Electronic Supplementary Information

Using graphene nanosheets as a conductive additive to enhance the rate performance of spinel LiMn₂O₄ cathode material

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Experimental details

Measurements of the conductivity

The conductivity of various electrodes (LMO, LMO-G (5 wt%), LMO-G (10 wt%), LMO-G (15 wt%) and LMO-G-D (15 wt%)) were measured according to the schematic illustration in Fig. S1. Firstly, the electrodes were clamped by two gold sheets and considered as resistance elements. Their resistance values were measured through the linear sweep voltammetry (LSV) in the potential region of 0 V – 1.0 V at the scan rate of 0.05 mV s⁻¹ by using a CHI760C electrochemical workstation. As seen in Fig.S2, the LSV curves of the five electrodes display well-defined straight lines, meaning that there exists the good linear relationship between the current (I) and applied potential (E) in each case. The resistance (R) values of these electrodes could be calculated according to Equation (1):

$$1/R = \Delta I / \Delta E$$
 (1)

where 1/R is the slope of a straight line. Secondly, seeing that each electrode is a regular cylinder, with the thicknesses of 20 µm and the diameters of 10 mm, the resistivity (ρ) values of the electrodes could be determined by means of Equation (2):

$$\mathbf{R} = \rho \cdot \mathbf{l} / \mathbf{S} \tag{2}$$

At last, the resistivity values were converted into the conductivity (κ) ones by the conversion formula shown by Equation (3)

$$\kappa = 1/\rho \tag{3}$$

Values of the 1/R, ρ and κ for various electrodes were listed in Table S1.

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Fig. S1. Schematic illustration for the measurements of the conductivity.



Fig. S2. The LSV curves of the electrodes (LMO, LMO-G (5 wt%), LMO-G (10 wt%) and LMO-G (15 wt%)) (a) and the magnified LSV curves of LMO-G (15 wt%) and LMO-G-D (15 wt%) (b).

	$1/\mathbf{R} / \Omega^{-1}$	$\rho / \Omega m$	$\kappa / S \text{ cm}^{-1}$
LMO	4.06×10 ⁻²	96.62	1.04×10 ⁻⁴
LMO-G (5 wt%)	1.17×10^{-1}	33.39	2.99×10 ⁻⁴
LMO-G (10 wt%)	8.26×10 ⁻²	47.53	2.11×10 ⁻⁴
LMO-G (15 wt%)	7.48×10 ⁻⁴	5253.34	1.90×10 ⁻⁶
LMO-G-D (15 wt%)	9.08×10 ⁻⁴	4338.96	2.30×10 ⁻⁶

Table S1. Values of the 1/R, ρ and κ for various electrodes.

EIS spectra



Fig. S3. Nyquist plots of LMO-G (15 wt%) and LMO-G-D (15 wt%) in LiNO $_3$

electrolyte (a) and $LiPF_6$ electrolyte (b).