

SUPPORTING INFORMATION

**The impact of new cathode materials relative to baseline performance of microbial fuel
cells all with the same architecture and solution chemistry**

Wulin Yang^a, Kyoung-Yeol Kim^a, Pascal E. Saikaly^b, and Bruce E. Logan^{a*}

^aDepartment of Civil and Environmental Engineering, The Pennsylvania State University,
University Park, Pennsylvania 16802, United States

^bBiological and Environmental Sciences and Engineering Division, Water Desalination and Reuse
Research Center, King Abdullah University of Science and Technology,
Thuwal 23955–6900, Saudi Arabia

*Corresponding Author. Telephone: +1 814 863 7908. Fax: +1 814 863 7304.
E-mail: blogan@psu.edu

Number of pages: 5

Number of figures: 0

Number of tables: 4

Figure 2

Ref	Cathode modified MFCs			Solution information					Reactor volumes		Area of materials		SSA		Power		Area Power		Volume Power								
	Reference	Year	Title	Reactor Type	Anode	Electrolyte	Concentration	Flow rate	Conductivity	Anode (mL)	Cathode (mL)	Total (mL)	Anode (cm ²)	Membrane (cm ²)	Cathode (cm ²)	Total (m ² /m ³)	Total (mW)	Anode (W/m ²)	Cat-T (W/m ²)	Cathode (W/m ²)	Cathode (W/m ²)	Anode (W/m ³)	Reactor (W/m ³)				
1	Zhang X, et	2015	Diffusion Layer Characteristics	fc1C, Air, 4cm	Brush	: SS CB+Pt Pt CC PTFE	near	1.00	(g/L)	(g/L)	(mM)																
2	Zhang, F et	2009	Power generation using an active	1C, Air, 4cm	Brush	AC Ni PT Pt CC PTFE	near	1.00	50	47.9	4.57	2.45	7	28	28	7	(none)	7	25	1.1		1.61	1.35	40	40		
3	Zhang, X et	2014	Enhanced Activated Carbon Cath	1C, Air, 4cm	Brush	- CB Ni PT Pt CC PTFE	near	1.00	50	48.0	4.58	2.45	6.82	28	28	7	(none)	7	25	0.9		1.22	1.06	31	31		
4	Wang et al	2011	Activity and stability of pyrolyze	1C, Air, 4cm	brush	EDTA CC Pt CC PTFE	near	1.00	50	47.9	4.57	2.45	7	28	28	7	(none)	7	25	1.1		1.56	1.34	1.46	39	39	
5	Lu et al Jasc	2016	Iron-rich nanoparticle encapsula	1C, Air, 4 cm	Brush	Nx C CC Pt CC PTFE	4 cm	1.0			100			19.8	19.8	7	(none)	7	35.35354	0.9		1.23	1.031	43	43		
6	Li et al	2016	Nitrogen-doped Co/Co9S8/part	1C, Air, 4 cm	Brush	S8 NP GC SP SS PTFE	4 cm		1	50	50.1			28	28	7	(none)	7	25	0.8		1.16	1.02	29	29		
7	Mecheri et	2016	Carbon-supported zirconium ox	1C, Air, 4 cm	Brush	2-C CC Pt CC PTFE	4 cm	1.0			100			28	28	7	(none)	7	25	0.4		0.60	0.43	0.95	15	15	
8	Mnagyen e	2016	Iron/Polyindole-based electroc	1C, Air, 4 cm	Brush	ID CNTs C Pt CC PTFE	4 cm	1.0			93.0			28	28	7	(none)	7	25	0.6		0.80	0.65	20	20		
9	Song et al	2015	Cobalt oxide/nanocarbon hydr	1C, Air, 4 cm	Brush	1/NCNT C Pt CC PTFE	4 cm		1		50.0			25	25	7	(none)	7	28	0.3		0.47	0.07	0.60	13	13	
10	Meng et al	2015	Facile synthesis of nitrogen an	1C, Air, 4 cm	Brush	1-NF CC Pt CC PTFE	4 cm	1.0			50			28	28	7	(none)	7	25	0.5		0.67	0.49	0.57	17	17	
11	Ma et al	2015	Silver/Iron oxide/graphitic carb	1C, Air, 4 cm	Brush	Ag/Fe3O4 Pt CC PTFE	4 cm		1		50.1			28	28	7	(none)	7	25	1.2		1.71	1.21	43	43		
12	Valipour (Y	2016	Application of graphene-based	1C, Air, 4cm	Brush	RG0 Ni Pt CC PTFE	4 cm	1			50			28	28	7	none	7	25	1.2		1.68	2.20	42	42		
13	Chen et al	2014	The performance of phosphorus	1C, Air, 4cm	C felt	-CB+P SS PTFE	4 cm	2		50	50.1	4.09	3.321	28	28	7	(none)	7	25	0.8		1.10	0.71		27	27	
14	Chen et al	2015	The performance of activated ca	1C, Air, 4cm	C felt	B+PO4 SS PTFE	4 cm	2		50	50.1	4.09	3.321	28	28	7	(none)	7	25	0.7		0.95	0.71		24	24	
15	Pu et al (sa	2014	Silver electrodeposition on the a	1C, Air, 4cm	C felt	CB+Ag SS PTFE	4 cm	2		50	50.1	4.09	3.321	28	28	7	(none)	7	25	0.8		1.08	0.64		27	27	
16	Liu et al (Ch	2015	Influence of different morpholo	1C, Air, 4cm	C felt	CB+Ag SS PTFE	4 cm	2		50	50.1	4.09	3.321	28	28	7	(none)	7	25	1.1		1.55	0.88		39	39	
17	Zhang et al	2015	Heteroatom-doped highly porou	1C, Air, 4 cm	C felt	2C SS PTFAC SS PTFE	4 cm	1		50				28	28	7	(none)	7	25	0.7		1.03	0.83	0.73	26	26	
18	Zhang et al	2015	N-type Cu2O doped activated ca	1C, Air, 4 cm	C felt	-Cu SS PTAC SS PTFE	4 cm	1		50	50.1			28	28	7	(none)	7	25	1.0		1.39	0.88		35	35	
19	Fu et al (sar	2015	The performance and mechanis	1C, Air, 4 cm	C felt	Fe3O4 SS AC SS PTFE	4 cm	1		50	50.1			28	28	7	(none)	7	25	1.0		1.43	0.78		36	36	
20	Ge et al (Sa	2016	The performance of nano urchin	1C, Air, 4 cm	C felt	Co2O4 SS AC SS PTFE	4 cm	1		50	50.1			28	28	7	(none)	7	25	1.2		1.73	0.76		43	43	
21	Liu et al (Ch	2016	The excellent performance and	1C, Air, 4 cm	C felt	Co3O4 SS AC SS PTFE	4 cm	1		50	50.1			28	28	7	(none)	7	25	1.0		1.42	0.87		36	36	
22	Ahn&Loga	2013	Altering anode thickness to impr	1C, Air, 4cm	C felt	1.32 cm thick Pt CC PTFE				50	48.0	4.58	2.45	7	28	7	(none)	7	25	0.0					0.604		
22	Ahn&Loga	2013	Altering anode thickness to impr	1C, Air, 4cm	C felt	1.64 cm thick Pt CC PTFE				50	48.0	4.58	2.45	7	28	7	(none)	7	25	0.0					0.764		
22	Ahn&Loga	2013	Altering anode thickness to impr	1C, Air, 4cm	C felt	1.27 cm thick Pt CC PTFE				50	48.0	4.58	2.45	7	28	7	(none)	7	25	0.0					1.05		
23	Dong et al	2012	A novel structure fo scalable air-	1C, Air, 4cm	CC	CB SS PTFE+CB	4 cm	1		50	50.1	4.09	3.321	28	28	7	(none)	7	25	0.6		0.80			20	20	
24	Gong et al	2014	Improved interfacial oxygen red	1C, Air, 4cm	CC	DTA CC PTFE	4 cm	1		50	50.1	4.09	3.321	28	28	7	(none)	7	25	0.5		0.72			0.51	18	18
25	Liu, H et al	2005	Production of electricity from ac	1C, Air, 4cm	CP	Pt CC none	4 cm	0.8		50	51.2	2.75	4.97	7	28	28	7	(none)	7	25					0.51	0	0

Figure 3

Ref	Cathode modified MFCs			Solution information				Reactor volumes		Area of materials			SSA		Power			Volume Power							
	Reference	Year	Type	Anode	Electrolyte	Concentration	Spacing	Anode	Cathode	Total	Anode	Membrane	Cathode	Cathode	Total	Anode	Cat-T	Cathode	Cathode	Anode	Reactor				
					Acetate	Glucose	PBS-pp	PBS-cal	Na ₂ HPO ₄	NaH ₂ PO ₄	H ₂ Conductivi	(mL)	(mL)	(mL)	(cm ²)	(cm ²)	(cm ²)	(m ² /m ³)	(mW)	(W/m ²)	(W/m ²)	(W/m ²)	(W/m ²)	(W/m ²)	(W/m ²)
1	Zhang X, et	2015	Diffusion Layer Characteristics for 1C, Air, 4cm	Brush	:[SS]CB+PTPT CC PTFE	near	1	50	47.9	4.57	2.45	7	28	28	7	(none)	7	25	1.1		1.61	1.35	40	40	
2	Zhang, F et	2009	Power generation using an activate 1C, Air, 4cm	Brush	AC Ni PTFBP CC PTFE	near	1	50	48.0	4.58	2.45	6.82	28	28	7	(none)	7	25	0.9		1.22	1.06	31	31	
3	Zhang, X et	2014	Enhanced Activated Carbon Cathoc 1C, Air, 4cm	Brush	:[+CB]Ni PTPT CC PTFE	near	1	50	47.9	4.57	2.45	7	28	28	7	(none)	7	25	1.1		1.56	1.34	1.46	39	39
4	Wang etal	2011	Activity and stability of pyrolyzed ir 1C, Air, 4cm	brush	EDTA CC PTPT CC PTFE	near	1.0	50					36	36	9	(none)	9	25			1.12	0.53	1.17		
5	Meng etal	2015	Facile synthesis of nitrogen and flu 1C, Air, 4 cm	Brush	^-NF CC PTPT CC PTFE	4 cm	1.0	50					28	28	7	(none)	7	25	0.5		0.67	0.49	0.57	17	17
6	Liu,Q et al.	2015	Cellulose-derived nitrogen and phc 1C, Air, 4cm	brush	lose&P SS PT CC PTFE	near	1.00	50	50.0	10.9233	3.042	14	28	28	7	(none)	7	25	1.6		2.29	1.68	1.68	57	57
7	Valpour Y	2016	Application of graphene-based nan 1C, Air, 4cm	Brush	RGO/Ni Pt CC PTFE	4 cm	1	50					28	28	7	none	7	25	1.2		1.68	2.20	42	42	
8	Watson et	2013	Influence of chemical and physical 1C, Air, 4cm	Brush	AC/PDMS/Pt CC PTFE	2.5 cm	1	100					28	28			7	25		N/A	1.62	2.11			
9	Watson et	2013	Improvement of activated carbons 1C, Air, 4cm	Brush	Ammonia Pt CC PTFE	2.5 cm	1	100					28	28			7	25		N/A	2.45	2.1			
10	Lu etal Jasc	2016	Iron-rich nanoparticle encapsulate 1C, Air, 4 cm	Brush	Nx/C CC PPT CC PTFE	4 cm	1.0	100				19.8	19.8	7	(none)	7	35.35354	0.9		1.23	1.031	43	43		
11	Mecheri et	2016	Carbon-supported zirconium oxide 1C, Air, 4 cm	Brush	32-C CC PPT CC PTFE	4 cm	1.0	100					28	28	7	(none)	7	25	0.4		0.60	0.43	0.95	15	15
12	Mnagyen e	2016	Iron/Polyindole-based electrocatal 1C, Air, 4 cm	Brush	1D/CNTs CPt CC PTFE	4 cm	1.0		93.0				28	28	7	(none)	7	25	0.6		0.80	0.65	20	20	
13	Logan et al	2007	Graphite fiber brush anodes for inc 1C, Air, 4cm	CC	Brush Pt CC PTFE	near	0.72	200	190.3	16.36	11.72	21	28	26			7	27	1.7		2.40	1.07	60	65	
14	Liu, H etal	2005	Power Generation in Fed-Batch mi 1C, Air, 4cm	CP+holes	00 mm vs SPt CC none	4	0.8	200	51.2	2.75	4.97		28	28	7	(none)	7	25	0.9		1.33	0.72	33	33	
15	Yang et al	2016	Immobilization of a Metal-Nitrogen 1C, Air, 4cm	Brush	Fe-N-C/ACPt CC PTFE	4	1	200	191.7	18.3	9.8									4.70	3.20				

