Supplementary Information for Stabilising Mn_3O_4 Nanosheet on Graphene *via* Forming 2D-2D Nanostructure for Improvement of Lithium Storage

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1. To test the formation mechanism of 2D-2D Mn_3O_4-NS/GNS, the XRD image for reaction intermediate of MnOOH is shown in Fig. S1.

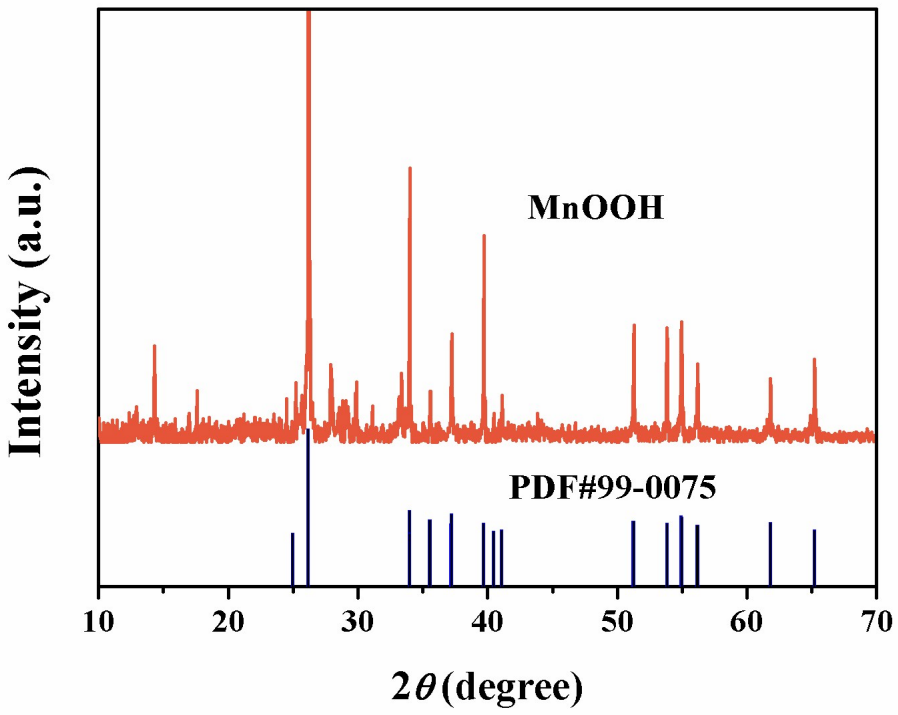


Fig. S1 X-Ray diffraction patterns of MnOOH.

2. The electrochemical performance of GN for comparing with the Mn_3O_4-NS/GNS composite is showed.

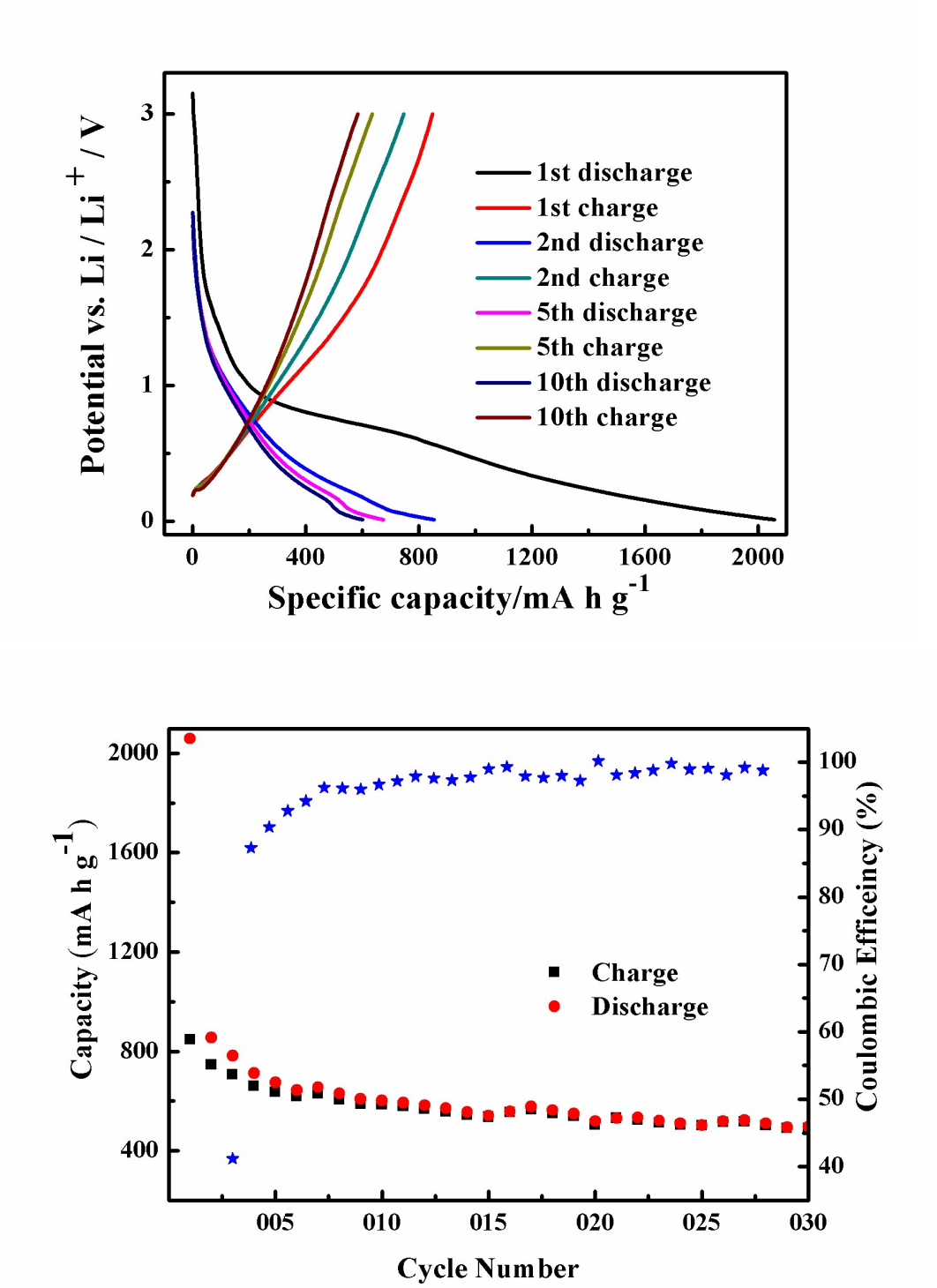
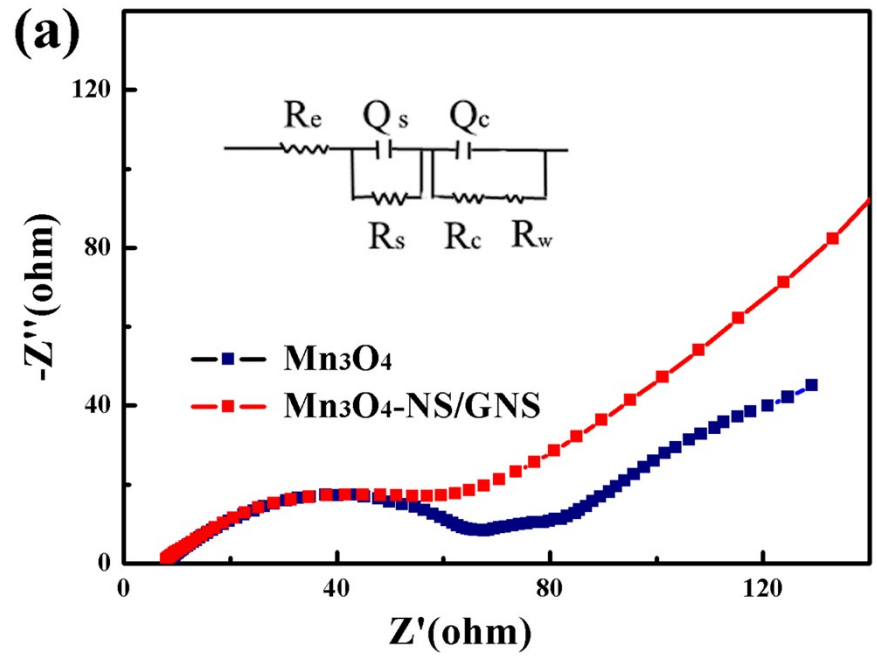
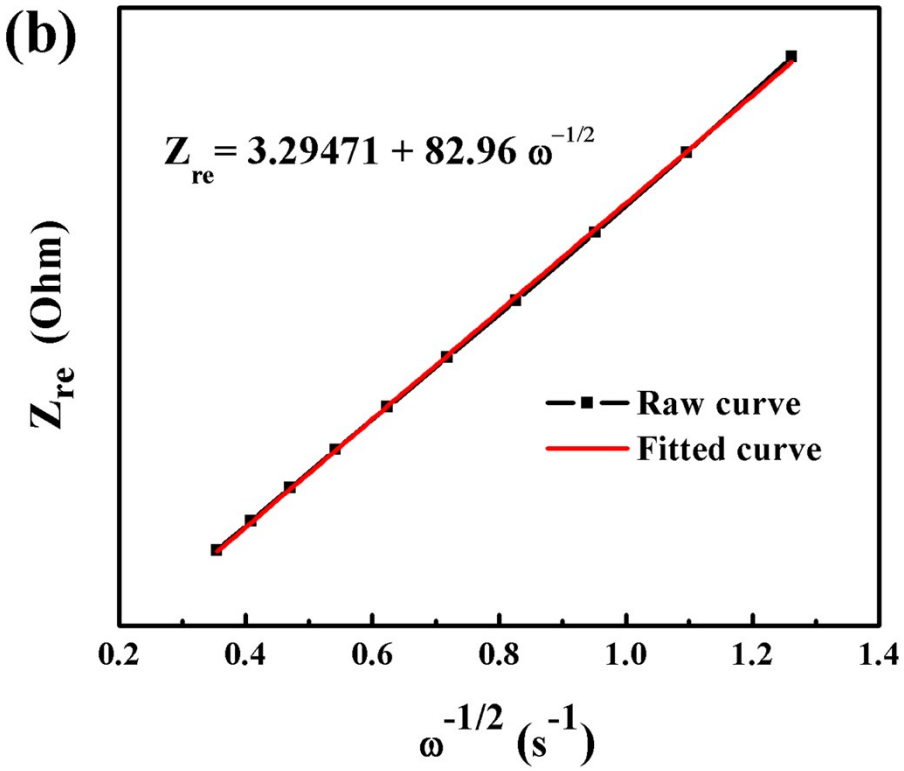


Fig. S2. Electrochemical characterization of graphene nanosheets (GNS) as electrode materials, (a) Galvanostatic charge and discharge curves for GNS at a current density of 50 mA g^{-1} for various cycles (1st, 2nd, 5th and 10th); (b) capacity retentions of two samples for 50 cycles at 50 mA g^{-1}.

3. EIS patterns of mica-like Mn_3O_4 and Mn_3O_4-NS/GNS composite are showed.


(a)
Re
Qs
Qc
Rs
Rc
Rw
Mn3O4
Mn3O4-NS/GNS
-Z''(ohm)
Z'(ohm)
0
40
80
120


(b)
Z_re = 3.29471 + 82.96 ω^-1/2
Raw curve
Fitted curve
Z_re (Ohm)
ω^-1/2 (s^-1)
0.2
0.4
0.6
0.8
1.0
1.2
1.4

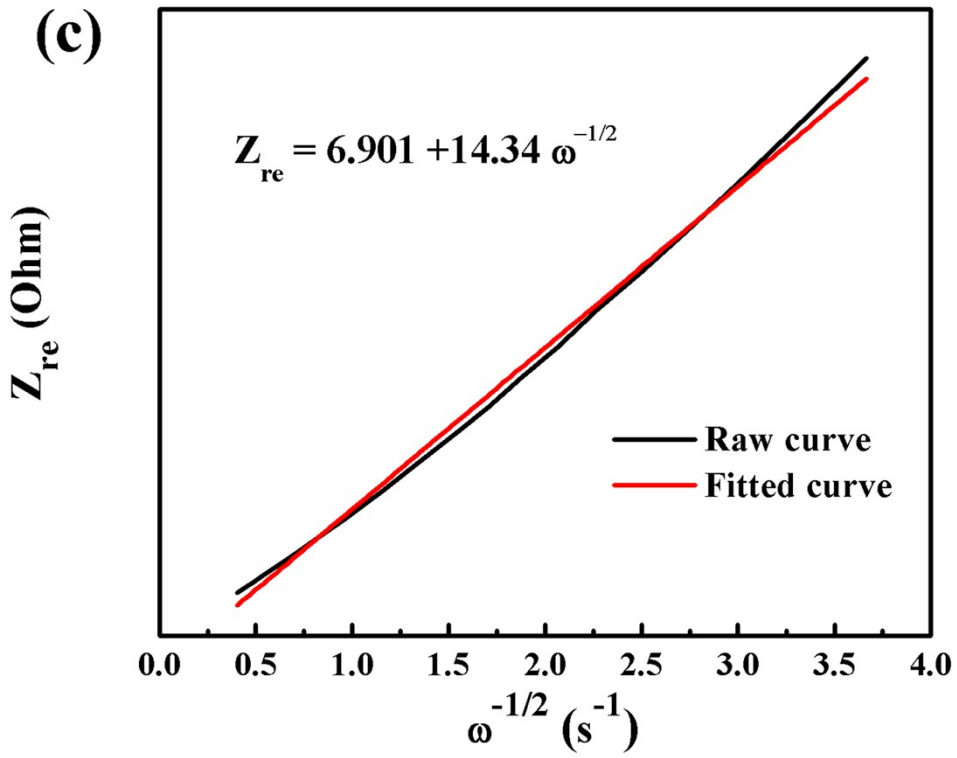


Fig. S3 EIS patterns of Mn_3O_4 and Mn_3O_4-NS/GNS composite, (a) Nyquist plots for Mn_3O_4 and Mn_3O_4-NS/GNS composite at same voltage; plotting of real and imaginary resistance vs. inverse square root of the angular frequency for Mn_3O_4 (b)and Mn_3O_4-NS/GNS composite (c).

4. The 2D structure is constructed by the Mn_3O_4 nanosheets stabilizing on the graphene, in which there are re-produced space for buffering the volume changing.

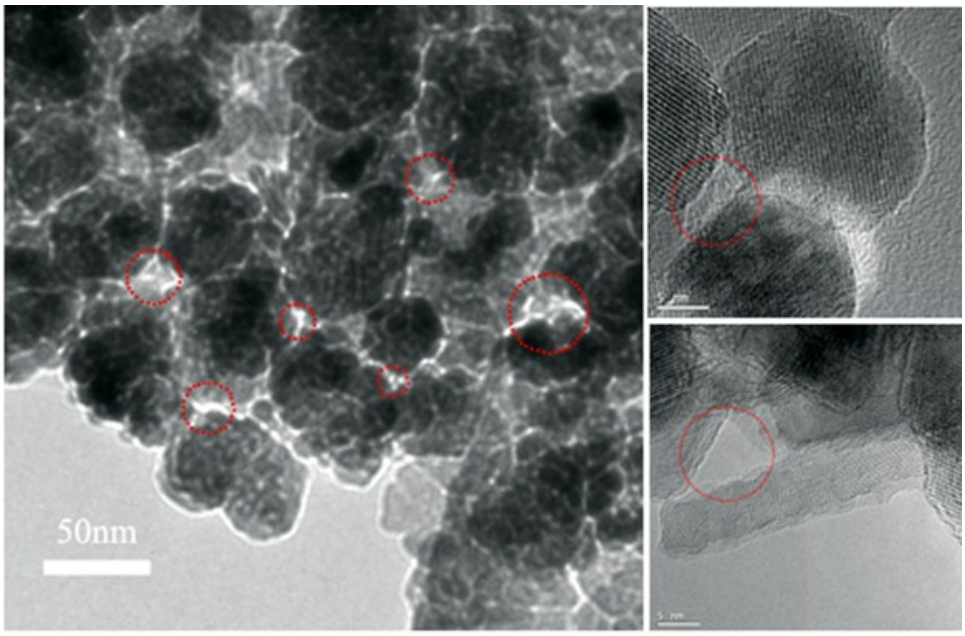


Fig. S4 The TEM images of reproduced structure in Mn_3O_4-NS/GNS composite.

5. The structure of the Mn_3O_4-NS/GNS composite for HRTEM.

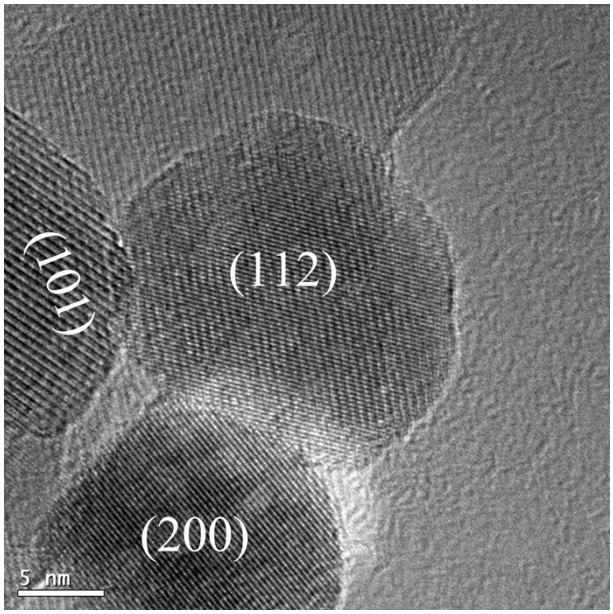


Fig. S5 HRTEM image of Mn_3O_4-NS/GNS 2D-2D structure