Supporting Information

Effect of Fe-N-Cs as Catalytic Active Support for Platinum towards ORR in Acidic Environment

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Supplementary Figures



Figure S1. XP survey spectra.



Figure S2. High resolution XPS of a) N1s, b) C1s, c) O1s and d) Fe2p.

Supplementary Tables

			Binding en	ergies / eV		
	1 wt%	1 wt%	5 wt%	5 wt%	40 wt%	40 wt%
	Pt/C	Pt/Fe-N-C	Pt/C	Pt/Fe-N-C	Pt/C	Pt/Fe-N-C
$Pt^{0} 4f_{7/2}$	71.21	71.30	71.50	71.86	71.35	71.61
$Pt^{0} 4f_{5/2}$	74.41	74.50	74.55	75.06	74.40	74.51
Δ (Pt ⁰ 4f _{7/2})	0.09		0.36		0.26	
Δ (Pt ⁰ 4f _{5/2})	0.09		0	0.51		11

Table S1: Pt⁰ peak positions of 1, 5, 40 wt% Pt/Cs and Pt/Fe-N-Cs from XP spectra.

Table S2	: Element	amount f	ractions of	of 1, 5,	40 wt%	b Pt/Cs a	and Pt/F	Fe-N-Cs	determine	d via
XPS.										

	1 wt%	5 wt%	40 wt%	1 wt%	5 wt%	40 wt%
	Pt/C	Pt/C	Pt/C	Pt/Fe-N-C	Pt/Fe-N-C	Pt/Fe-N-C
Pyridinic N /	_	_	_	16	0.8	2.0
at%	_	-	-	1.0	0.0	2.0
Pyrrolic N / at%	-	-	-	5.2	0.0	3.6
Graphitic N / at%	-	-	-	1.5	3.2	1.7
Nitroxide / at%	-	-	-	1.2	1.0	1.3
N content / at%	3.1	2.6	1.8	9.5	4.9	8.5
O content / at%	12.7	10.6	9.4	12.4	2.7	9.9
C content / at%	83.6	85.8	83.0	70.7	91.6	72.6
Pt ⁰ content / at%	0.3	0.1	3.6	2.2	0.4	3.9
Pt ²⁺ content / at%	0.3	0.8	1.4	4.4	0.2	3.9
Pt ⁴⁺ content / at%	0.0	0.0	1.0	0.8	0.1	1.2
Pt content / at%	0.6	0.9	5.9	7.4	0.8	9.0
Sum / at%	100	100	100	100	100	100

	Mass Activity @	0.9 V norma	alized by mass of	Pt	
$MA_{Pt} / A g_{Pt}^{-1}$	Before AST	SD	After AST	SD	Loss / %
1 wt% Pt/C	111.73	103.46	65.09	61.06	42
1 wt% Pt/Fe-N-C	36.90	21.76	15.15	8.50	59
5 wt% Pt/C	357.62	19.33	82.57	36.85	77
5 wt% Pt/Fe-N-C	170.78	80.42	51.03	26.08	70
40 wt% Pt/C	351.74	34.24	76.77	8.38	78
40 wt% Pt/Fe-N-C	222.53	41.19	58.00	23.29	74
Fe-N-C	-	-	-	-	-
Mass	s Activity @0.9 V	normalized	by total mass of	catalyst	
Mass MA _{total} / A g _{total} ⁻¹	s Activity @0.9 V Before AST	normalized SD	by total mass of o After AST	catalyst SD	Loss / %
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C	s Activity @0.9 V Before AST 0.40	normalized SD 0.37	by total mass of of After AST 0.23	catalyst SD 0.22	Loss / % 42
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C 1 wt% Pt/Fe-N-C	Activity @0.9 V Before AST 0.40 0.50	normalized SD 0.37 0.30	by total mass of o After AST 0.23 0.20	SD 0.22 0.12	Loss / % 42 59
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C 1 wt% Pt/Fe-N-C 5 wt% Pt/C	s Activity @0.9 V Before AST 0.40 0.50 13.48	normalized SD 0.37 0.30 0.73	by total mass of o After AST 0.23 0.20 3.11	catalyst SD 0.22 0.12 1.39	Loss / % 42 59 77
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C 1 wt% Pt/Fe-N-C 5 wt% Pt/C 5 wt% Pt/Fe-N-C	s Activity @0.9 V Before AST 0.40 0.50 13.48 10.23	normalized SD 0.37 0.30 0.73 4.81	by total mass of o After AST 0.23 0.20 3.11 3.06	catalyst SD 0.22 0.12 1.39 1.57	Loss / % 42 59 77 70
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C 1 wt% Pt/Fe-N-C 5 wt% Pt/C 5 wt% Pt/Fe-N-C 40 wt% Pt/C	Activity @0.9 V Before AST 0.40 0.50 13.48 10.23 135.70	normalized SD 0.37 0.30 0.73 4.81 13.21	by total mass of 6 After AST 0.23 0.20 3.11 3.06 29.62	catalyst SD 0.22 0.12 1.39 1.57 3.24	Loss / % 42 59 77 70 78
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C 1 wt% Pt/Fe-N-C 5 wt% Pt/C 5 wt% Pt/Fe-N-C 40 wt% Pt/C 40 wt% Pt/Fe-N-C	s Activity @0.9 V Before AST 0.40 0.50 13.48 10.23 135.70 84.87	normalized SD 0.37 0.30 0.73 4.81 13.21 15.71	by total mass of 6 After AST 0.23 0.20 3.11 3.06 29.62 22.12	SD 0.22 0.12 1.39 1.57 3.24 8.88	Loss / % 42 59 77 70 78 78 74

Table S3: Mass activities of 1, 5, 40 wt% Pt/Cs and Pt/Fe-N-Cs at 0.9 V_{RHE} .

fuele of filled of it, of it of the of and fulle it eb at off the	Table S4: Mass activities	of 1, 5, 40	wt% Pt/Cs and	Pt/Fe-N-Cs at 0.7	V _{RHE} .
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	Mass Activity @	0.7 V norma	alized by mass of	Pt	
$MA_{Pt} / A g_{Pt}^{-1}$	Before AST	SD	After AST	SD	Loss / %
1 wt% Pt/C	3664.52	2331.45	1548.28	1531.79	58
1 wt% Pt/Fe-N-C	2099.60	2248.31	847.29	618.6	60
5 wt% Pt/C	14950.98	1024.81	1986.49	326.14	87
5 wt% Pt/Fe-N-C	6739.31	2458.86	1614.03	145.23	76
40 wt% Pt/C	20036.82	6893.72	5665.66	1418.16	72
40 wt% Pt/Fe-N-C	6910.21	908.29	2675.58	638.76	61
Fe-N-C	-	-	-	-	-
Mass	s Activity @0.7 V	normalized	by total mass of	catalyst	
Mass MA _{total} / A g _{total} ⁻¹	s Activity @0.7 V Before AST	normalized SD	by total mass of of After AST	catalyst SD	Loss / %
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C	s Activity @0.7 V Before AST 13.19	normalized SD 8.39	by total mass of of After AST 5.58	SD 5.51	Loss / % 58
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C 1 wt% Pt/Fe-N-C	s Activity @0.7 V Before AST 13.19 28.56	normalized SD 8.39 30.58	by total mass of o After AST 5.58 11.52	sD 5.51 8.42	Loss / % 58 60
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C 1 wt% Pt/Fe-N-C 5 wt% Pt/C	s Activity @0.7 V Before AST 13.19 28.56 563.65	normalized SD 8.39 30.58 38.64	by total mass of o After AST 5.58 11.52 74.89	catalyst SD 5.51 8.42 12.30	Loss / % 58 60 87
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C 1 wt% Pt/Fe-N-C 5 wt% Pt/C 5 wt% Pt/Fe-N-C	s Activity @0.7 V Before AST 13.19 28.56 563.65 403.68	normalized SD 8.39 30.58 38.64 147.29	by total mass of 0 After AST 5.58 11.52 74.89 96.68	catalyst SD 5.51 8.42 12.30 8.70	Loss / % 58 60 87 76
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C 1 wt% Pt/Fe-N-C 5 wt% Pt/C 5 wt% Pt/Fe-N-C 40 wt% Pt/C	s Activity @0.7 V Before AST 13.19 28.56 563.65 403.68 7730.20	normalized SD 8.39 30.58 38.64 147.29 2659.60	by total mass of a After AST 5.58 11.52 74.89 96.68 2185.81	catalyst SD 5.51 8.42 12.30 8.70 547.13	Loss / % 58 60 87 76 72
Mass MA _{total} / A g _{total} ⁻¹ 1 wt% Pt/C 1 wt% Pt/Fe-N-C 5 wt% Pt/C 5 wt% Pt/Fe-N-C 40 wt% Pt/C 40 wt% Pt/Fe-N-C	s Activity @0.7 V Before AST 13.19 28.56 563.65 403.68 7730.20 2635.55	normalized SD 8.39 30.58 38.64 147.29 2659.60 346.42	by total mass of a After AST 5.58 11.52 74.89 96.68 2185.81 1020.47	catalyst SD 5.51 8.42 12.30 8.70 547.13 243.62	Loss / % 58 60 87 76 72 61