Supporting Information

H_2O_2 production in microbial electrochemical cells fed with primary sludge

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SUPPORTING INFORMATION

8 pages including cover page

2 tables

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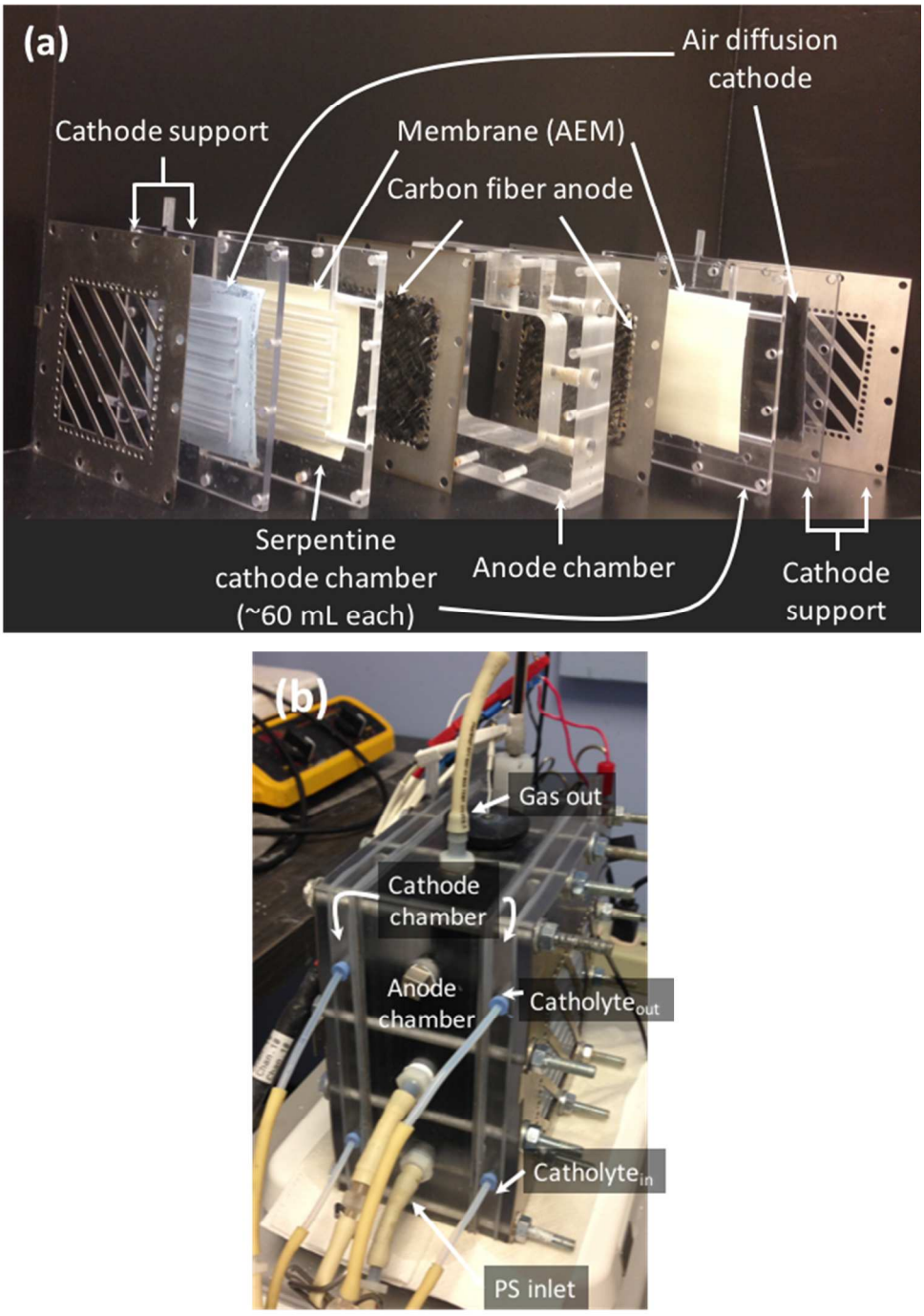


Figure S1. Microbial peroxide producing cell (MPPC) design. All of the reactor components (a) and the assembled system (b).

Table S1. Characteristics of PS influent and MEC and MPPC effluents for experiments with a 9-day HRT

	MEC		MPPC	
	Influent	Effluent	Influent	Effluent
TCOD	7450 (±330)	2860 (±20)	7700 (±90)	3940 (±40)
SSCOD	370	280	420 (±20)	340 (±20)
TSS	4260 (±40)	1880 (±20)	4590 (±140)	2650 (±70)
VSS	3740 (±20)	1680 (±10)	3890 (±130)	2210 (±60)

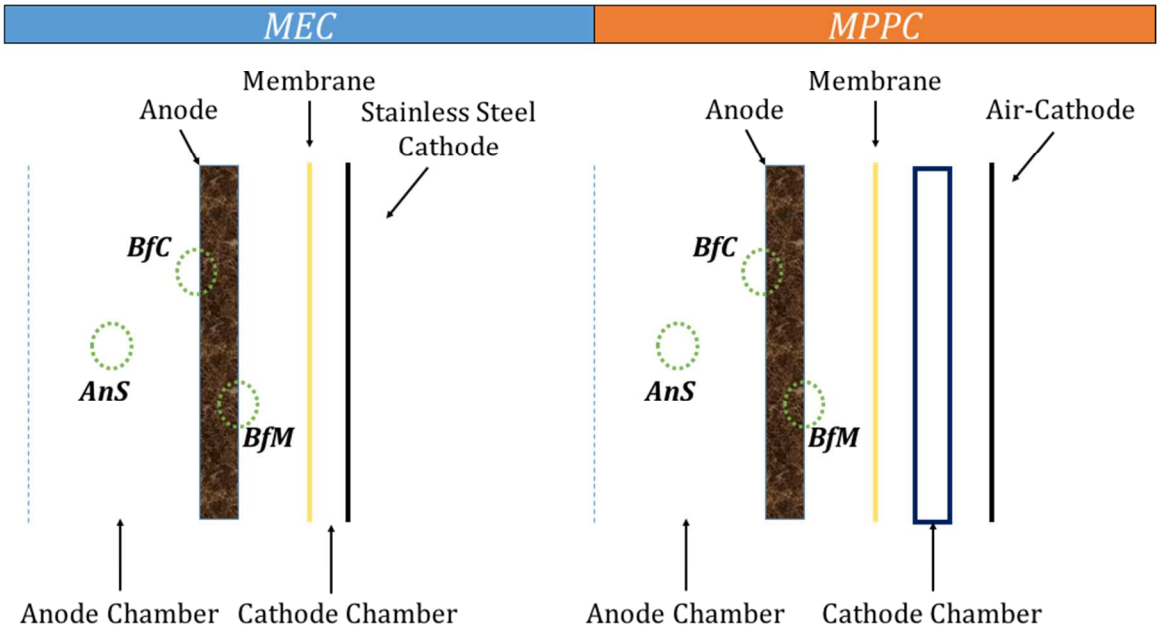


Figure S2. Schematic view for the sampling locations in the MEC and MPPC at the end of operation: anode suspension (AnS), biofilm of chamber side (BfC), and biofilm of membrane side (BfM).

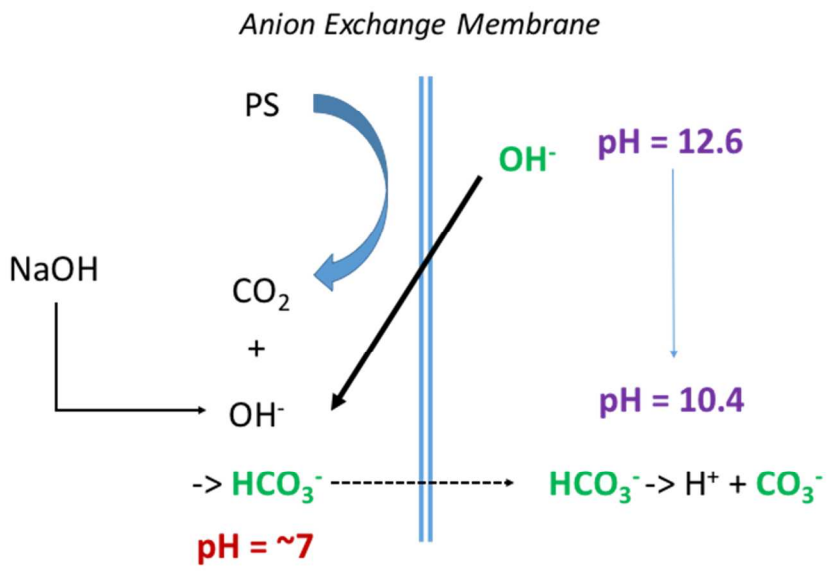


Figure S3. Possible mechanisms ion migration and diffusion across the anion exchange membrane between the anode and the cathode.

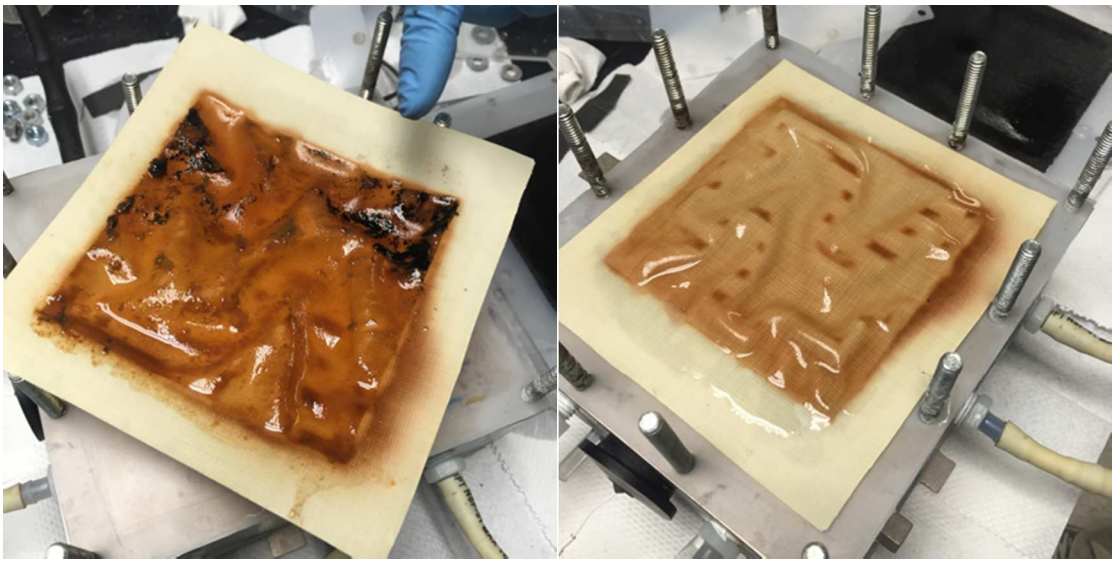


Figure S4. Anion exchange membrane used during MPPC fed with PS for 27 days. Left (anode side) and Right (cathode-chamber side).

Abiotic H_2O_2 decay tests in different salt solutions

We performed H_2O_2-decay tests using 40 mL bottles in 100-mM solutions of sodium carbonate, sodium bicarbonate, and sodium hydroxide with ~2700 mg L^{-1} of H_2O_2. Although pH was maintained stable during ~1 day operation, the H_2O_2 concentration in sodium carbonate decreased very rapidly (99% removed in 23 hours), while H_2O_2 in the positive control with deionized water was very stable. H_2O_2 concentrations in sodium hydroxide and sodium bicarbonate were relatively stable, with 9 and 28% removals in 23 hours.

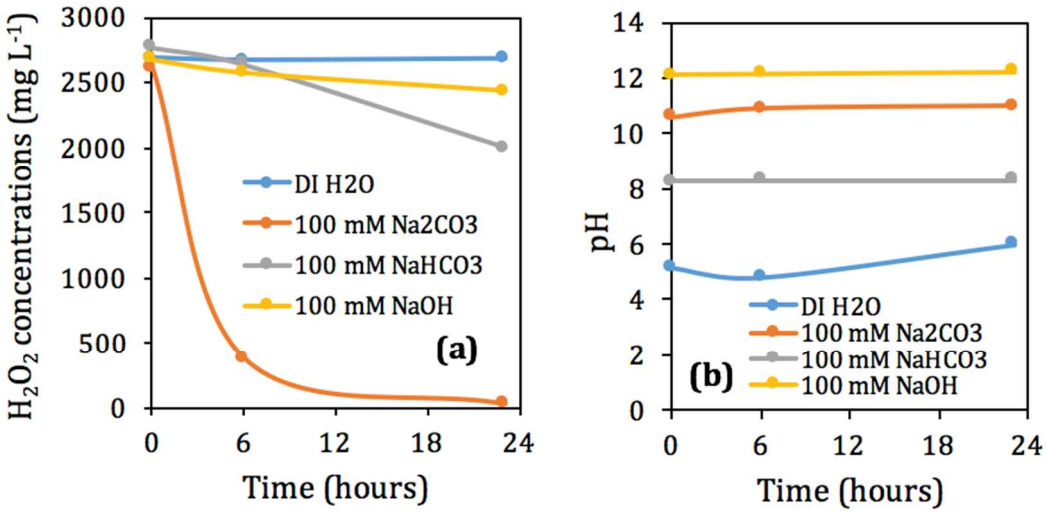
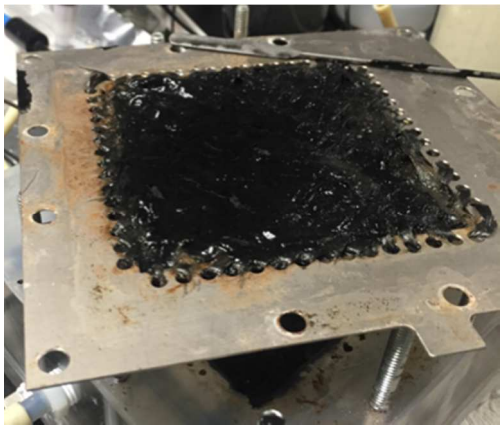


Figure S5. H_2O_2 decay with time in different solutions: 100 mM sodium carbonate, sodium bicarbonate, and sodium hydroxide. (a) H_2O_2 concentration and (b) pH.

MEC

Chamber side of anode	Membrane side of anode
	

MPPC

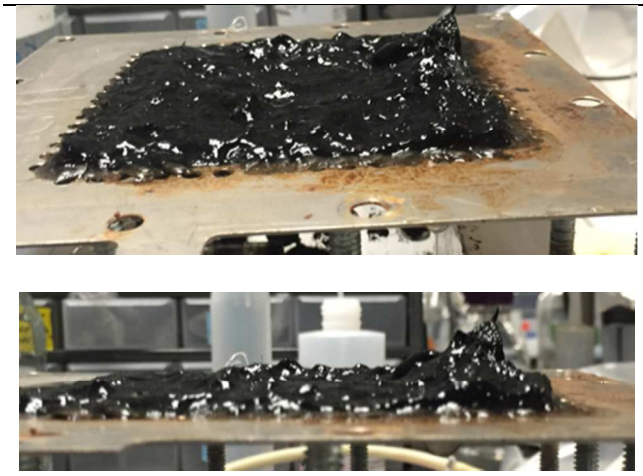
Chamber side of anode	Membrane side of anode
	

Figure S6. Comparisons of solid biomass on carbon fiber anodes towards chamber and membrane after MEC (top) and MPPC (bottom) operation

Table S2. A summary of H_2O_2-producing microbial electrochemical cell studies using real wastewater

Source	Anolyte	Anode HRT	Membrane type	Catholyte	Maximum H_2O_2 conc. (wt %)	Maximum current & voltage applied	Energy input (kWh/kg H_2O_2)	PPE (%)*
Arends et al. (2014)	Wetland effluent	Batch	AEM	50 mM NaCl	0.056%	10 A/m^2 at 0.6 V	2.5	~40
Modin & Fukushi (2012)	Domestic wastewater	6 min HRT	CEM	50 mM NaCl	0.008%	0.2 A/m^2 at 0.6 V	18.2	4.8
Modin & Fukushi (2013)	Domestic wastewater	15 min HRT	CEM	50 mM NaCl	0.23%	0.5 A/m^2 at 1 V	8.3	37-66
Sim et al. (2015)	Raw domestic wastewater	2-10 hr HRT	CEM	Deionized water	0.001%	0.56 A/m^2 at 12 V	78	~10-70
This study	Primary sludge	9 day HRT	AEM	50 mM NaOH	0.023%	1 A/m^2 at 0.2 V	0.87	4-72

* PPE: H_2O_2 production efficiency