Supporting Information

Graphene-like δ-MnO_2 decorated with ultrafine CeO_2 as a highly-efficient catalyst for long-life lithium–oxygen batteries

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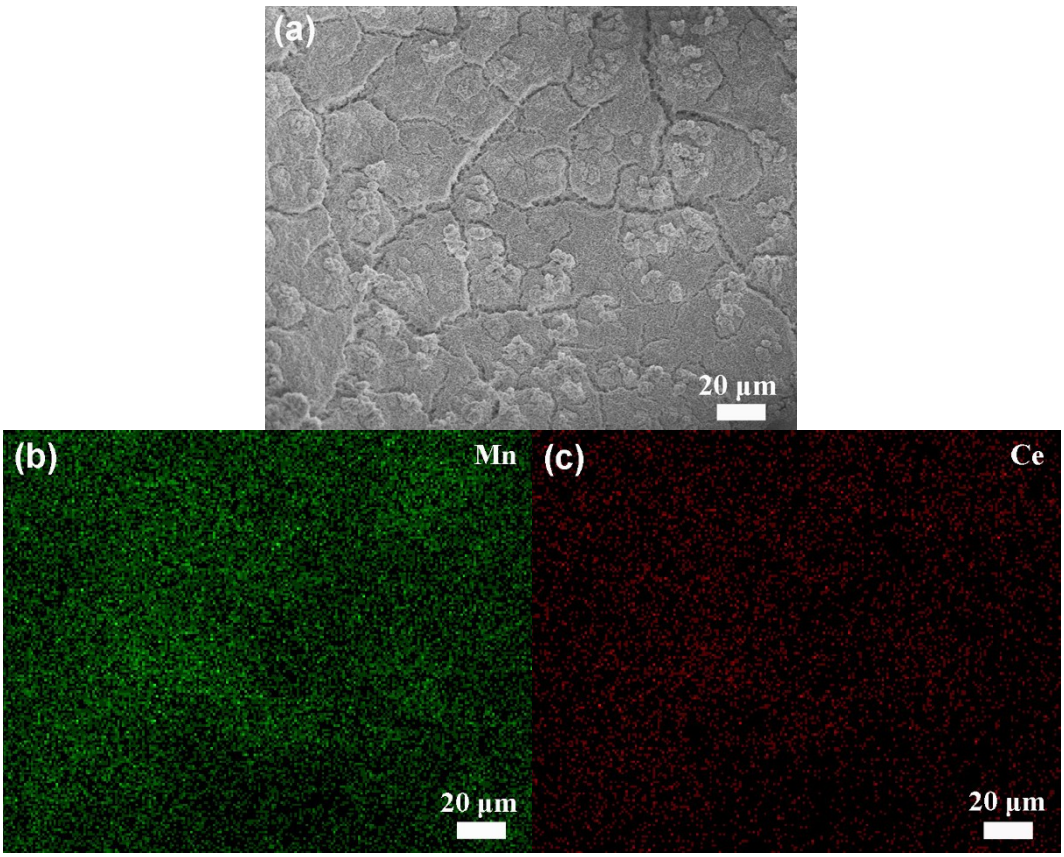

Fig. S1. Low-magnification SEM image and the corresponding EDS mapping of Mn and Ce elements in CeO_2/δ-MnO_2.

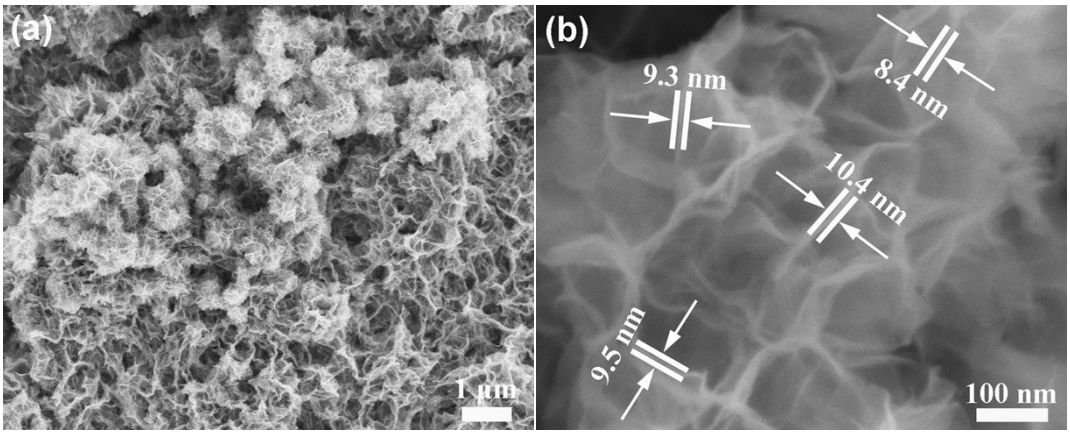

Fig. S2. SEM images of bare δ-MnO_2.

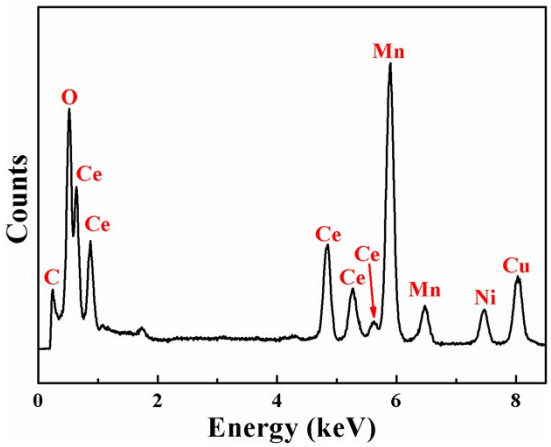

Fig. S3. TEM-EDS of the CeO_2/δ-MnO_2 catalyst.

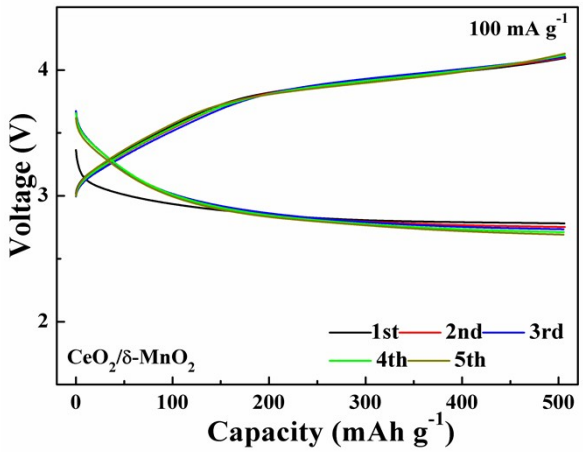

Fig. S4. Voltage profiles of δ-MnO_2-catalyzed Li–O_2 cell at a limited capacity of 500 mAh g^{-1} with a rest time of 1 h after each charge and discharge step.

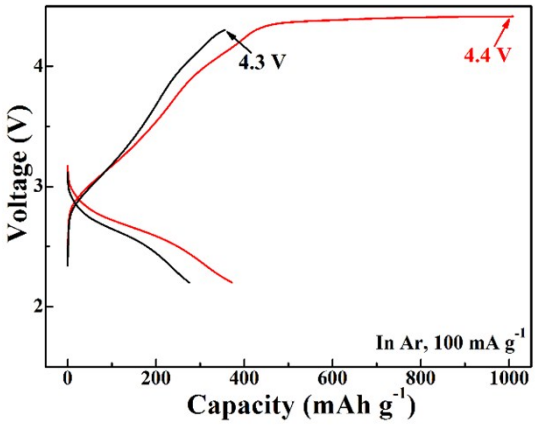

Fig. S5. Voltage profile of Li–CeO_2/δ-MnO_2 cells charged to 4.3 and 4.4 V at a current density of 100 mA g^{-1} in Ar.

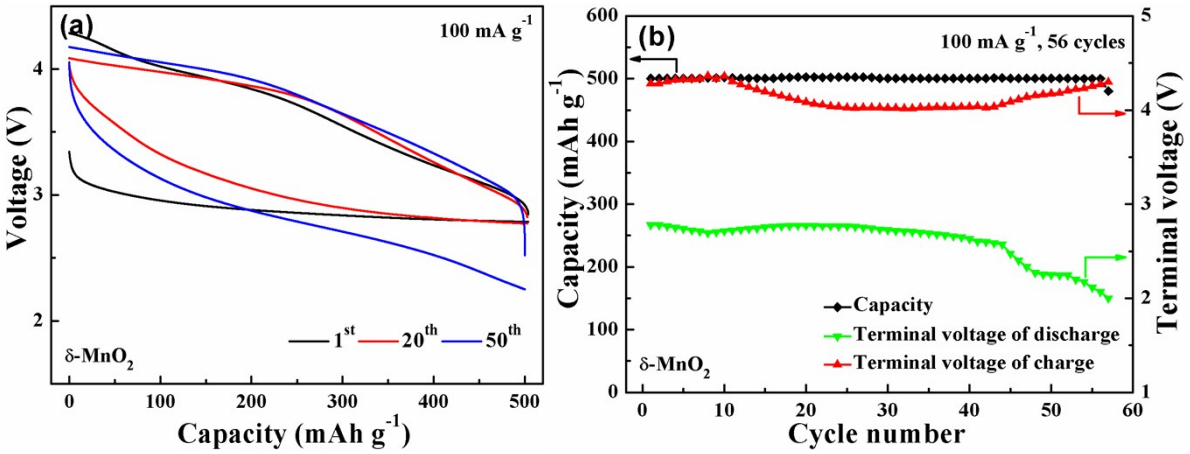

Fig. S6. (a) Voltage profiles and (b) terminal voltages of δ-MnO_2-catalyzed Li–O_2 cell at a limited capacity of 500 mAh g^{-1}.

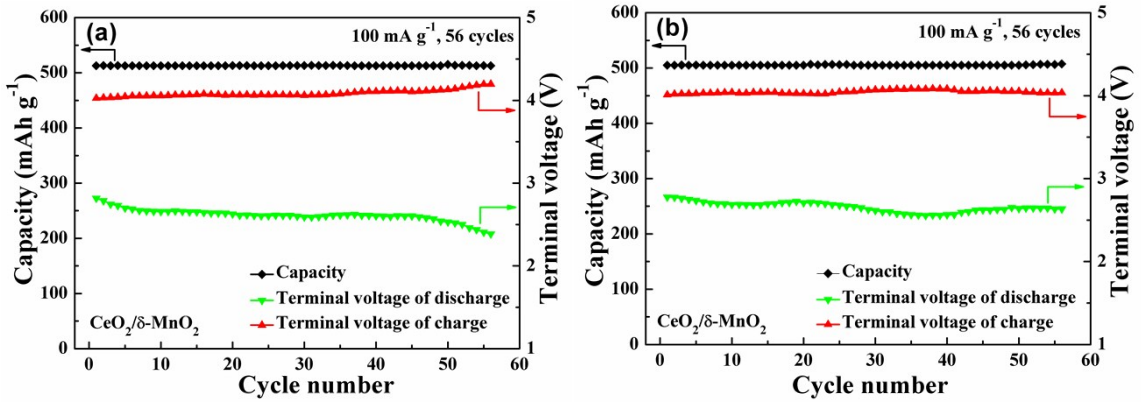

Fig. S7. Terminal voltages of CeO_2/δ-MnO_2-catalyzed Li–O_2 cells with a (a) low (Ce:Mn=5:95) and (b) high (Ce:Mn=23:77) CeO_2/δ-MnO_2 molar ratios at a limited capacity of 500 mAh g^{-1}.

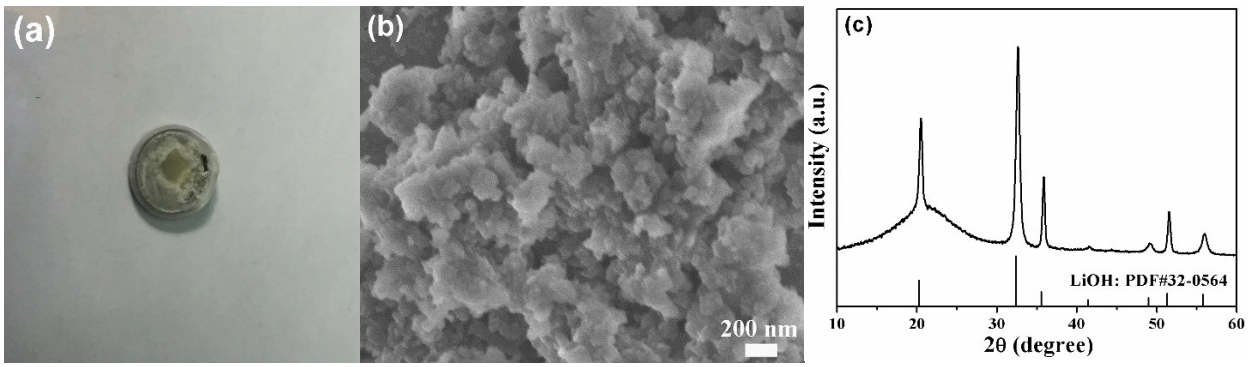

Fig. S8. (a) Digital photo, (b) SEM image and (c) XRD patterns of the Li anode from the dead cell cycled at 100 mA g^{-1} in the 1 M $LiClO_4$/TEGDME electrolyte.

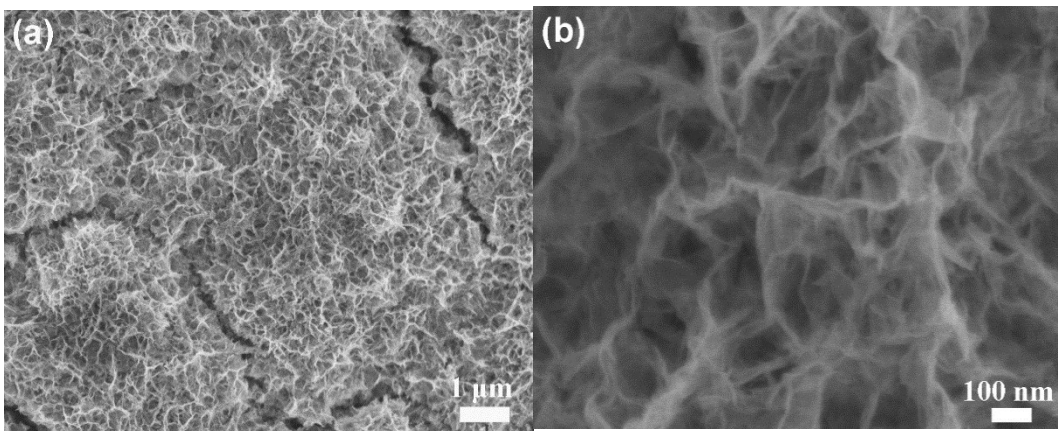

Fig. S9. SEM images of the CeO_2/δ-MnO_2 electrode from the dead cell cycled at 100 mA g^{-1} in the 1 M $LiClO_4$/TEGDME electrolyte.

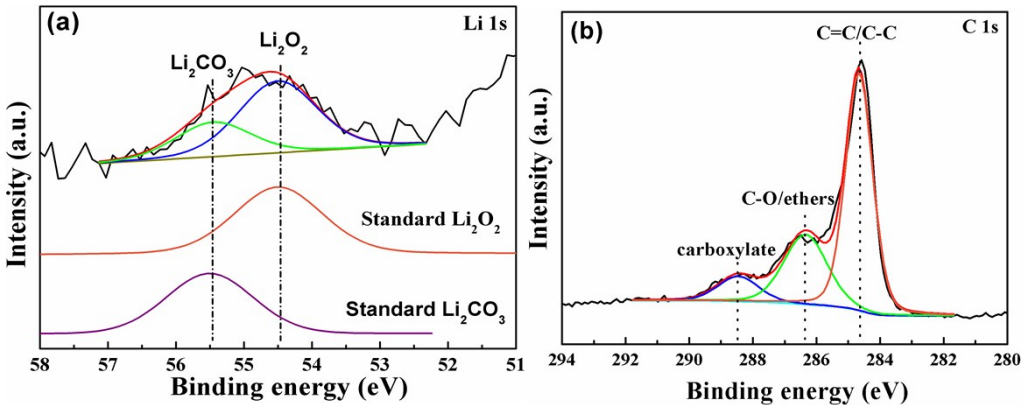

Fig. S10. (a) Li 1s and (b) C 1s of theCeO_2/δ-MnO_2electrode from the dead cell cycled at 100 mA g^{-1} in the 1 M $LiClO_4$/TEGDME electrolyte.

Table S1 Comparison of electrochemical performance using CeO_2-based catalysts.

Catalyst	Maximum capacity/current density	Capacity limited/current density	Cycle number	Reference
CeO_2/δ-MnO_2	**8260 mAh g^{-1}/100 mA g^{-1}（~0.05 mA cm^{-2}）**	**500 mAh g^{-1}/100mA g^{-1}（~0.05 mA cm^{-2}）**	**296**	**This work**
CeO_2/CNT	~2000 mAh g^{-1}/20 mA g^{-1}	– –	– –	[1]
CeO_2@N-RGO	11900 mAh g^{-1}/400 mA g^{-1}	1000 mAhg^{-1}/400mA g^{-1}	40	[2]
MnO_x@CeO_2	2617 mAh g^{-1}/100 mA g^{-1}	1000 mAh g^{-1}/200mA g^{-1}	30	[3]
Ag@CeO_2	3415 mAh g^{-1}/100 mA g^{-1}	500 mAh g^{-1}/200mA g^{-1}	50	[4]
Zr-CeO_2	8435 mAh g^{-1}/0.1 mA cm^{-2}	1000 mAh g^{-1}/1 mA cm^{-2}	40	[5]
G/Zr-CeO_2	3254 mAh g^{-1}/0.2 mA cm^{-2}	500 mAh g^{-1}/1 mA cm^{-2}	14	[6]

References

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