Supplementary Information (SI) for Energy Advances.

Analysis of the Impact of Remote Oxygen Plasma Treatment on the Surface Chemistry and Electrochemical Properties of Graphite Felt Electrodes for Redox Flow Batteries

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Chemical shift	GF pristine					GF400					GF400 anomalous	P10s					P60s					P600s				
C1s	Sample1	Sample2	Sample3	**Average**	**STD**	Sample1	Sample2	Sample3	**Average**	**STD**	Sample1	Sample1	Sample2	Sample3	**Average**	**STD**	Sample1	Sample2	Sample3	**Average**	**STD**	Sample1	Sample2	Sample3	**Average**	**STD**
C=C	80.63	77.96	77.82	78.80	1.58	76.73	74.15	76.62	75.83	1.46	63.74	69.20	69.97	70.19	69.79	0.52	74.74	76.66	69.93	73.78	3.47	73.70	73.18	70.39	72.42	1.78
C-C Low BE C-H	7.24	8.41	7.51	7.72	0.61	7.22	6.06	6.93	6.74	0.60	13.41	3.98	6.99	3.09	4.69	2.04	6.02	5.28	8.74	6.68	1.82	5.53	4.68	5.11	5.11	0.43
C-C high BE Adv. C	0.96	1.59	3.65	2.07	1.41	0.84	7.63	3.93	4.13	3.40	10.95	7.97	4.52	6.03	6.17	1.73	3.33	2.68	4.77	3.59	1.07	4.65	4.51	10.35	6.50	3.33
C-O	0.60	0.70	1.49	**0.93**	0.49	1.36	1.32	1.26	**1.31**	0.05	5.53	3.77	4.20	5.18	**4.38**	0.72	4.75	6.07	4.72	**5.18**	0.77	5.23	3.45	4.80	**4.49**	0.93
C=O	0.72	1.01	0.55	**0.76**	0.23	2.27	2.06	1.37	**1.90**	0.47	5.57	5.95	4.77	3.52	**4.75**	1.22	2.12	0.87	2.46	**1.82**	0.84	1.54	2.75	1.09	**1.79**	0.86
O-C=O	0.32	0.56	0.48	**0.45**	0.12	1.19	0.65	0.96	**0.93**	0.27	0.80	4.14	4.66	4.60	**4.47**	0.28	3.16	3.69	3.44	**3.43**	0.27	4.71	3.76	5.32	**4.60**	0.79
Pi-Pi*	9.52	9.78	8.51	9.27	0.67	10.38	8.12	8.93	9.14	1.15	0.00	4.99	4.89	6.65	5.51	0.99	5.87	4.74	4.87	5.16	0.62	4.71	7.67	2.94	5.11	2.39
Residual STD	1.51	1.07	1.20	1.26		1.60	1.01	1.26			3.33	1.11	1.25	1.16	1.17		1.38	1.38	1.07	1.28		1.59	1.76	1.41	1.59	
O1s	Sample1	Sample2	Sample3	**Average**	**STD**	Sample1	Sample2	Sample3	**Average**	**STD**	Sample1	Sample1	Sample2	Sample3	**Average**	**STD**	Sample1	Sample2	Sample3	**Average**	**STD**	Sample1	Sample2	Sample3	**Average**	**STD**
C=O	53.19	55.67	48.02	**52.29**	3.90	60.37	36.32	48.02	**48.24**	12.03	53.73	53.97	49.18	42.98	**48.71**	5.51	38.91	31.02	38.58	**36.17**	4.46	37.95	44.51	36.98	**39.81**	4.10
C-O aliphatic	39.78	40.64	45.62	**42.01**	3.15	33.20	61.02	45.62	**46.61**	13.94	45.80	42.10	46.23	51.58	**46.64**	4.75	58.36	66.38	54.61	**59.78**	6.01	60.35	49.41	58.43	**56.06**	5.84
Ads O2, H2O	6.46	3.69	6.35	**5.50**	1.57	6.42	2.66	6.32	5.13	2.14	0.48	3.93	4.59	5.43	4.65	0.75	2.74	2.61	5.81	**3.72**	1.81	1.70	6.08	4.59	4.12	2.23
Residual STD	1.16	0.95	0.96	1.02		1.07	0.94	0.91	0.97		2.47	0.92	0.99	0.83	0.91		0.88	0.92	1.01	0.93		1.03	0.81	0.94	0.93	
Regions	Sample1	Sample2	Sample3	**Average**	**STD**	Sample1	Sample2	Sample3	**Average**	**STD**	Sample 1	Sample1	Sample2	Sample3	**Average**	**STD**	Sample1	Sample2	Sample3	**Average**	**STD**	Sample1	Sample2	Sample3	**Average**	**STD**
C1s	98.34	97.73	97.47	97.85	0.45	95.17	95.92	96.48	95.86	0.54	88.33	86.20	86.39	86.67	86.42	0.24	89.96	89.40	89.38	89.58	0.33	88.57	90.02	88.78	89.12	0.78
O1s	1.66	2.27	2.53	2.15	0.45	4.83	4.08	3.52	4.14	0.54	11.67	13.80	13.61	13.33	13.58	0.24	10.04	10.60	10.62	10.42	0.33	11.43	9.98	11.22	10.88	0.78

XPS analysis.

Table S1: Deconvolution of High resolution XPS data

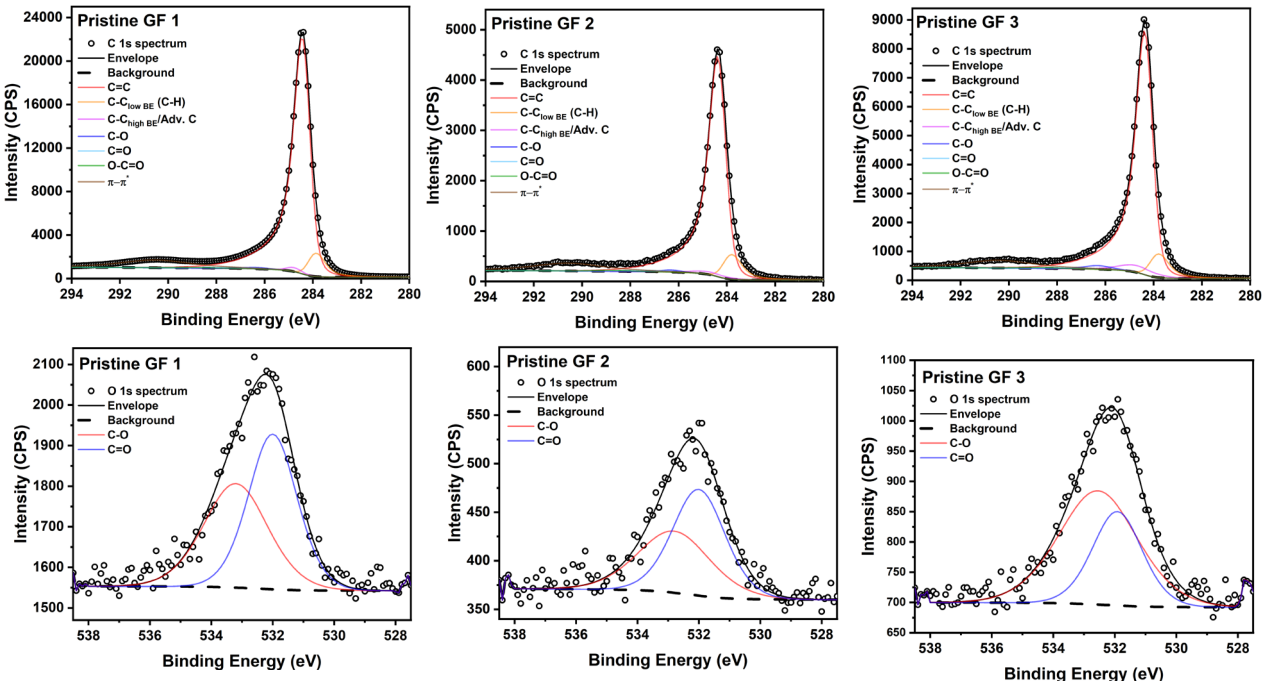

Figure S1: Pristine **GF** high resolution C1s & O1s spectra.

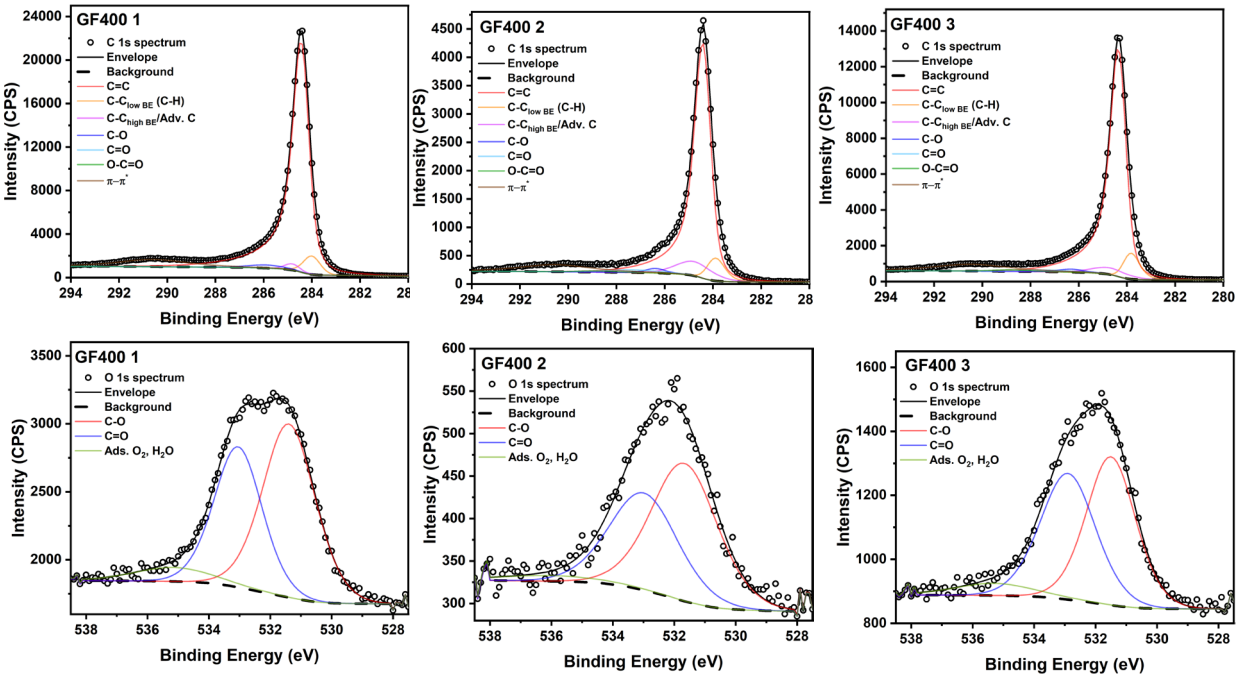

Figure S2: **GF400** high resolution C1s & O1s spectra.

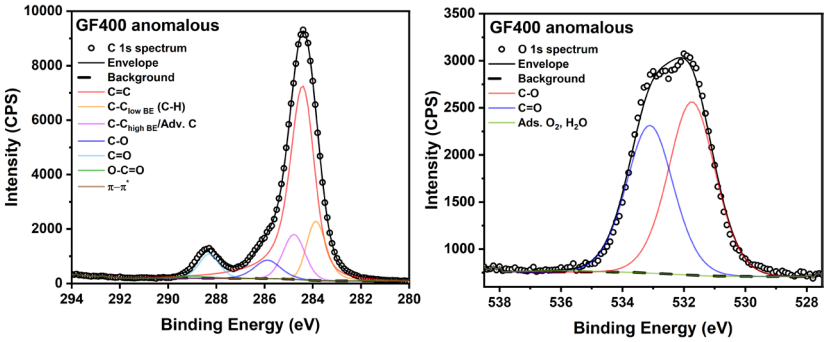

Figure S3: Anomalous **GF400** high resolution C1s & O1s spectra.

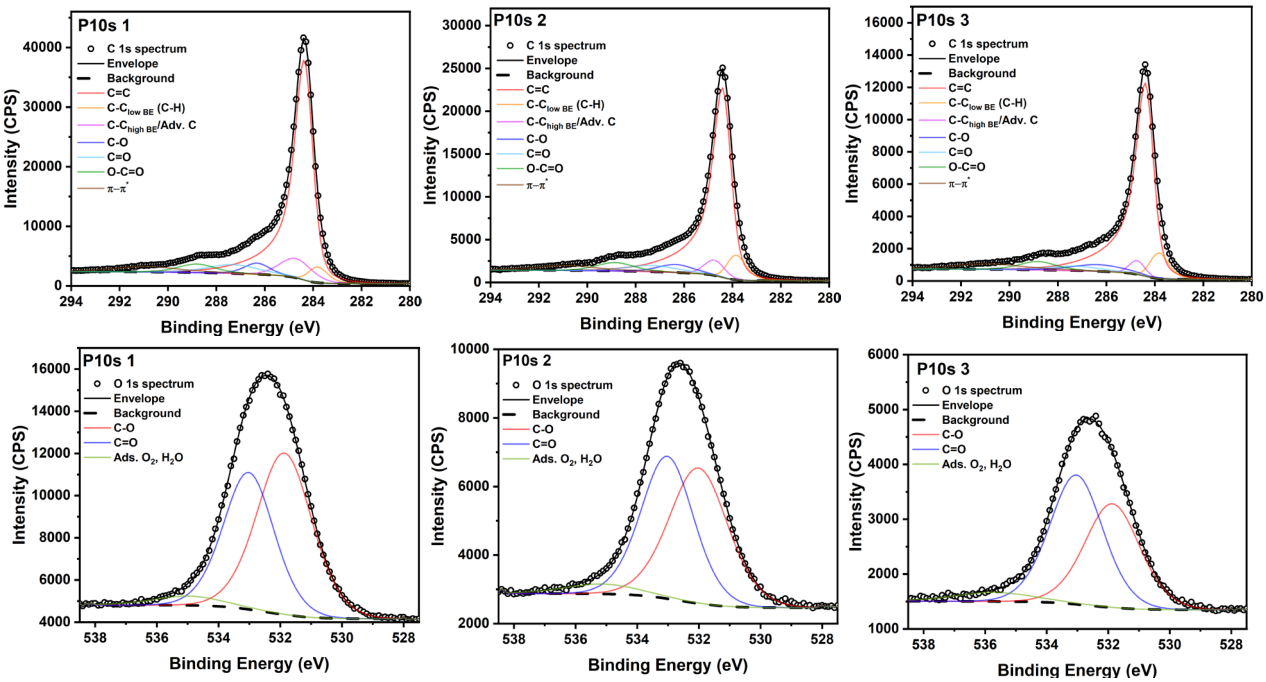

Figure S4: **P10s** high resolution C1s & O1s spectra.

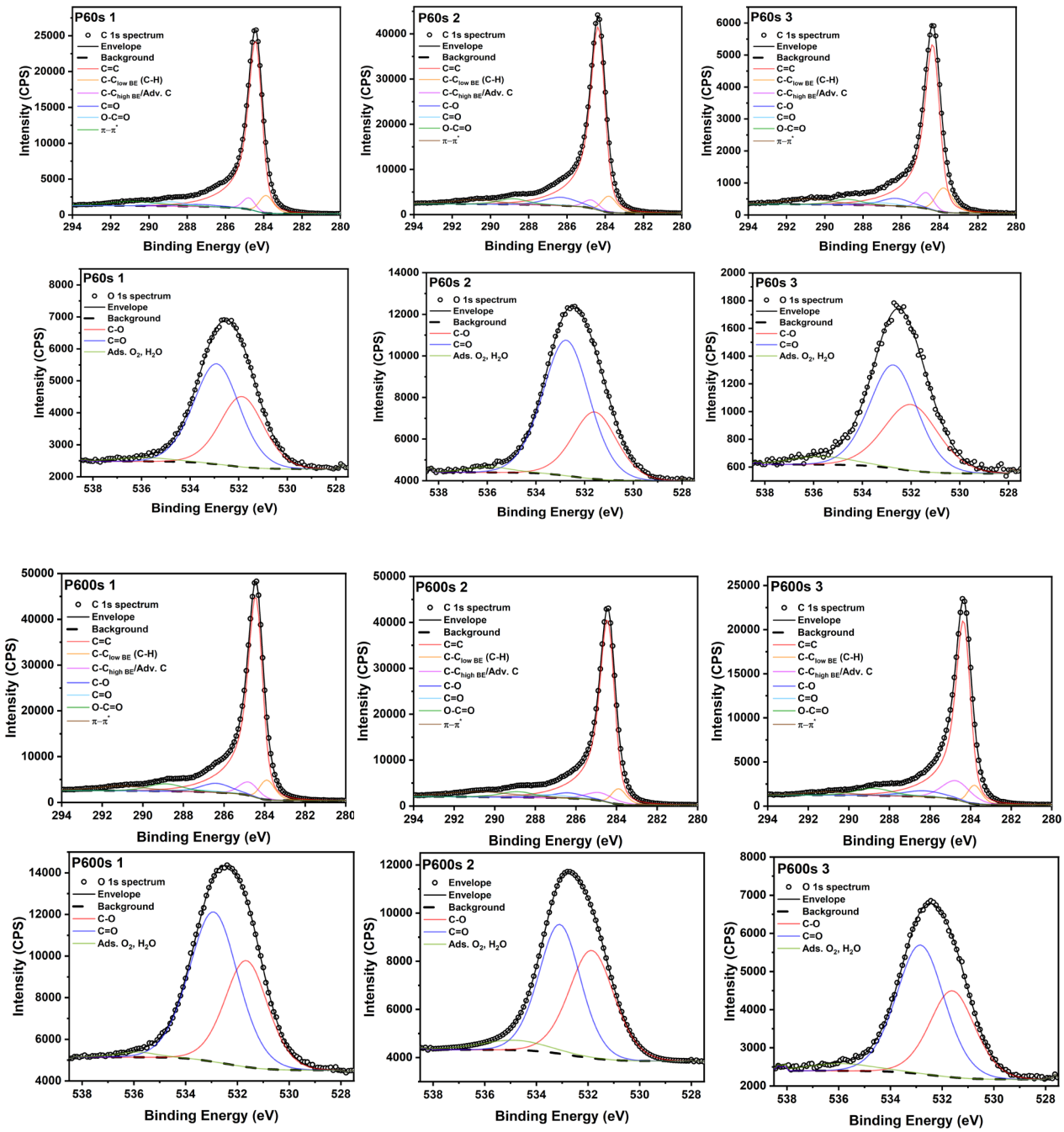

Figure S6: **P600s** high resolution C1s & O1s spectra.

Raman analysis.

Table S2: Raman analysis including Gaussian and Lorentzian contributions for each band

Pristine	Id/Ig	**2.679907518**	**GF400**	Id/Ig	**3.713565667**	**P10s**	Id/Ig	3.239609023	**P60s**	Id/Ig	**3.283421792**	**P600s**	Id/Ig	**3.503555243**
D1 band	Value	Range	**D1 band**	Value	Range	**D1 band**	Value	Range	**D1 band**	Value	Range	**D1 band**		Range
Center	1332.14763	1320to1360	Center	1333.94587	1320to1360	Center	1333.57716	1320to1360	Center	1332.5819	1320to1360	Center	1333.638	1320to1360
Area	289903.8301		Area	432141.682		Area	254386.9861		Area	482337.7709		Area	224918.4845	
wG	36.80391	5-60	wG	39.0275	5-60	wG	40.53759	5-60	wG	36.17939	5-60	wG	41.08113	5-60
wL	40	5-40	wL	40	5-40	wL	40	5-40	wL	40	5-40	wL	40	5-40
FWHM	**62.62825**		FWHM	**64.62409**		FWHM	**65.99181**		FWHM	**62.07194**		FWHM	**66.48632**	
Area %	65.51077466		Area %	70.70440982		Area %	62.83770222		Area %	69.37630864		Area %	64.20012701	
G band			**G band**			**G band**			**G band**			**G band**		
Center	1599.62903	1580to1610	Center	1599.08449	1580to1610	Center	1599.32798	1580to1610	Center	1598.34704	1580to1610	Center	1599.92889	1580to1610
Area	108176.8039		Area	116368.3965		Area	78523.97752		Area	146900.9471		Area	64197.21366	
Gw	59.63946	5-60	Gw	60	5-60	Gw	59.91332	5-60	Gw	60	5-60	Gw	60	5-60
Lw	8.90526	5-60	Lw	6.26352	5-60	Lw	5	5-60	Lw	6.28942	5-60	Lw	5	5-60
FWHM	**64.54405**		FWHM	**63.41925**		FWHM	**62.6315**		FWHM	**63.43368**		FWHM	**62.71811**	
Area %	24.44516246		Area %	19.03949362		Area %	19.39669317		Area %	21.12927093		Area %	18.32427993	
D4 band			**D4 band**			**D4 band**			**D4 band**			**D4 band**		
Center	1210	1190to1210	Center	1210	1190to1210	Center	1210	1190to1210	Center	1210	1190to1210	Center	1210	1190to1210
Area	28893.98248		Area	32756.92096		Area	18721.27312		Area	32050.27745		Area	30638.71136	
Gw	57.69697	50-100	Gw	161.39144	50-100	Gw	139.3241	50-200	Gw	129.30389	50-200	Gw	88.94766	50-200
Lw	200	50-200	Lw	5	50-200	Lw	5	50-200	Lw	62.15468	50-200	Lw	141.98034	50-200
FWHM	**216.43228**		FWHM	**164.08122**		FWHM	**142.01653**		FWHM	**165.72796**		FWHM	**186.70882**	
Area %	6.529293436		Area %	5.3594894		Area %	4.624457421		Area %	4.609902177		Area %	8.745431329	
D3 band			**D3 band**			**D3 band**			**D3 band**			**D3 band**		
Center	1510	1510to1530	Center	1513.50276	1510to1530	Center	1510	1510to1530	Center	1510	1510to1530	Center	1510	1510to1530
Area	42824.71936		Area	61065.86035		Area	70299.72608		Area	64389.82262		Area	59604.4445	
Gw	100	5-100	Gw	100	5-100	Gw	150	5-150	Gw	100	5-150	Gw	150	5-150
Lw	100	5-100	Lw	100	5-100	Lw	125.89049	5-150	Lw	100	5-150	Lw	96.37261	5-150
FWHM	**163.75959**		FWHM	**163.75959**		FWHM	**228.3376**		FWHM	**163.75959**		FWHM	**208.08296**	
Area %	9.677280009		Area %	9.991226943		Area %	17.36516998		Area %	9.261410731		Area %	17.01333226	
D2 band			**D2 band**			**D2 band**			**D2 band**			**D2 band**		
Center	1623.11865	1610to1630	Center	1618.86937	1610to1630	Center	1621.08663	1610to1630	Center	1619.99649	1610to1630	Center	1619.48278	1610to1630
Area	10482.65493		Area	38559.83526		Area	11917.99331		Area	36655.05744		Area	13323.08427	
Gw	29.99223	5-50	Gw	39.04722	5-50	Gw	34.25234	5-50	Gw	37.40419	5-50	Gw	38.70923	5-50
Lw	5	5-50	Lw	5	5-50	Lw	5	5-50	Lw	5	5-50	Lw	5	5-50
FWHM	**32.75537**		FWHM	**41.7895**		FWHM	**37.0043**		FWHM	**40.14951**		FWHM	**41.45211**	
Area %	2.368809148		Area %	6.308927161		Area %	2.943937212		Area %	5.272223598		Area %	3.802905325	

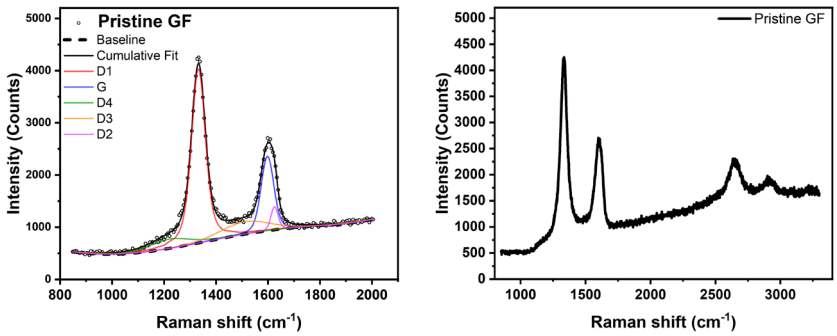

Figure S7: Pristine **GF** Raman spectrum and D/G band deconvolution.

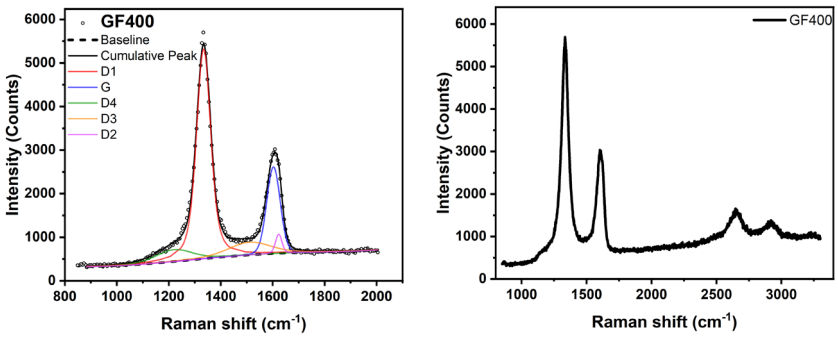

Figure S8: **GF400** Raman spectrum and D/G band deconvolution.

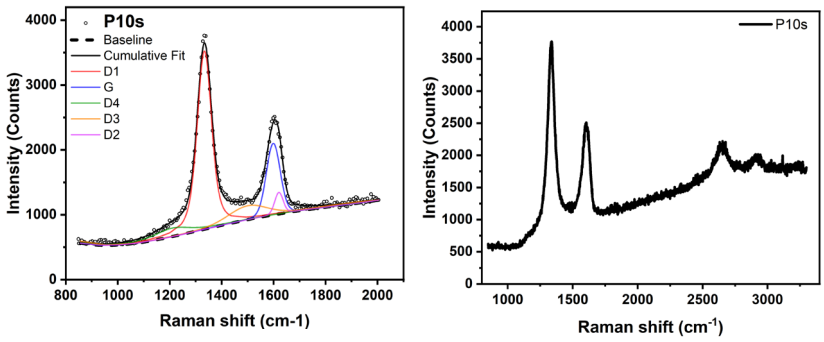

Figure S9: **P10s** Raman spectrum and D/G band deconvolution.

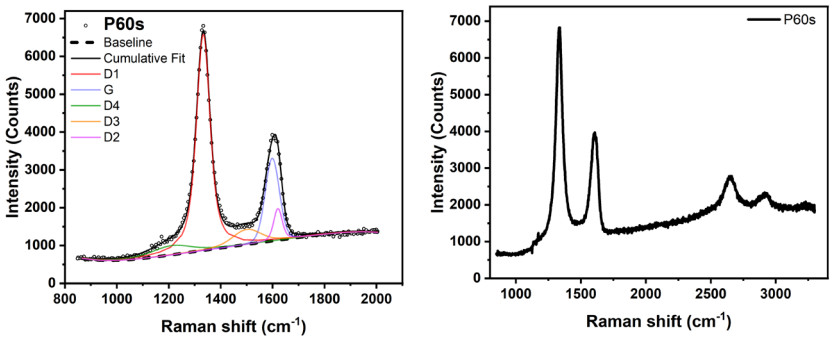

Figure S10: **P60s** Raman spectrum and D/G band deconvolution.

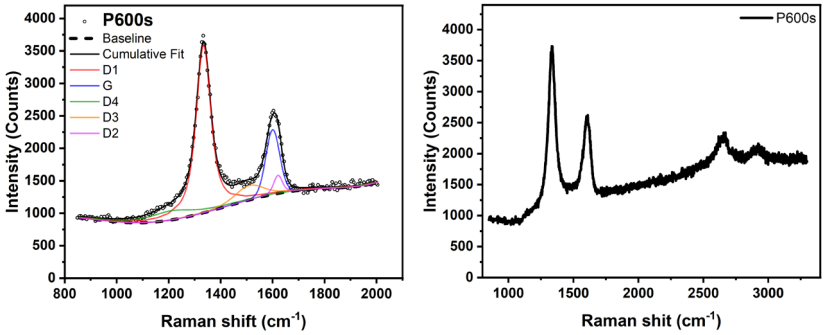

Figure S11: **P600s** Raman spectrum and D/G band deconvolution.

Electrochemical double layer capacitance analysis

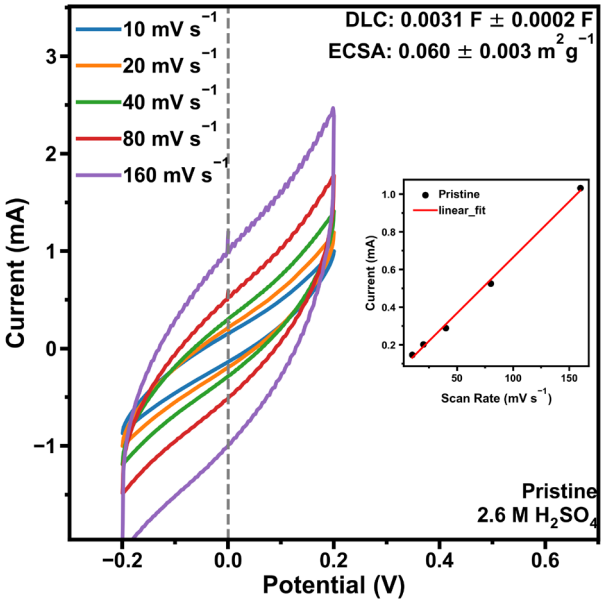

Figure S12: Pristine **GF** cyclic voltammetry showcasing non-faradaic current at different scan rates and linear fit of a current vs scan rate plot.

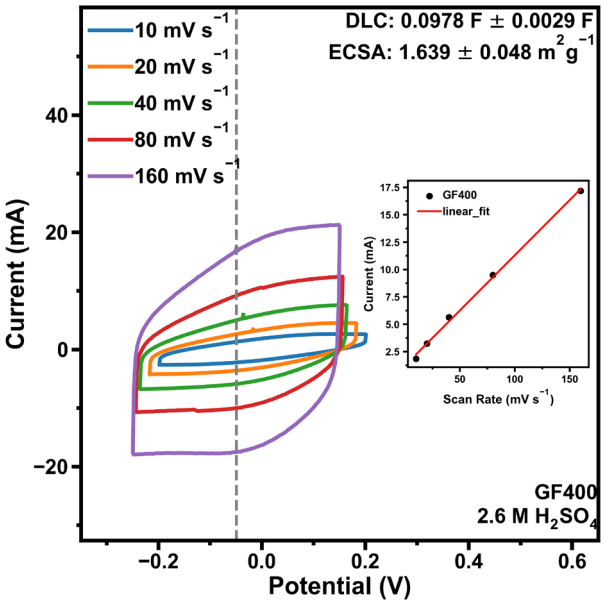

Figure S13: **GF400** cyclic voltammetry showcasing non-faradaic current at different scan rates and linear fit of a current vs scan rate plot.

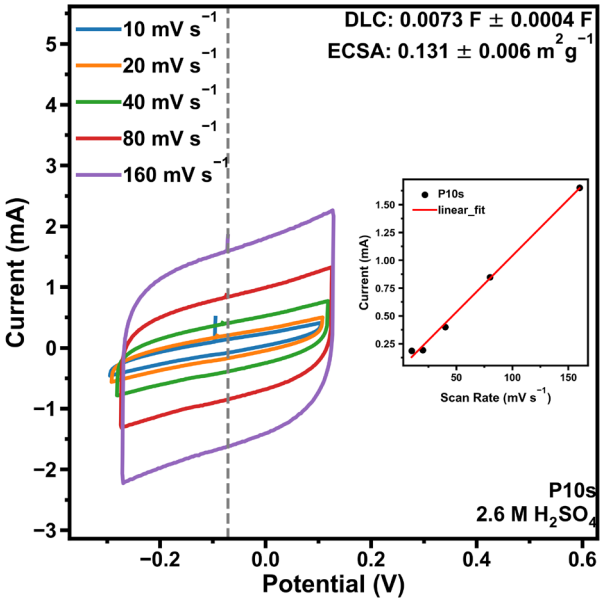

Figure S14: **P10s** cyclic voltammetry showcasing non-faradaic current at different scan rates and linear fit of a current vs scan rate plot.

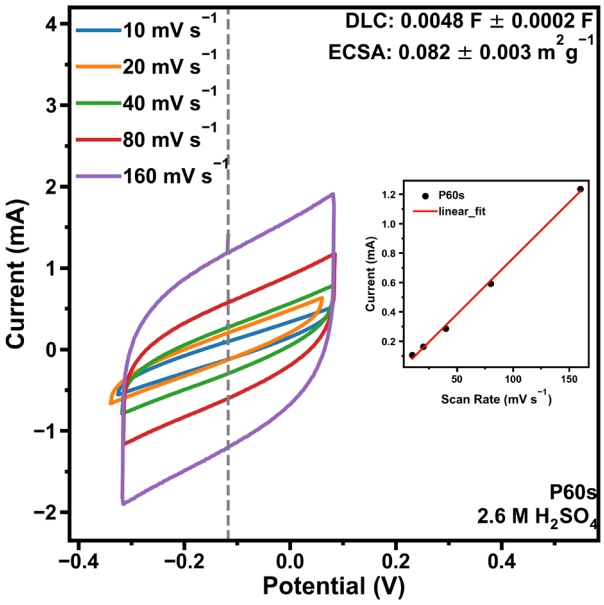

Figure S15: **P60s** cyclic voltammetry showcasing non-faradaic current at different scan rates and linear fit of a current vs scan rate plot.

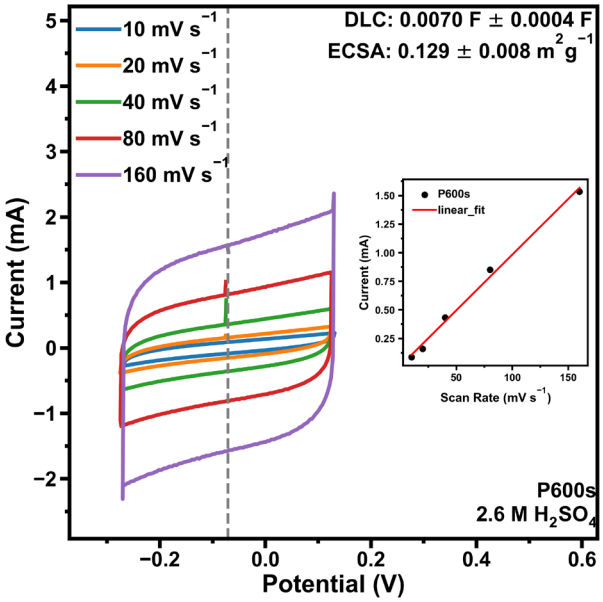

Figure 16: **P60s** cyclic voltammetry showcasing non-faradaic current at different scan rates and linear fit of a current vs scan rate plot.

BET analysis.

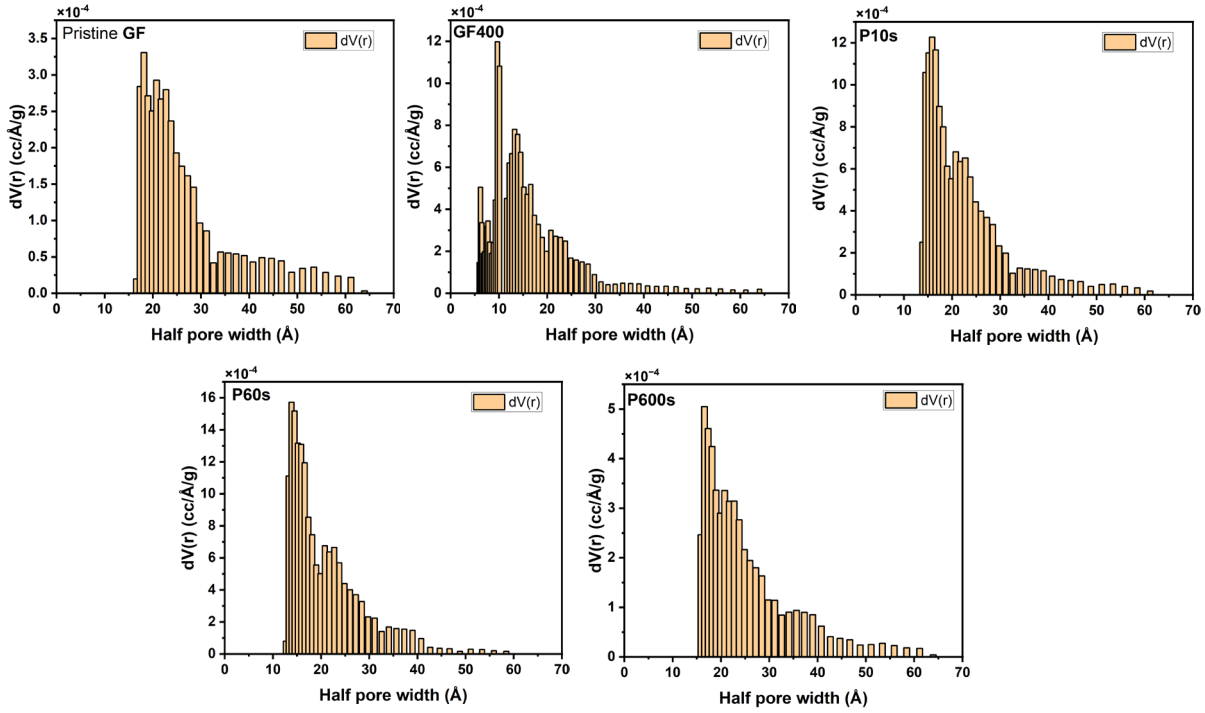

Figure S17: Pore-size distributions from electrodes as derived from BET analysis.

Single-electrolyte cell analysis.

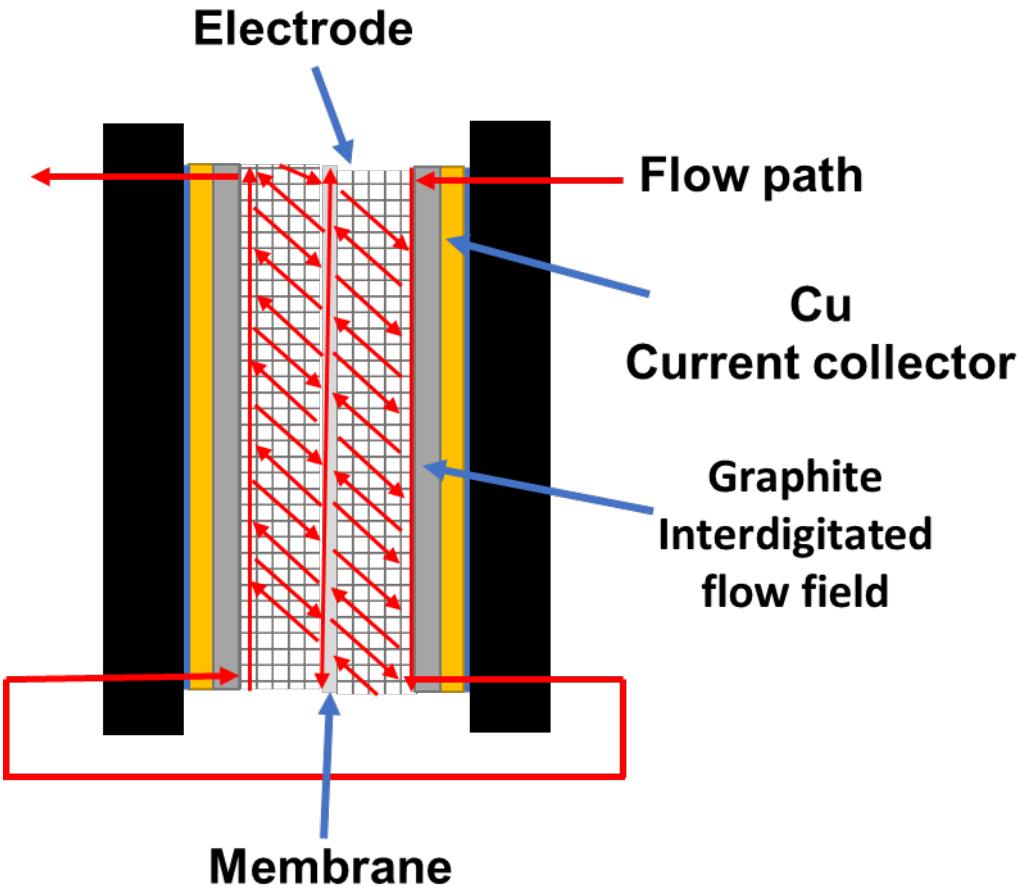

Figure S18: Schematic of a Single-electrolyte flow cell.

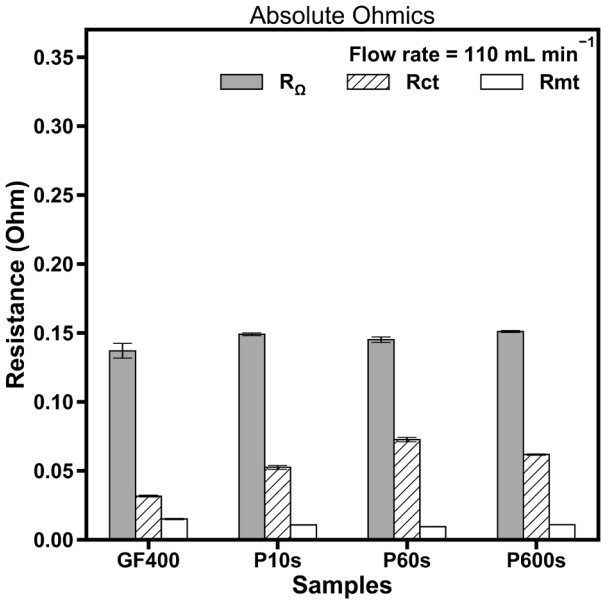

Figure S19: Breakdown of impedance contributions: Ohmic resistance (Rs), charge-transfer resistance (Rct) and mass-transport resistance (Rmt) at 110 mL min^{-1}

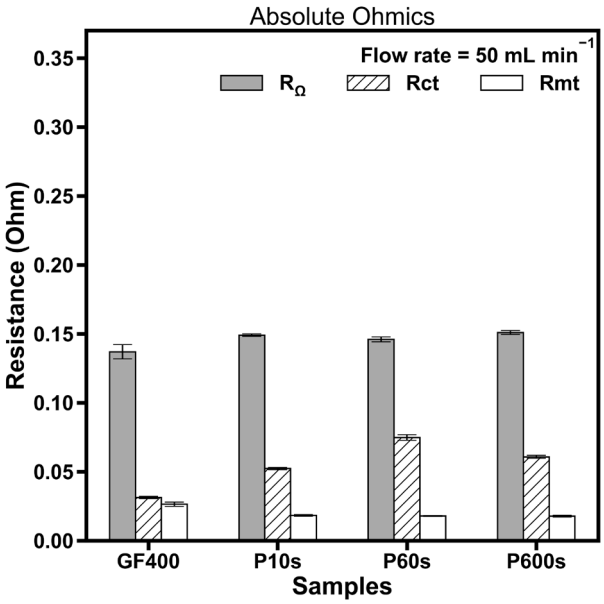

Figure S20: Breakdown of impedance contributions: Ohmic resistance (Rs), charge-transfer resistance (Rct) and mass-transport resistance (Rmt) at 50 mL min^{-1}

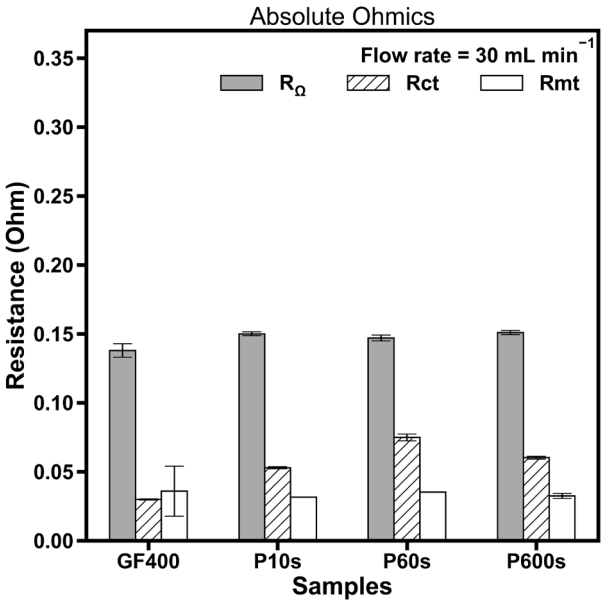

Figure S21: Breakdown of impedance contributions: Ohmic resistance (Rs), charge-transfer resistance (Rct) and mass-transport resistance (Rmt) at 30 mL min^{-1}

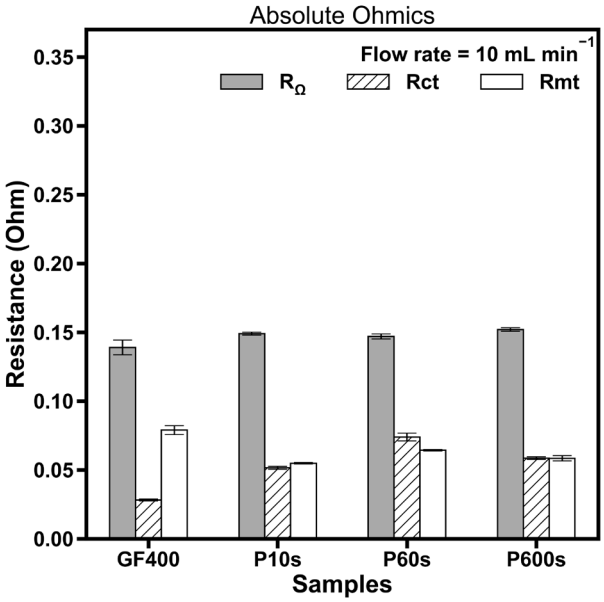

Figure S22: Breakdown of impedance contributions: Ohmic resistance (Rs), charge-transfer resistance (Rct) and mass-transport resistance (Rmt) at 10 mL min^{-1}

Pressure drop analysis.

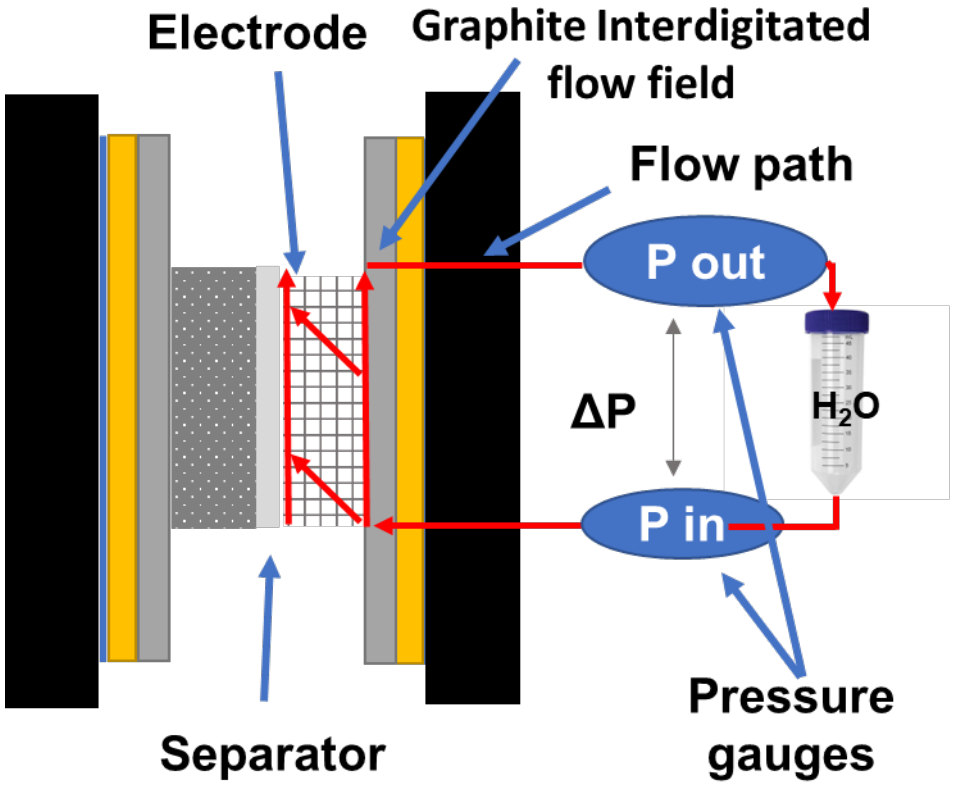

Figure S23: Schematic of a Flow cell set up to perform pressure drop measurements.

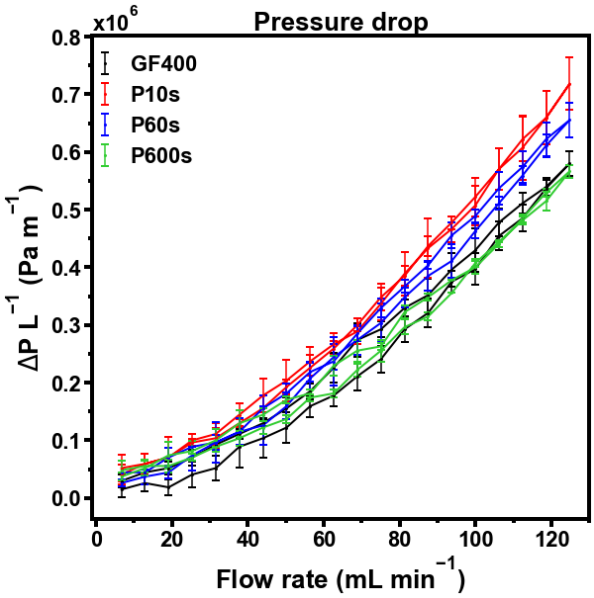

Figure S24: Pressure drop plot from different electrodes showcasing curve hysteresis.

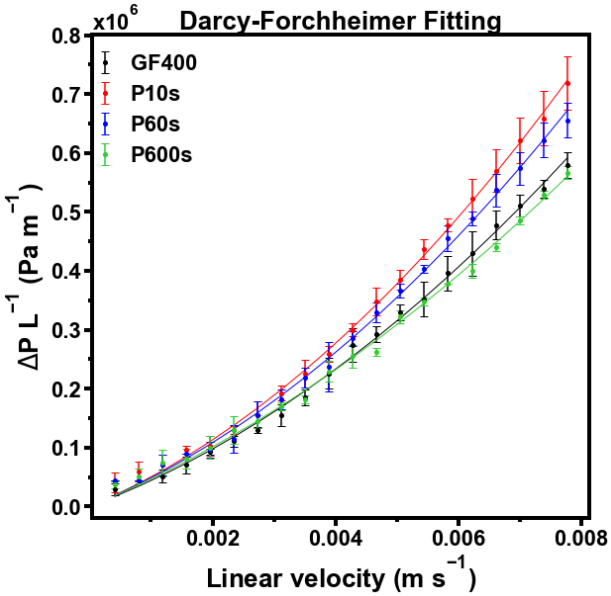

Figure S25: Darcy-Forchheimer fitting.

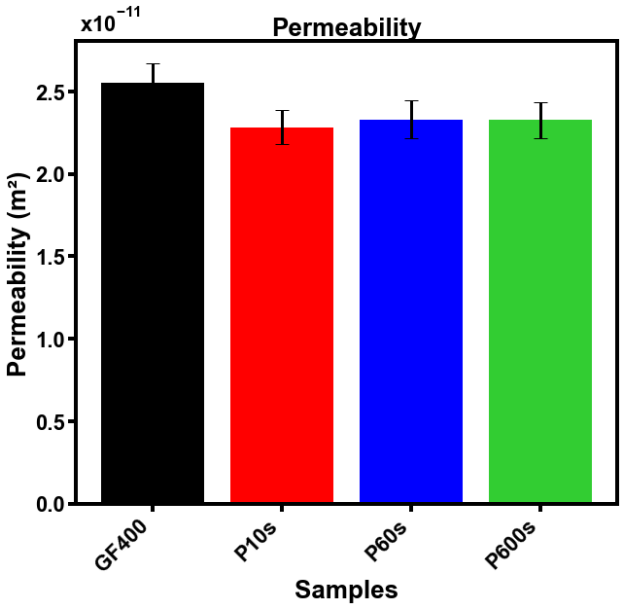

Figure S26: Permeability values derived from Darcy-Forchheimer fitting