Electronic Supplementary Information

Porous $LiMn_2O_4$ nanorods with durable high-rate capability for rechargeable Li-ion batteries

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This file contains Figs. S1–S8.

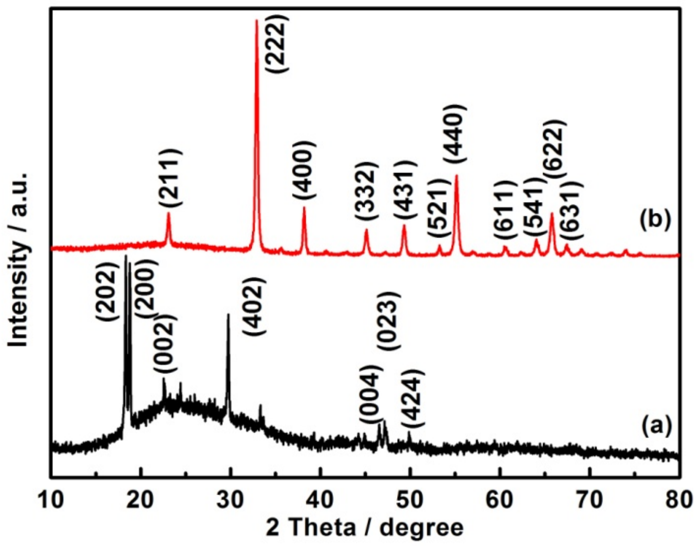

Fig. S1 XRD patterns of (a) MnC_2O_4 nanorods synthesized through the micro-emulsion method at room temperature and (b) porous Mn_2O_3 nanorods prepared by calcining the MnC_2O_4 precursors at 450 °C for 6 h.

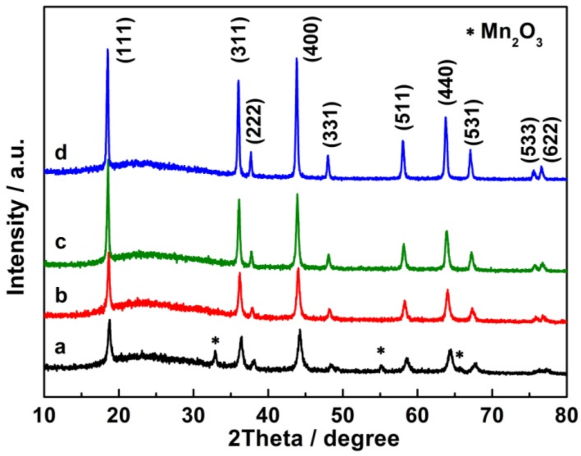

Fig. S2 XRD patterns of the products obtained from the solid-state reaction between porous Mn_2O_3 nanorods and LiOH at different temperatures: (a) 450 °C, (b) 500 °C, (c) 600 °C, and (d) 700 °C. The asterisk denotes Mn_2O_3.

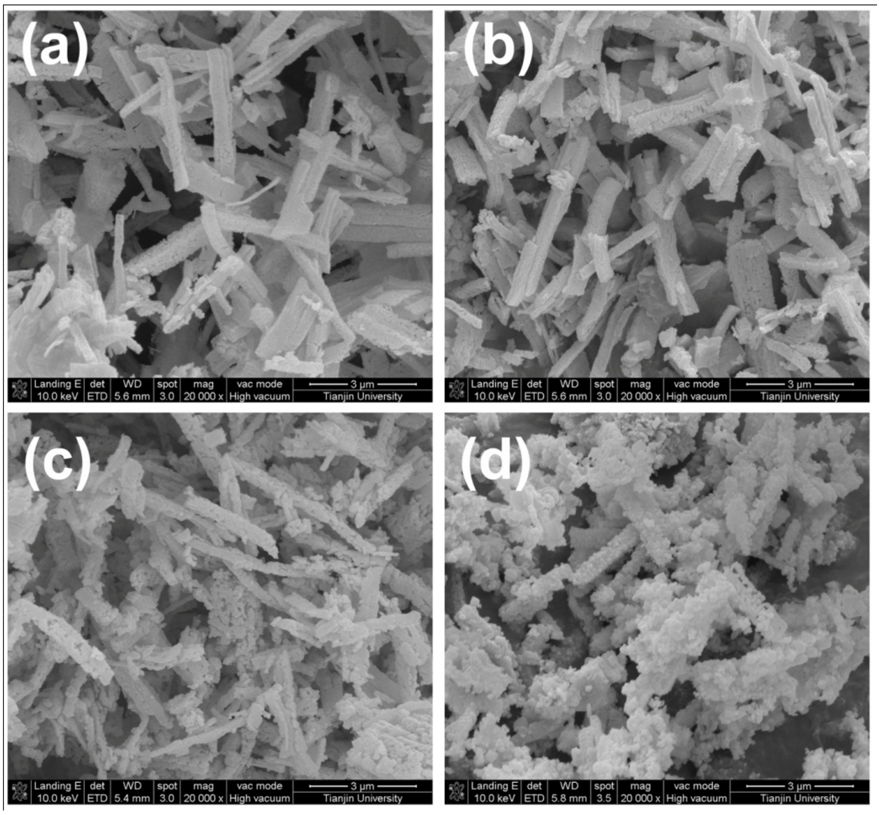

Fig. S3 SEM images of the products obtained from the solid-state reaction between porous Mn_2O_3 nanorods and LiOH at different temperatures: (a) 500 °C, (b) 600 °C, (c) 700 °C, and (d) 800 °C.

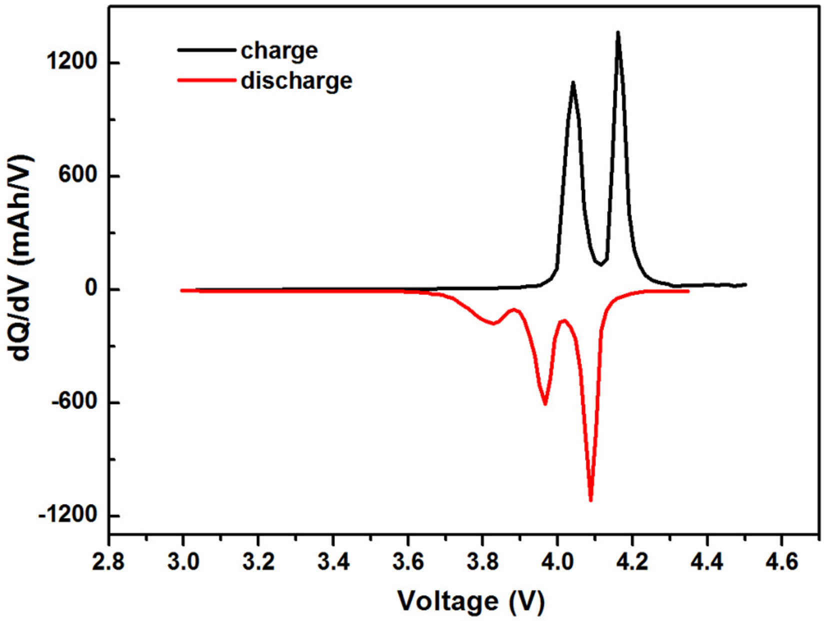

Fig. S4 Differential capacities versus voltage (dQ/dV) from the initial 1C charge and discharge curves of the porous spinel nanorods prepared at 700 °C.

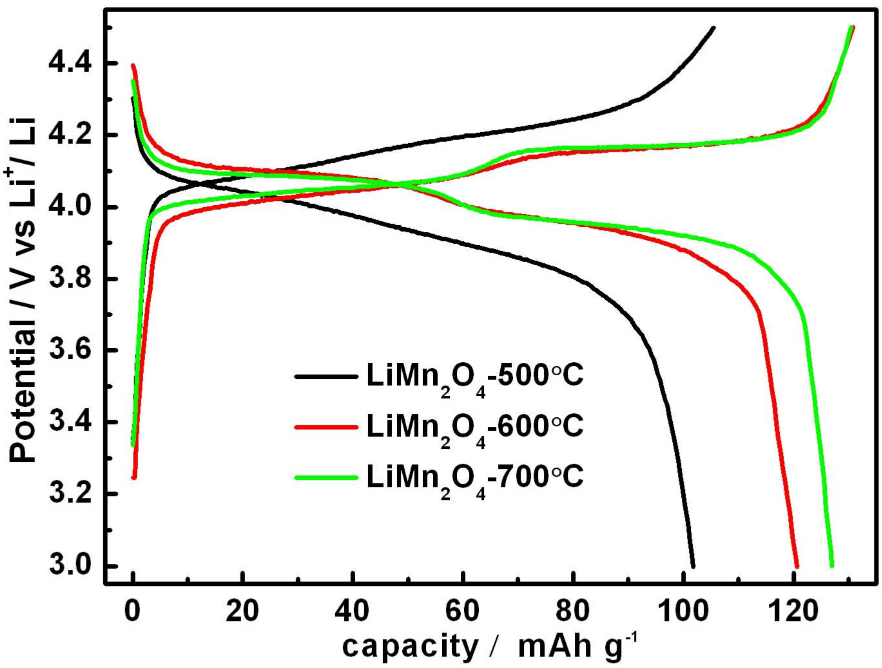

Fig. S5 Charge-discharge curves at the second cycle (at 1 C rate) of the porous nanorods prepared at different temperatures.

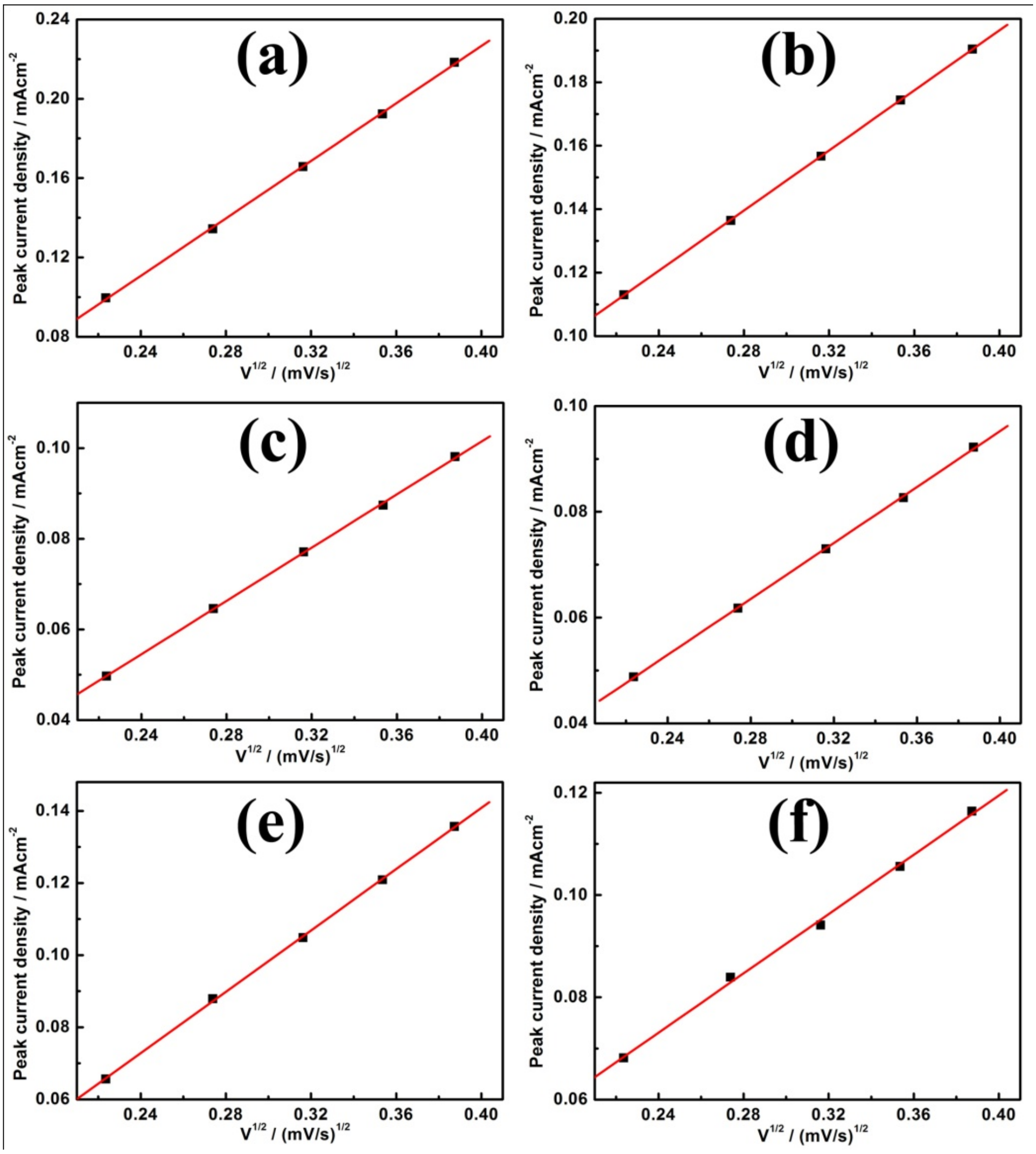

Fig. S6 Plots of the peak current density versus the square root of potential scan rate derived from the CVs of $LiMn_2O_4$ porous nanorods (a,b), nanorods (c,d) and nanoparticels (e,f). (a,c,e) and (b,d,f) correspond to the reductive peaks centered at lower and higher potential, respectively.

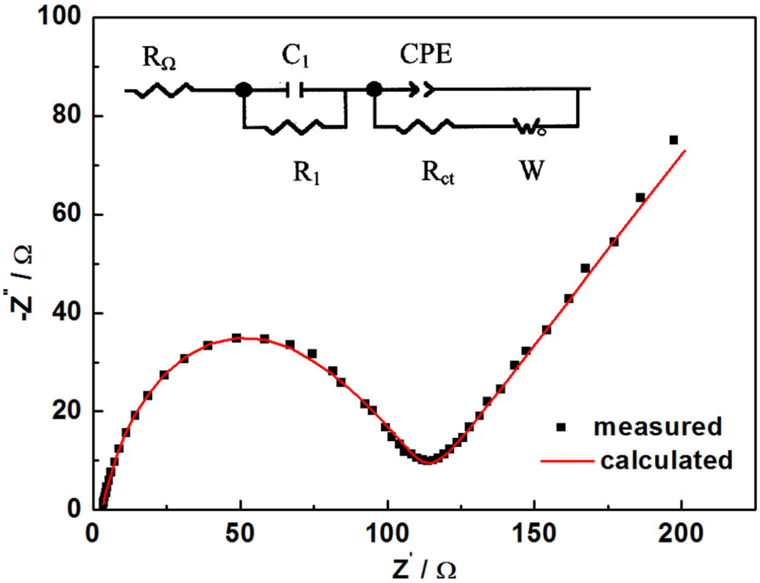

Fig. S7 Electrochemical impedance data (points) and the fitted curve (line) of the porous nanorods measured at potential of 4.2 V versus Li^+/Li. The inset shows the equivalent circuit for modeling the impedance data.[1] Diffusion coefficient of lithium (D) can be calculated from the fitted impedance data by applying the following equation:

$D = L^2/W_T$

where W_T is the Warburg element and L is the thickness of the film.[1] The W_T value is obtained by fitting the impedance data with ZView software and the L value is measured from SEM image. Thus, the lithium diffusivity for the porous spinel nanorods is $(5\times10^{-4})^2/3.066 = 8.15\times10^{-8}$ cm^2/s.

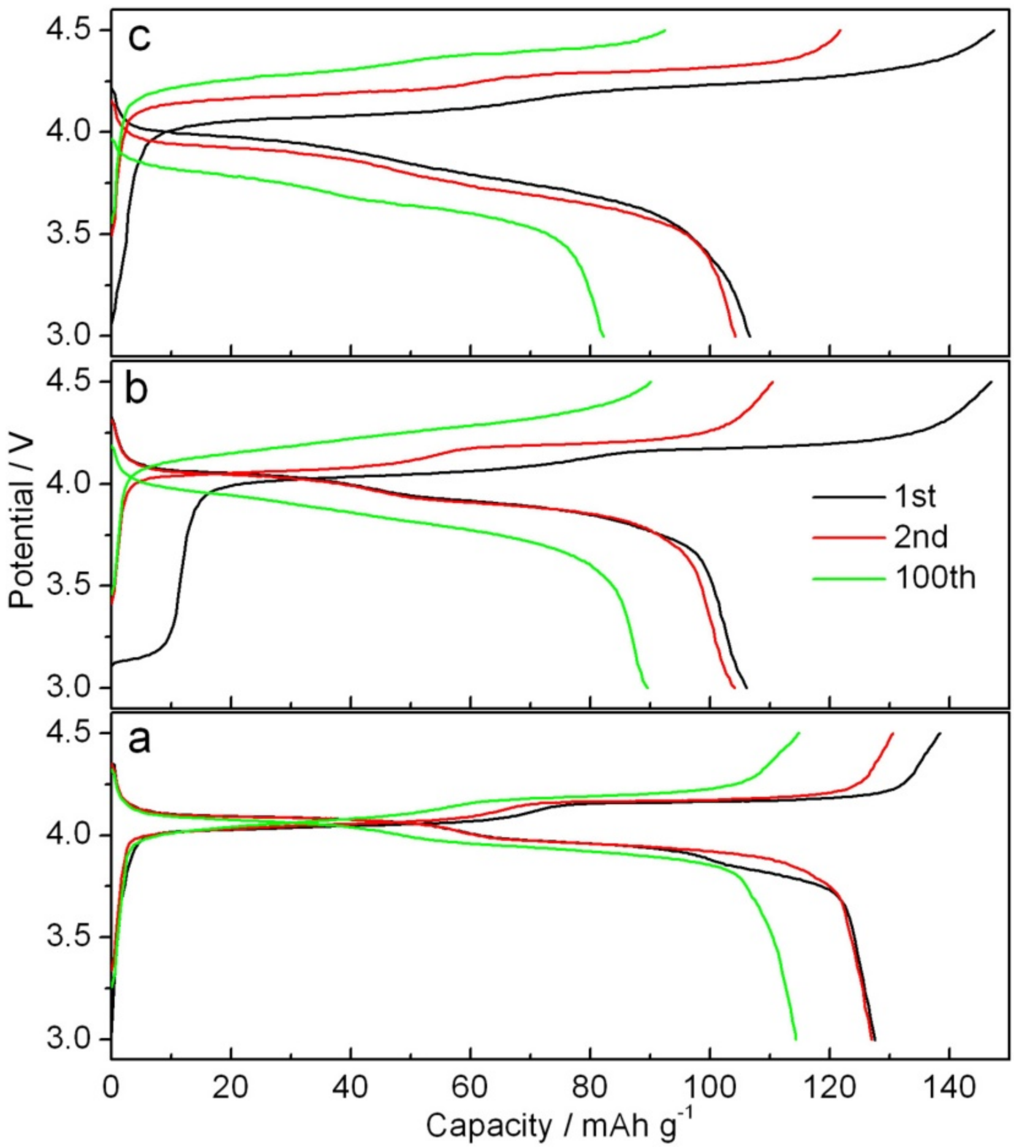

Fig. S8 Charge/discharge curves of $LiMn_2O_4$ (a) porous nanorods, (b) nanoparticles, and (c) nanorods at the constant current rate of 1 C.

Reference

[1] K. A. Striebel, E. Sakai and E. J. Cairns, *J. Electrochem. Soc.*, 2002, **149**, A61.