SUPPLEMENTARY MATERIAL

Ag-Mn_xO_y on Graphene Oxide Derivatives as Oxygen Reduction Reaction Catalyst in Alkaline Direct Ethanol Fuel Cells

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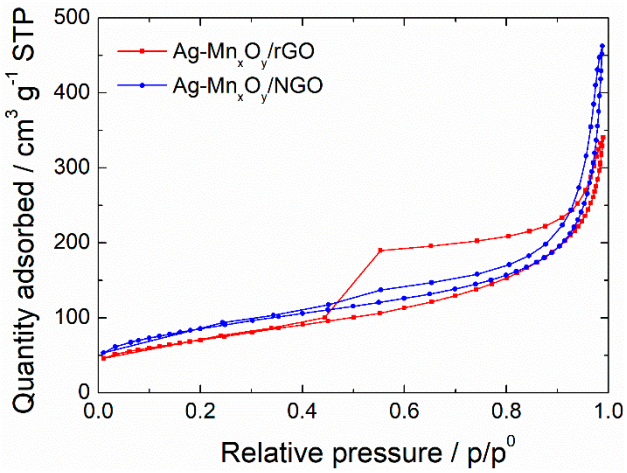

Figure S1. Adsorption/desorption isotherms of Ag-Mn_xO_y/rGO and Ag-Mn_xO_y/NGO.

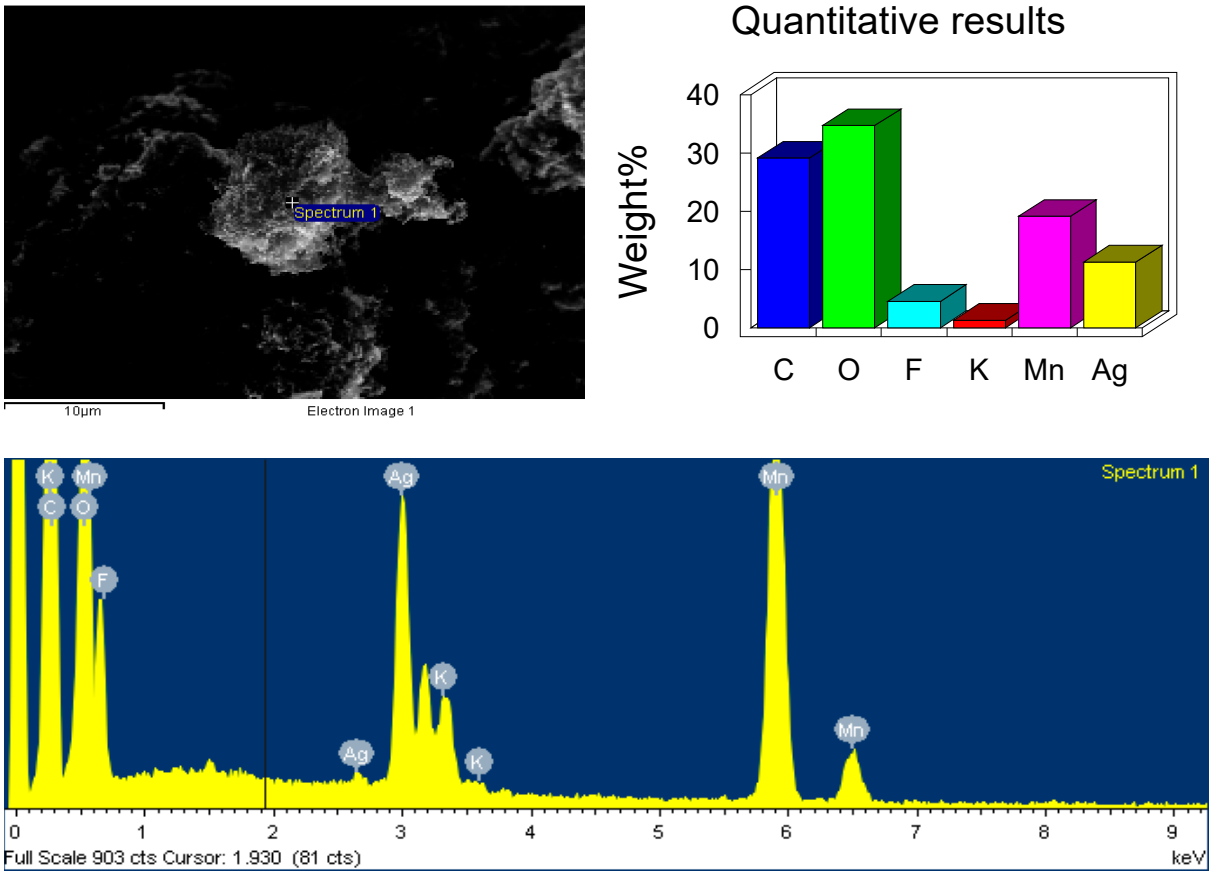

Figure S2. EDX results of Ag-Mn_xO_y/rGO.

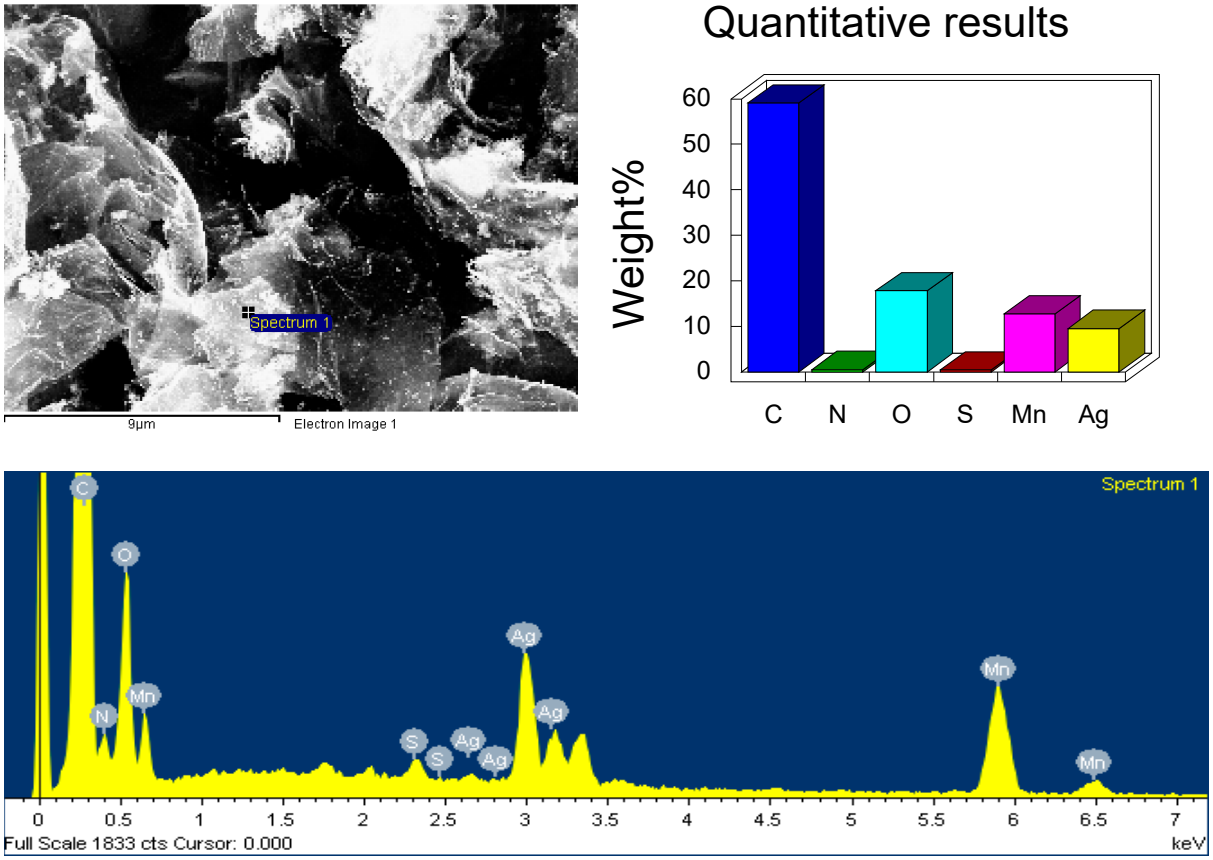

Figure S3. EDX results of Ag-Mn_xO_y/NGO.

Table S1. ICP-MS results of the Ag-Mn_xO_y/C catalysts.

Catalysts	Mn (wt%)	Ag (wt%)	K (wt%)	Cu (ppm)	Ni (ppm)	Fe (ppm)	Al (ppm)	Cr (ppm)	Ti (ppm)	Co (ppm)	Mg (ppm)
Ag-Mn_xO_y/rGO	13.81	9.51	0.89	6.70	<2.4	<2.4	98.4	<2.4	<2.4	<2.4	44.9
Ag-Mn_xO_y/NGO	11.64	9.05	0.40	11700	11500	6600	1783	1583	267	261	125

	Ca (ppm)	Zn (ppm)	V (ppm)	Mo (ppm)	Ba (ppm)	Se (ppm)	Pb (ppm)	Sr (ppm)	Cd (ppm)	As (ppm)
Ag-Mn_xO_y/rGO	35.8	15.9	<2.4	<2.4	6.13	<2.4	<2.4	<2.4	<2.4	<2.4
Ag-Mn_xO_y/NGO	105	76.6	24.9	23.8	5.39	20.1	13.0	4.65	3.61	3.47

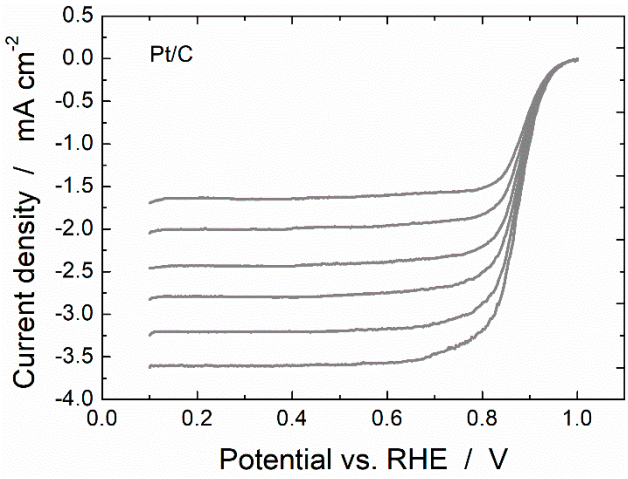

Figure S4. Potentiodynamic ORR curves of comm. Pt/C in O_2 saturated 1 M KOH at 10 mV s^{-1} at different rotation rates.

Table S2. Limiting current density of the graphene derivatives, Ag-Mn_xO_y/C composites and Pt/C catalysts without/with EtOH at different rpm.

Catalysts	400 rpm / mA cm^{-2}	600 rpm / mA cm^{-2}	900 rpm / mA cm^{-2}	1200 rpm / mA cm^{-2}	1600 rpm / mA cm^{-2}	2000 rpm / mA cm^{-2}
rGO	-1.05/ -1.02	-1.24/ -1.21	-1.49/ -1.45	-1.70/ -1.65	-1.96/-1.88	-2.17/ -2.05
NGO	-0.99/ -0.91	-1.17/ -1.09	-1.42/ -1.30	-1.60/ -1.48	-1.84/-1.69	-2.06/ -1.87
Ag-Mn_xO_y/rGO	-1.56/ -1.43	-1.88/ -1.71	-2.28/ -2.07	-2.63/ -2.37	-3.01/-2.72	-3.41/ -3.04
Ag-Mn_xO_y/NGO	-1.51/ -1.35	-1.80/ -1.62	-2.18/ -1.94	-2.49/ -2.21	-2.85/-2.52	-3.18/ -2.80

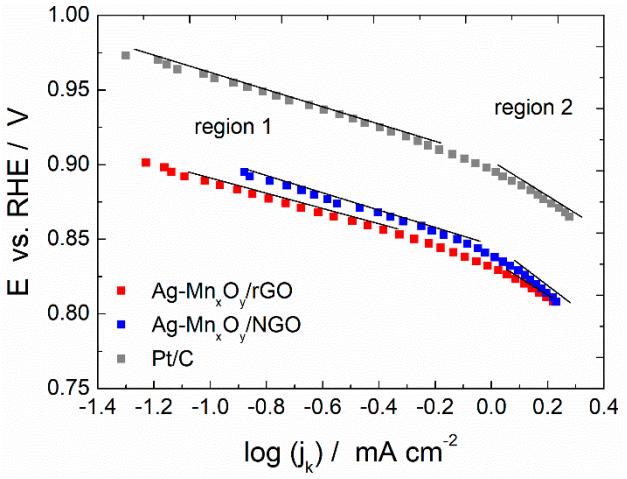

Figure S5. Tafel Plot of Ag-Mn_xO_y/C composites and Pt/C derived from the ORR curves in O_2 saturated 1 M KOH at 10 mV s^{-1} at different rotation rates.

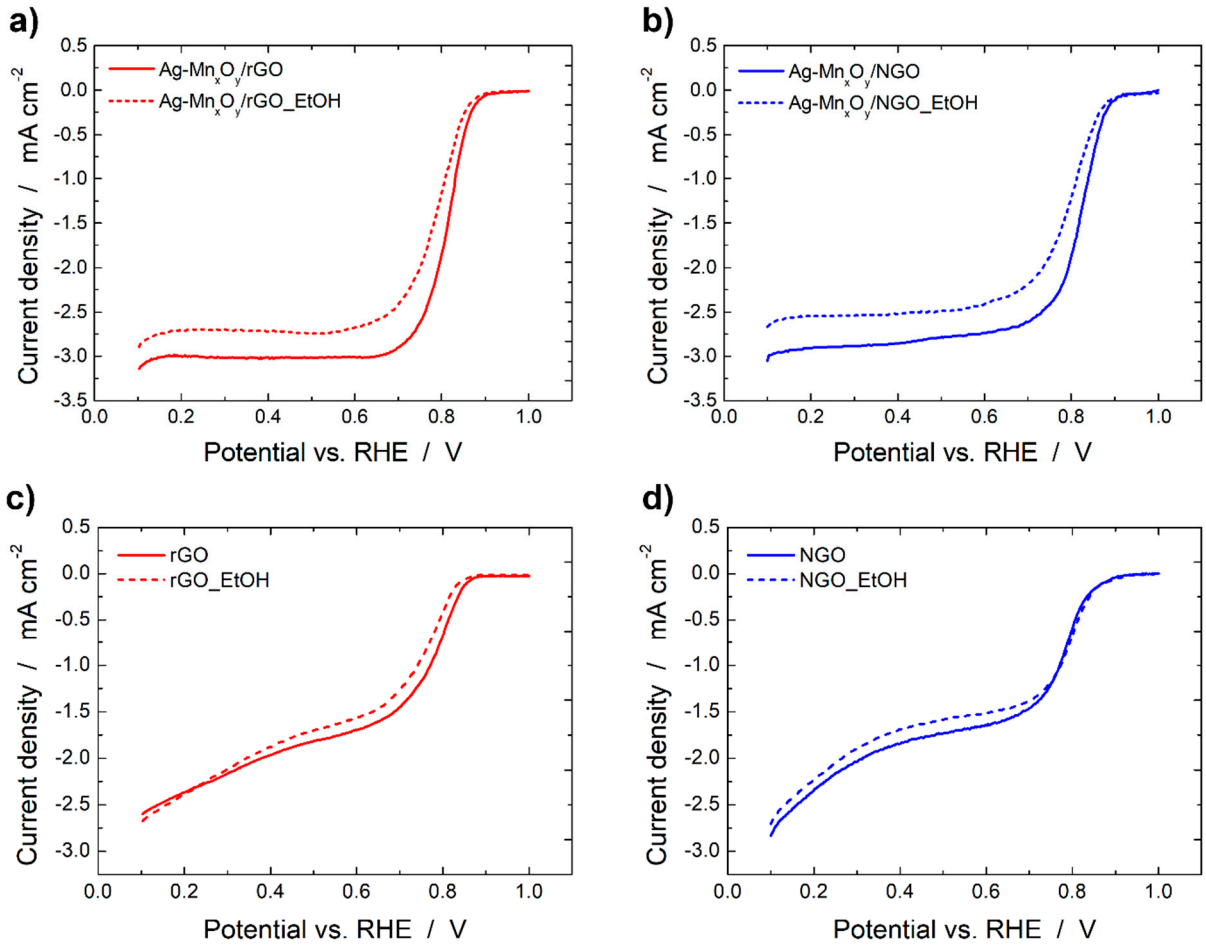

Figure S6. Potentiodynamic ORR curves of Ag-Mn$_x$O$_y$/rGO (a) and Ag-Mn$_x$O$_y$/NGO (b) catalysts and blank support materials (c, d) in O_2 saturated 1 M KOH at 10 mV s^{-1} at 1600 rpm with and without EtOH.