APPENDIX D
EXPERIMENTAL DATA

Table D.1 Data results of direct current

Current (A)	Voltage (V)	Hydrogen Flow Rate (mL/min)	Efficiency (%)
30	5.78	281.54	27.42
30	5.65	287.98	28.34
30	5.61	301.23	30.04
40	6.17	417.10	28.42
40	6.44	387.59	25.61
40	6.53	394.01	24.76
50	7.09	487.06	23.14
50	7.09	461.02	21.74
50	7.02	446.77	21.19
60	7.70	564.02	20.03
60	7.82	567.72	19.69
60	7.68	561.30	20.23

Table D.2 Data results of current characteristics at 30 A

Frequency (Hz)	Duty Cycle (%)	Current Output (A)	Voltage (V)	Hydrogen Flow Rate (mL/min)	Efficiency (%)
1	20	12.55	1.58	90.35	74.36
1	20	12.50	1.55	81.40	68.40
1	20	12.07	1.53	84.53	73.73
1	50	22.75	3.45	201.13	41.84
1	50	23.43	3.56	210.40	42.45
1	50	22.70	3.43	201.37	42.21
1	80	27.79	4.96	253.92	30.38
1	80	28.09	4.98	256.95	30.30
1	80	28.18	5.12	255.85	29.31
5	20	12.34	1.40	54.58	51.12
5	20	12.22	1.41	53.97	49.82
5	20	12.00	1.40	54.98	52.35
5	50	22.48	3.40	171.16	36.90
5	50	22.12	3.22	182.68	42.44
5	50	23.17	3.35	196.57	41.89
5	80	26.07	4.79	235.75	31.03
5	80	26.24	4.88	232.66	29.90
5	80	24.73	4.92	247.93	33.46
10	20	8.55	1.28	31.82	47.95
10	20	8.04	1.00	31.46	46.86
10	20	8.39	1.14	31.56	47.16
10	50	17.74	3.15	127.52	38.23
10	50	17.56	3.17	123.37	37.02
10	50	17.07	3.53	126.21	38.08
10	80	22.83	4.74	168.70	26.02
10	80	23.13	4.78	176.92	26.82
10	80	23.05	4.89	174.35	26.58
50	50	16.57	2.86	78.99	27.00
50	50	16.55	2.85	85.37	29.45
50	50	17.17	2.85	95.04	31.81
50	80	24.42	4.49	154.85	22.30
50	80	21.34	4.74	158.40	25.57
50	80	22.97	4.70	173.37	25.96
100	50	16.66	2.85	84.59	28.51

Table D.2 Data results of current characteristics at 30 A (Continued)

Frequency (Hz)	Duty Cycle (%)	Current Output (A)	Voltage (V)	Hydrogen Flow Rate (mL/min)	Efficiency (%)
100	50	16.78	2.83	92.09	31.32
100	50	16.76	2.88	87.22	29.28
100	80	23.23	4.68	192.81	28.40
100	80	22.74	4.65	188.55	28.20
100	80	22.76	4.65	181.80	27.58

Table D.3 Data results of current characteristics at 40 A

Frequency (Hz)	Duty Cycle (%)	Current Output (A)	Voltage (V)	Hydrogen Flow Rate (mL/min)	Efficiency (%)
1	20	21.08	1.71	133.25	61.71
1	20	20.81	1.79	111.03	49.77
1	20	19.9	1.73	101.50	49.41
1	50	37.84	4.05	283.71	31.05
1	50	37.93	4.02	269.83	29.69
1	50	36.93	3.87	272.16	31.92
1	80	46.66	6.24	373.19	20.99
1	80	46.4	6.05	371.74	21.61
1	80	47.06	6.19	383.34	21.67
5	20	18.26	1.71	83.78	44.61
5	20	17.5	1.62	73.51	42.88
5	20	17.92	1.74	94.10	50.59
5	50	35.4	4.13	243.75	27.61
5	50	34.71	4.15	258.66	29.79
5	50	34.42	4.19	264.97	30.61
5	80	44.96	6.28	340.84	199.85
5	80	44.53	6.21	357.30	21.24
5	80	45	6.21	350.89	20.67
10	20	13.87	1.65	60.41	43.25
10	20	13.53	1.63	58.02	43.09
10	20	13.64	1.64	59.67	43.43
10	50	29.63	4.03	203.10	28.05
10	50	30.22	4.07	218.59	29.28
10	50	30.38	4.07	216.74	28.81
10	80	41.13	6.13	313.44	20.44
10	80	41.56	6.18	315.31	20.18
10	80	41.71	6.18	313.51	19.98
50	20	9.84	1.5	42.95	47.50
50	20	9.74	1.57	42.95	46.18
50	20	9.87	1.52	42.95	46.54
50	50	22.05	3.95	206.15	39.54
50	50	22.37	3.9	209.16	39.99
50	50	23.06	3.95	199.45	36.44
50	80	35.15	5.78	291.47	23.92
50	80	34.92	5.8	299.75	24.66

Table D.3 Data results of current characteristics at 40 A (Continued)

Frequency (Hz)	Duty Cycle (%)	Current Output (A)	Voltage (V)	Hydrogen Flow Rate (mL/min)	Efficiency (%)
50	80	35.13	5.87	318.18	25.75
100	50	22.52	3.86	194.92	35.99
100	50	22.4	3.83	195.33	37.67
100	50	22.35	3.82	198.82	38.46
100	80	36.94	6.04	277.04	20.51
100	80	35.89	6.16	309.29	23.23
100	80	36.3	6.03	311.70	23.58

Table D.4 Data results of current characteristics at 50 A

Frequency (Hz)	Duty Cycle (%)	Current Output (A)	Voltage (V)	Hydrogen Flow Rate (mL/min)	Efficiency (%)
1	20	19.26	2.07	158.93	56.07
1	20	19.64	2.09	157.57	63.40
1	20	19.19	2.04	157.35	66.47
1	50	44.14	4.96	354.68	27.11
1	50	42.72	4.85	341.42	27.57
1	50	43.84	5.04	368.17	28.01
1	80	57.94	7.51	483.89	18.62
1	80	57.7	7.47	478.50	18.58
1	80	58.41	7.44	476.15	18.35
5	20	19.06	2.04	116.37	49.82
5	20	18.63	2.04	132.77	58.22
5	20	18.95	2.02	131.78	57.38
5	50	43.23	4.86	328.45	26.41
5	50	43.35	4.86	329.38	26.41
5	50	43.89	4.94	309.65	24.10
5	80	52.33	7.31	448.02	19.78
5	80	52.54	7.26	450.10	19.93
5	80	53.21	7.23	445.15	19.57
10	20	17.6	1.93	98.90	48.90
10	20	17.55	1.89	105.03	52.83
10	20	17.38	1.9	105.26	53.27
10	50	37.61	4.67	286.08	27.53
10	50	37.63	4.63	295.24	28.58
10	50	36.02	4.68	245.14	24.43
10	80	48.11	7.06	408.58	20.25
10	80	48.35	7.09	403.93	19.85
10	80	48.6	7.12	405.21	19.75
50	20	11.43	1.66	61.84	53.75
50	20	11.37	1.66	62.03	53.52
50	20	11.39	1.66	61.91	53.55
50	50	26.85	4.27	203.51	29.76
50	50	27.78	4.28	188.54	26.56
50	50	27.06	4.28	196.03	27.87

Table D.4 Data results of current characteristics at 50 A (Continued)

Frequency (Hz)	Duty Cycle (%)	Current Output (A)	Voltage (V)	Hydrogen Flow Rate (mL/min)	Efficiency (%)
50	80	33.95	5.79	271.32	19.02
50	80	33.74	5.77	297.21	20.88
50	80	33.84	5.78	283.82	19.77
100	20	12.03	1.76	52.18	40.46
100	20	11.67	1.71	50.43	41.76
100	20	11.81	1.74	51.21	40.67
100	50	27.12	4.42	188.61	26.27
100	50	26.49	4.44	202.94	28.6
100	50	28.02	4.54	199.51	26.28
100	80	43.25	6.92	289.67	16.26
100	80	35.19	6	277.21	18.66
100	80	39.09	6.49	293.06	17.77

Table D.5 Data results of solution temperature

Solution Temperature (K)	Current Density (mA/cm^2)	Hydrogen Flow Rate (L/min)	Potential cells (V)
303	100	0.10	7.20
313	100	0.15	6.40
323	100	0.14	5.10
333	100	0.18	4.80
343	100	0.21	4.60
353	100	0.22	4.40
303	100	0.09	7.18
313	100	0.15	6.45
323	100	0.13	5.09
333	100	0.17	4.74
343	100	0.21	4.57
353	100	0.22	4.51
303	100	0.09	7.22
313	100	0.14	6.33
323	100	0.14	5.02
333	100	0.18	4.89
343	100	0.20	4.51
353	100	0.22	4.32
303	200	0.12	8.00
313	200	0.19	7.10
323	200	0.22	6.05
333	200	0.28	5.50
343	200	0.28	5.60
353	200	0.33	5.50
303	200	0.12	8.14
313	200	0.18	7.03
323	200	0.21	6.04
333	200	0.28	5.45
343	200	0.28	5.67
353	200	0.32	5.44
303	200	0.12	7.92
313	200	0.18	7.08
323	200	0.21	6.12
333	200	0.28	5.54
343	200	0.29	5.74
353	200	0.32	5.23
303	300	0.23	8.20
313	300	0.29	7.50
323	300	0.32	6.60
333	300	0.40	6.45
343	300	0.43	6.20
353	300	0.43	6.10
303	300	0.22	8.21

Table D.5 Data results of solution temperature (Continued)

Solution Temperature (K)	Current Density (mA/cm^2)	Hydrogen Flow Rate (L/min)	Potential cells (V)
313	300	0.27	7.42
323	300	0.32	6.66
333	300	0.39	6.54
343	300	0.44	6.14
353	300	0.44	6.06
303	300	0.22	8.34
313	300	0.30	7.61
323	300	0.32	6.47
333	300	0.41	6.80
343	300	0.43	6.19
353	300	0.45	6.11
303	400	0.29	8.80
313	400	0.38	7.90
323	400	0.41	7.40
333	400	0.53	7.35
343	400	0.55	7.35
353	400	0.57	7.20
303	400	0.28	8.84
313	400	0.37	7.84
323	400	0.41	7.49
333	400	0.52	7.49
343	400	0.54	7.45
353	400	0.57	7.16
303	400	0.28	8.82
313	400	0.38	7.81
323	400	0.40	7.58
333	400	0.53	7.28
343	400	0.54	7.12
353	400	0.56	7.11
303	500	0.37	9.20
313	500	0.45	8.70
323	500	0.54	8.20
333	500	0.62	8.15
343	500	0.69	8.10
353	500	0.73	8.00
303	500	0.36	9.31
313	500	0.44	8.67
323	500	0.54	8.34
333	500	0.61	8.25
343	500	0.69	8.16
353	500	0.73	7.85
303	500	0.36	9.22

Table D.5 Data results of solution temperature (Continued)

Solution Temperature (K)	Current Density (mA/cm^2)	Hydrogen Flow Rate (L/min)	Potential cells (V)
313	500	0.45	8.56
323	500	0.53	8.40
333	500	0.62	8.31
343	500	0.65	8.21
353	500	0.74	8.10
303	600	0.43	10.10
313	600	0.55	9.60
323	600	0.59	9.15
333	600	0.74	8.95
343	600	0.79	8.60
353	600	0.83	8.60
303	600	0.43	10.17
313	600	0.55	9.58
323	600	0.58	9.16
333	600	0.73	8.90
343	600	0.78	8.58
353	600	0.84	8.50
303	600	0.42	10.15
313	600	0.54	9.64
323	600	0.57	9.17
333	600	0.74	8.89
343	600	0.79	8.61
353	600	0.85	8.60