Supporting Information

Impact of cathodic electron acceptor on microbial fuel cell internal resistance

Kathryn Lawson[1], Ruggero Rossi[1], John M. Regan[1], Bruce E. Logan[1]*

[1]Department of Civil and Environmental Engineering, The Pennsylvania State University,
231Q Sackett Building, University Park, PA 16802, USA
*Corresponding author: e-mail: blogan@psu.edu; phone: +1-814-863-7908; fax: +1-814-863-7304

Information in the Tables S1–S4 provides information for the reported measurements on electrolye and electrode resistances and working whole cell and electrode potentials.

Table S1: Electrode spacings (for cells with two values, one reactor for each distance) used to calculate the electrolyte resistances. The anode-reference electrode is assumed to be zero.

Reactor	**Anode-Membrane** [m]	**Cathode-Reference** [m]	**Cathode-Membrane** [m]
FC-B	0.010, 0.014	0	0.040
FC-F-S	0.010, 0.014	0.030	0.013, 0.014
FC-F	0.010, 0.014	0.030	0.013, 0.014
A-70	0.012, 0.013	0.010	0
A-30	0.012, 0.013	0.010	0

Table S2: Individual $E_{cat,e}$ values obtained from the y-intercepts from linear regressions.

Reactor	**Anode** [mV]	**Cathode** [mV]	**Whole Cell** [mV]
FC-B	-273 ± 18	511 ± 5	773 ± 25
FC-F-S	-293 ± 14	488 ± 2	755 ± 18
FC-F	-289 ± 11	502 ± 22	763 ± 36
A-70	-278 ± 3	237 ± 1	517 ± 6
A-30	-272 ± 2	230 ± 23	502 ± 25

Table S3: Resistances of the individual MFC components based on linear regressions.

Reactor	**Anode Resistance** [mΩ m^2]	**Cathode Resistance** [mΩ m^2]	**Whole Cell Resistance** [mΩ m^2]
FC-B	25 ± 3	11 ± 1	62 ± 4
FC-F-S	22 ± 2	19 ± 0	73 ± 3
FC-F	22 ± 2	29 ± 5	84 ± 8
A-70	17 ± 1	20 ± 0	51 ± 1
A-30	21 ± 1	28 ± 6	62 ± 6

Table S4: Calculated reactor component resistances based on measured distances for anolyte and catholyte, and membrane resistance calculated by difference using eq. 1.

Reactor	**Anolyte** [mΩ m^2]	**Catholyte** [mΩ m^2]	**Membrane** [mΩ m^2]
FC-B	19 ± 0	6 ± 0	2 ± 0
FC-F-S	16 ± 1	17 ± 0	-1 ± 0
FC-F	15 ± 0	17 ± 0	1 ± 0
A-70	17 ± 0	0 ± 0	-3 ± 0
A-30	17 ± 0	0 ± 0	-3 ± 0

Tables S5-S12 summarize statistical tests to examine whether the results were significantly different.

Table S5: ANOVA for anode slopes, reactors grouped by cathode category (A or F)

Variable	Df	Sum Sq	Mean Sq	F value	Pr(>F)
current density	1	23732.1	23732.1	95.1143	6.94E-08
reactor	1	336.8	336.8	1.3497	0.26348
current density : reactor	1	831.2	831.2	3.3314	0.08795
Residuals	15	3742.7	249.5		

Table S6: Pairwise comparison of anode slopes, reactors grouped by cathode category (A or F)

Cathode Categories	estimate	SE	df	t.ratio	p.value
A - F	-10.9	6	15	-1.825	0.0879

Table S7: ANOVA for anode slopes, reactors grouped by cathode group

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
current density	1	23732.1	23732.1	901.834	2.46E-10
cathode group	4	4444.7	1111.2	4.22E+01	7.77E-06
current density : cathode group	4	229.2	57.3	2.177	0.1528
Residuals	9	236.8	26.3		

Table S8: Pairwise comparison of anode slopes, reactors grouped by cathode group

Cathode Groups	estimate	SE	df	t.ratio	p.value
FC-B - FC-F-S	2.545	2.68	9	0.95	0.8705
FC-B - FC-F	2.426	3.69	9	0.658	0.9607
FC-B - A-70	8.01	2.74	9	2.925	0.0948
FC-B - A-30	3.623	3.12	9	1.163	0.7711
FC-F-S - FC-F	-0.119	3.85	9	-0.031	1
FC-F-S - A-70	5.465	2.96	9	1.847	0.4058
FC-F-S - A-30	1.078	3.31	9	0.326	0.9971
FC-F - A-70	5.584	3.89	9	1.434	0.6238
FC-F - A-30	1.196	4.17	9	0.287	0.9982
A-70 - A-30	-4.387	3.36	9	-1.307	0.6942

Table S9: ANOVA for F cathode slopes, reactors grouped by cathode group

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
whole cell current density	1	490.4	490.4	37.206	0.001715
cathode group	2	15261.9	7630.9	578.938	1.21E-06
current density : cathode group	2	644.7	322.3	24.456	0.00262
Residuals	5	65.9	13.2		

Table S10: Pairwise comparison of F cathode slopes, reactors grouped by cathode group

Cathode Groups	estimate	SE	df	t.ratio	p.value
FC-B - FC-F-S	7.42	1.9	5	3.914	0.0254
FC-B - FC-F	17.5	2.61	5	6.703	0.0026
FC-F-S - FC-F	10.07	2.73	5	3.693	0.0317

Table S11: ANOVA for A cathode slopes, reactors grouped by cathode group

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
current density	1	3764.8	3764.8	60.487	0.001474
cathode group	1	2787.2	2787.2	44.7806	0.002594
current density : cathode group	1	131.7	131.7	2.1164	0.21942
Residuals	4	249	62.2		

Table S12: Pairwise comparison of A cathode slopes, reactors grouped by cathode group

Cathode Groups	estimate	SE	df	t.ratio	p.value
A-70 - A-30	7.51	5.16	4	1.455	0.2194

Figures S1 and S2 show the range of data used for the EPS method to determine resistances and working potentials.

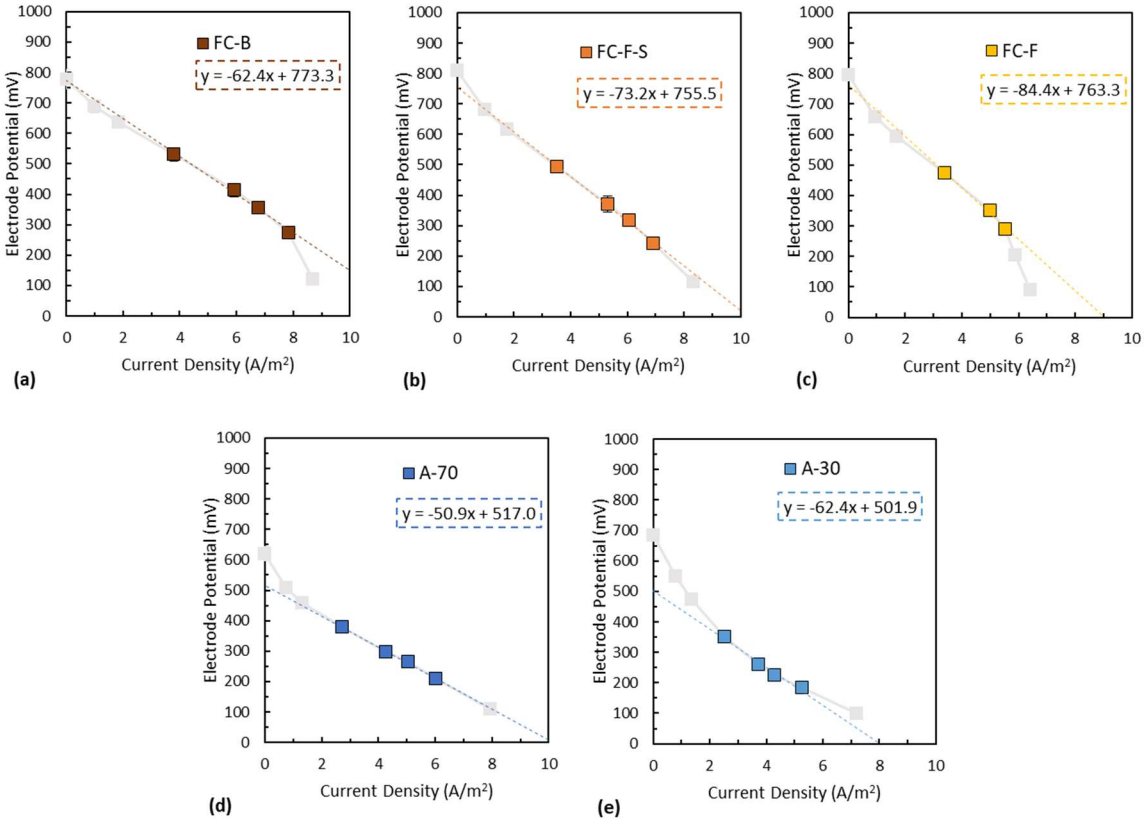

Figure S1: Linear regressions on whole cell polarization data

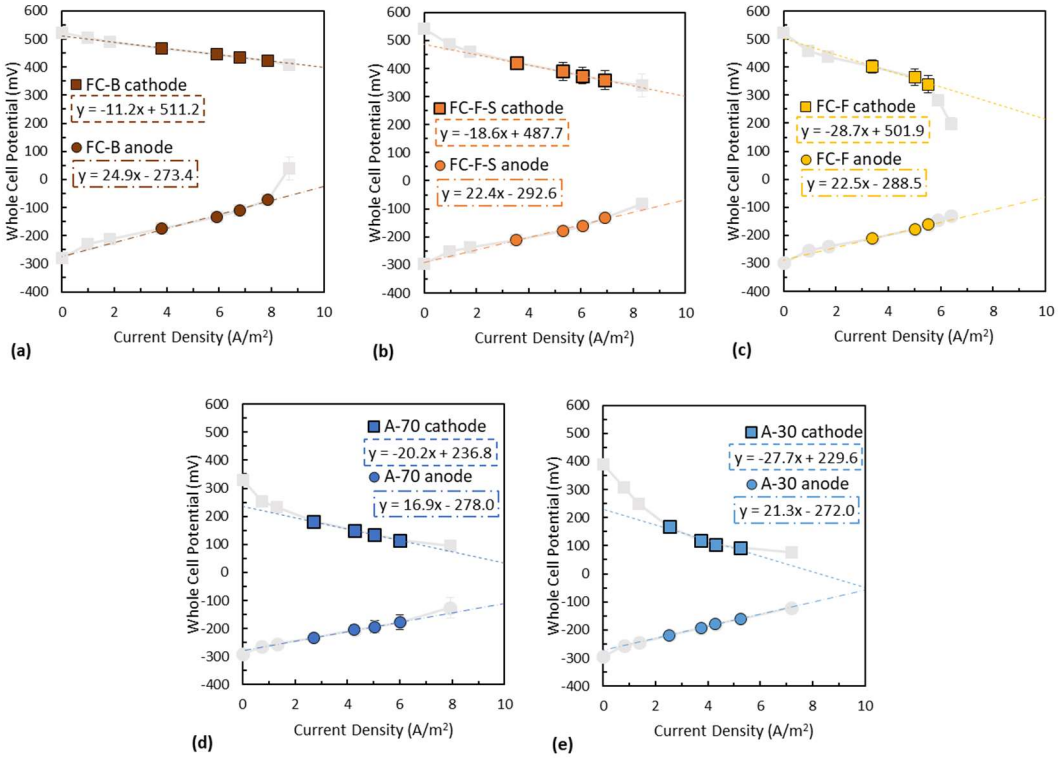

Figure S2: Linear regressions on anode and cathode polarization data