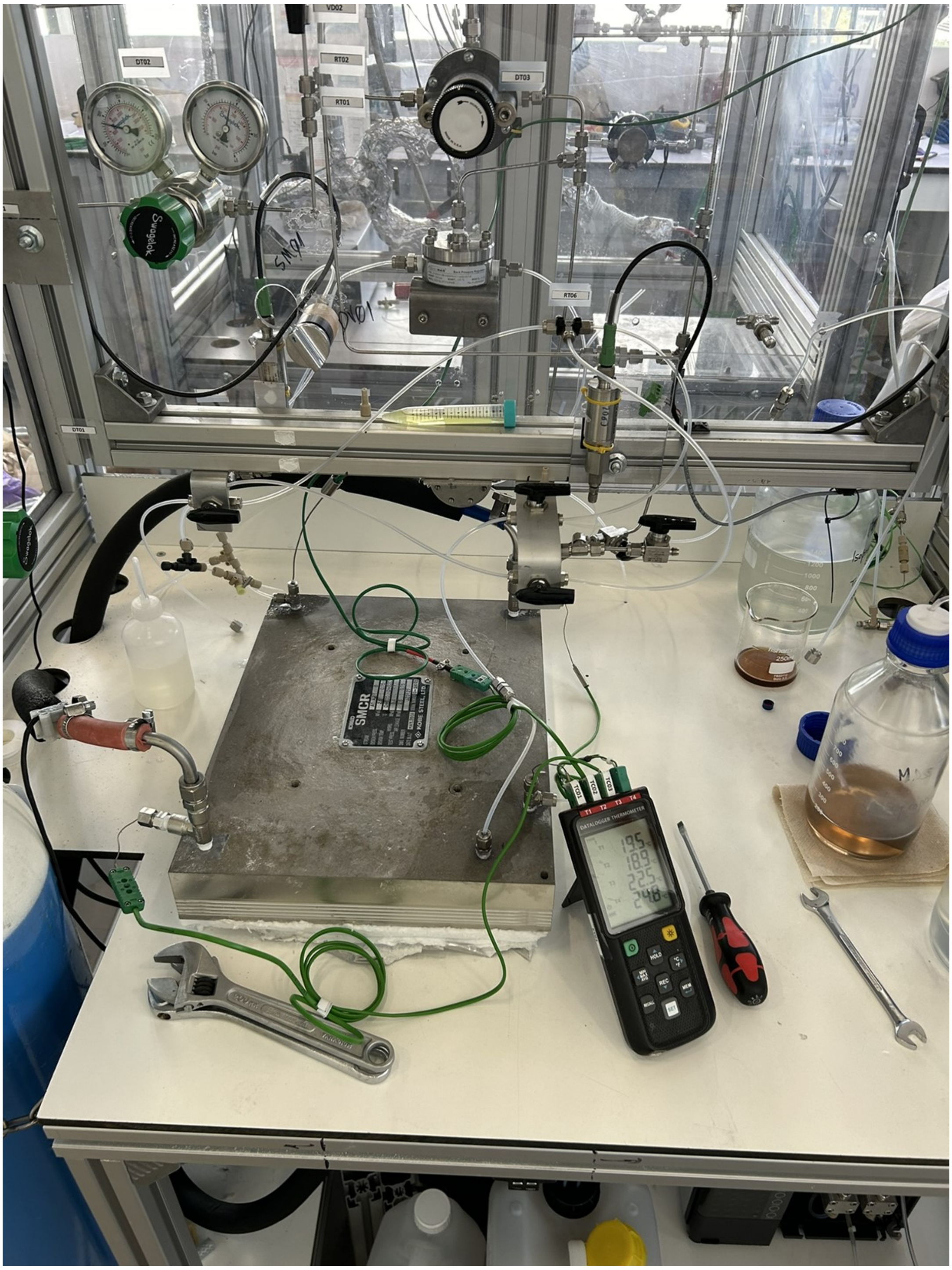


Figure S 1. Uninsulated Kobelco SMCR® reactor

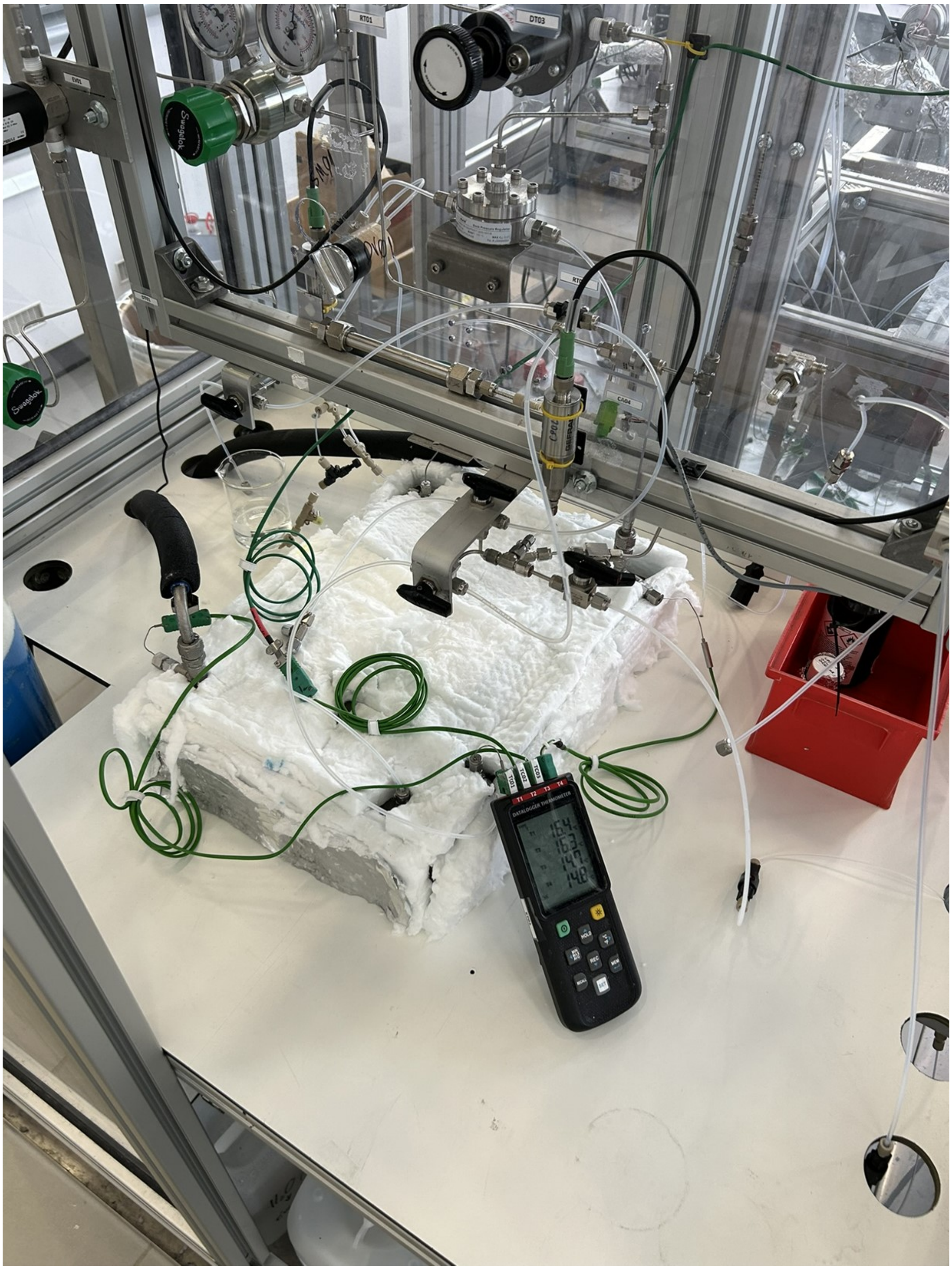


Figure S 2. Insulated Kobelco SMCR® reactor

Figure S 3. Experimental setup

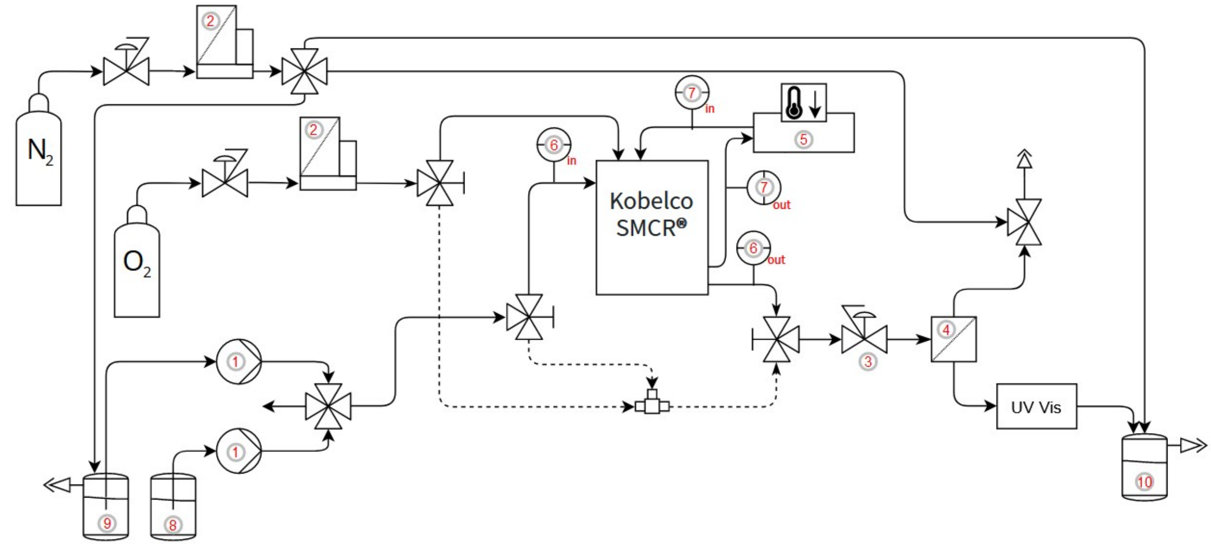


Figure S 4. Scheme of the experimental setup

2. Typical chromatograms

All products and reactants are commercially available. The products were unequivocally identified by comparison of the GC retention times and mass spectra of authentic samples.

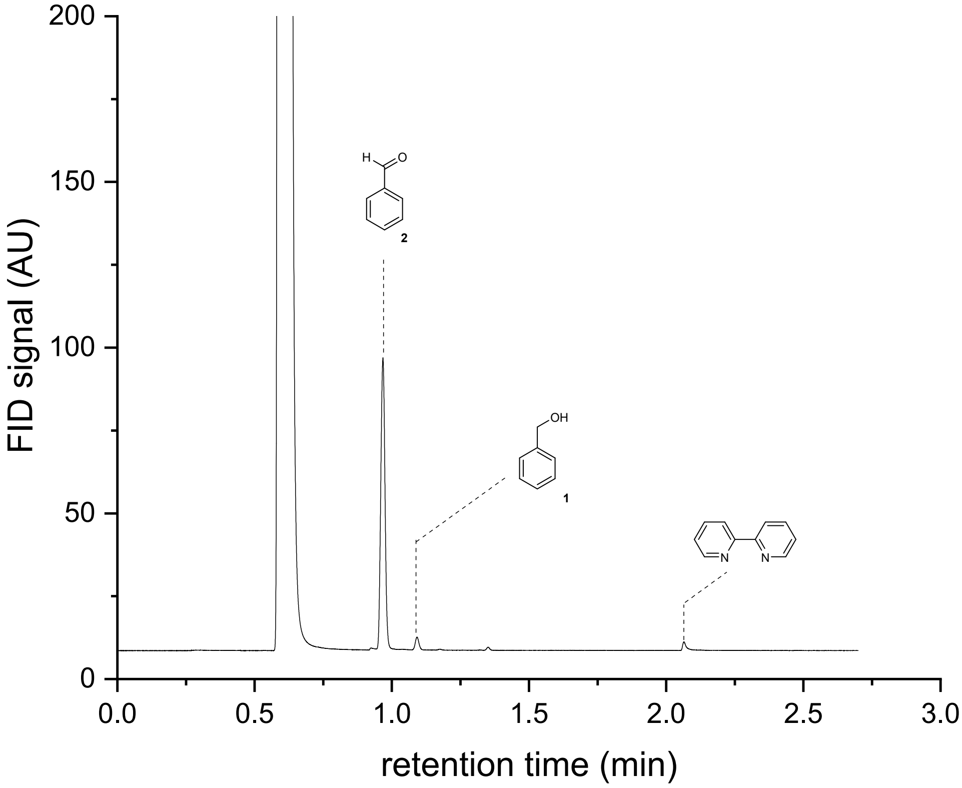


Figure S 5. Typical chromatogram for benzyl alcohol oxidation into benzaldehyde. See reference [1] for details.

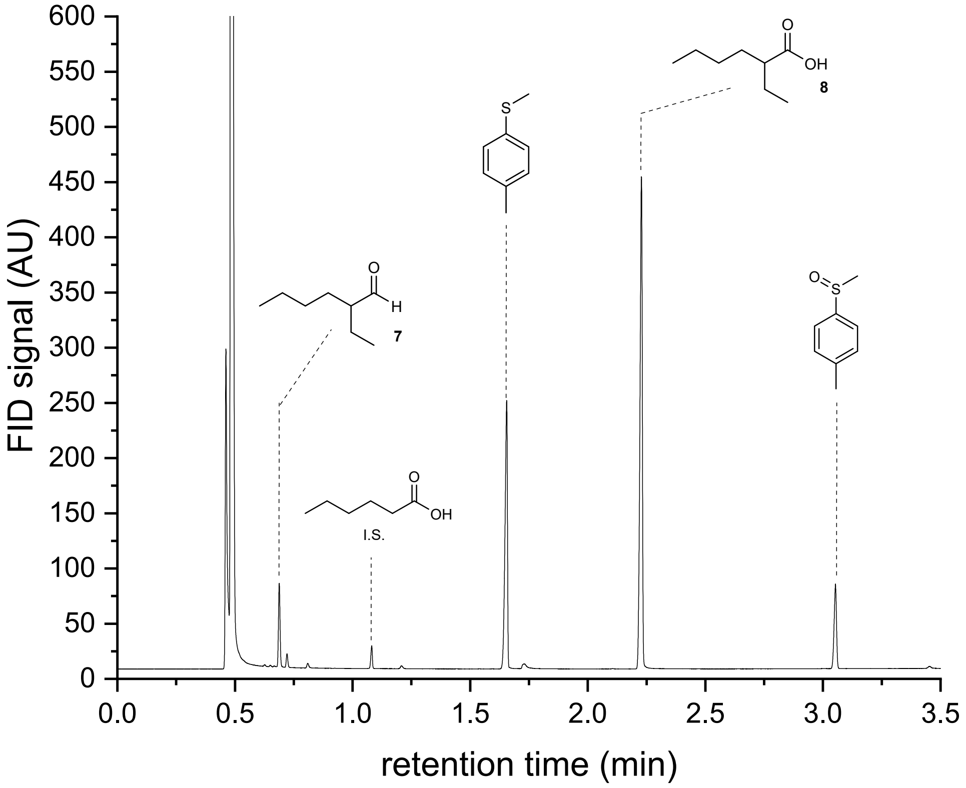


Figure S 6. Typical chromatogram for 2-ethylhexanal **7** oxidation into 2-ethylhexanoic acid **8** with simultaneous determination of the concentration of peracid **13**. See reference [2] for details.

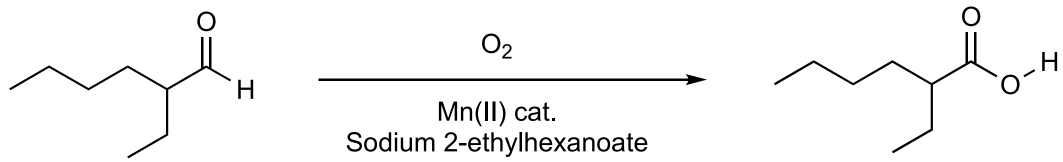
3. Data retrieved from literature and experiments to calculate volumetric productivity ($kg/L_R/h$) for oxidation of alcohols in Table 1.

Table S 1. Comparison of the productivity for batch and continuous flow aerobic oxidation of alcohols

Entry	Alcohol	Catalytic system [a)]	Residence time	Temp. (°C)	Yield	O_2 (bar)	Reactive reactor volume (mL)	Vol. prod. ($kg/L_R/h$)	Ref
1	0.4 M benzyl alcohol **1** in CH_3CN	Cu/TEMPO	1 min	25	99 %	5	43	0.48	This work
2	1 M 4-fluorobenzothiophen-2-yl-methanol in DMSO	Cu/TEMPO	32 h	50	92%	0.2 [c)]	80’000 [b)]	0.002 [b)]	[3]
3	0.4 M cinnamyl alcohol 3 in CH3CN	Cu/TEMPO	4 min	25	99	5	43	0.15	This work
4	0.4 M benzyl alcohol 1 in CH3CN	Cu/TEMPO	5 min.	100	99 %	3.2 [c)]	66	0.06	[4]
5	0.4 M benzyl alcohol 1 in CH3CN	Cu/TEMPO	5 min	r.t.	99 %	5	5	0.08	[1]
6	0.4 M benzyl alcohol 1 in CH3CN	Cu/TEMPO	0.6 min	40	99 %	3.2 [c)]	2.5 [b)]	0.87	[5]
7	0.3 M benzyl alcohol 1 in toluene	Pd/Pyridine	2.5 h	100	87 %	1.9 [c)]	400	0.016	[6]
8	0.06 M benzyl alcohol 1 in AcOH	Fe/TEMPO	2.3 min	80	85 %	8	25	0.008	[7]
9	0.4 M 1-octanol in 5 CH3CN	Cu/TEMPO	6.1 min	60	95 %	5	43	0.12	This work
10	0.3 M 1-octanol in 5 CH3CN	Cu/TEMPO	2.5 min	65	99 %	3.2 [c)]	2.5 [b)]	0.03	[5]
11	0.2 M 1-octanol in 5 CH3CN	Cu/TEMPO	45 min	100	95 %	3.2 [c)]	38	0.0007	[4]
12	0.4 M 1-octanol in 5 CH3CN	Cu/ABNO	3.1 min	60	99 %	5	43	0.24	This work
[a)] For detail, see Table 1; [b)] Reaction performed in batch. [c)] Calculated O_2 pressure (air or diluted O_2 in N_2 was used)									

4. Data retrieved from literature and experiments to calculate volumetric productivity (kg/L_R/h) for oxidation of 2-ethylhexanal in Table 2.

Table S 2. Comparison of the productivity for the continuous flow aerobic oxidation of 2-ethylhexanal



Entry	Catalyst	Concentration	Reactive reactor volume (mL)	Residence time	Conv./Selec.	Volumetric productivity	Ref
1	0.0005 mol% [a)]	5.6 M (neat)	15	~ 2 min [b)]	> 99% / 97%	4.1 kg/L_R/h	[8]
2	0.0125 mol% [c)]	5.6 M (neat)	43	30s	> 99% / 98%	14.0 kg/L_R/h	This work
3	0.0001 mol% [d)]	1.5 M	20 (3 x 6.52)	13.4 min	90% / 96%	0.28 kg/L_R/h	[9]

[a)] PFA tubing ; Mn(II) catalyst; sodium 2-ethylhexanoate 2 mol%; reactive reactor volume: 15 mL; Q_L: 1.25 ccm; Q_G: 100 Nccm, F_G/F_L: 0.58, P O_2: 7.5 bar, Q_G/Q_L: 8.6. b) *approximation from experimental conditions* [c)] Kobelco SMRC®; Mn(II) catalyst; sodium 2-ethylhexanoate 9 mol%; reactive reactor volume: 43 mL; Q_L: 12.5 ccm; Q_G : 1000 Nccm, F_G/F_L: 0.58, P O_2: 10 bar, Q_G/Q_L: 8.6 . [d)] Continuous stirred-tank reactor; Mn(II) catalyst; sodium 2-ethylhexanoate 2 mol%; reactive reactor volume: 20 mL (3 x 6.52); Q_L: 0.5 ccm; Q_G: 4.8 Nccm, P O2: 1.38 bar.

5. References

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