Electronic Supplementary Material (ESI) for RSC Advances.

Electronic Supplementary Information

Self-standing $Li_{1.2}Mn_{0.6}Ni_{0.2}O_2$/Graphene Membrane as Binder-free cathode for Li-ion batteries

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Figure S1. The suspension of graphene sheet dispersed ethylene glycol for different durations. The suspension shows nearly no change after 96 hours, exhibiting the excellent dispersion of graphene sheet.

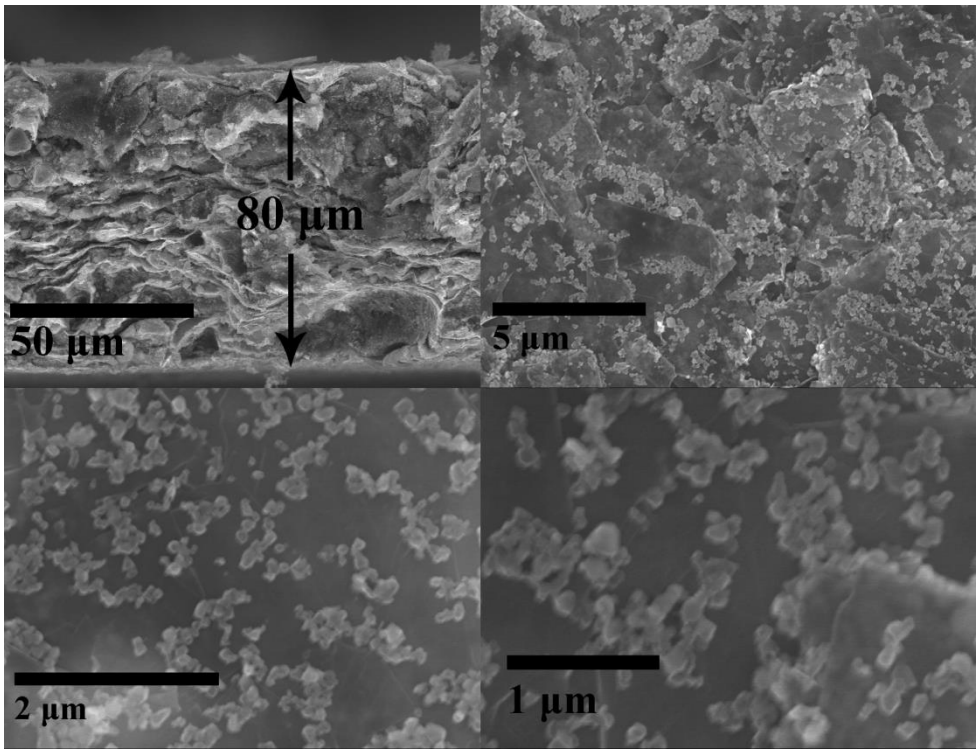

Figure S2. SEM images of LMR/G-30.

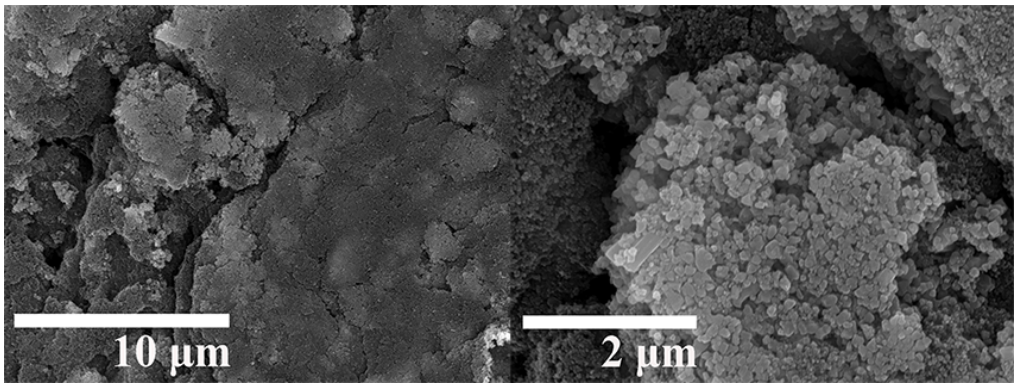

Figure S3. SEM images of LMR cathode electrode.

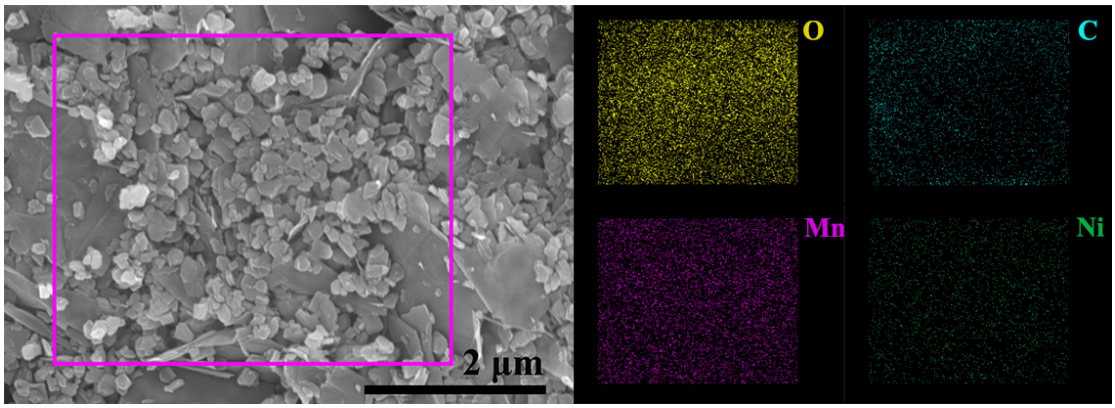

Figure S4. SEM image and corresponding EDS elemental mapping of LMR/G.

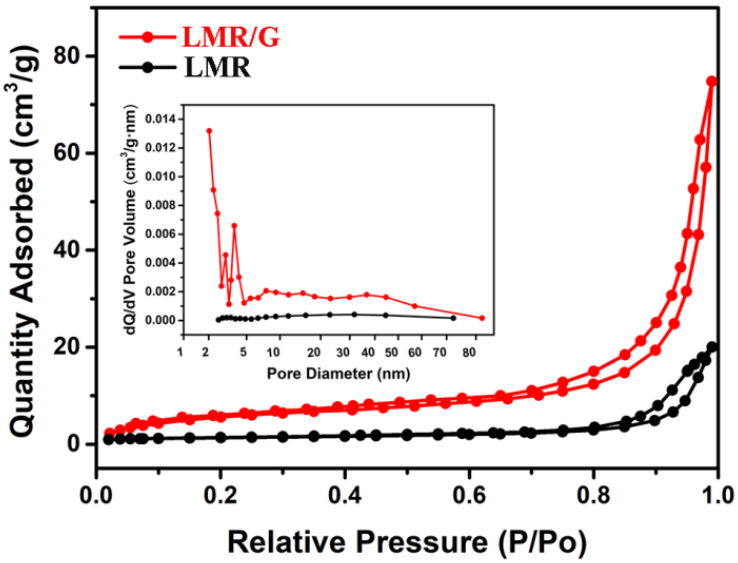

Figure S5. Nitrogen adsorption-desorption isotherms and pore size distribution of LMR and LMR/G.

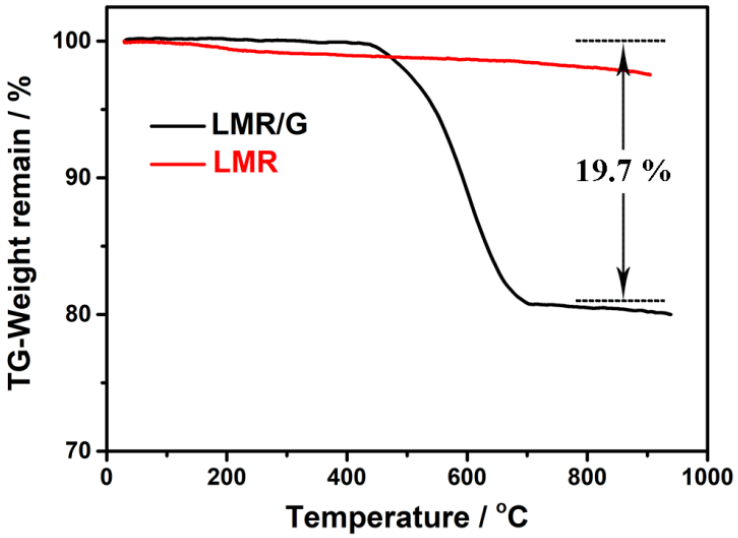

Figure S6. TG curves of LMR and LMR/G.

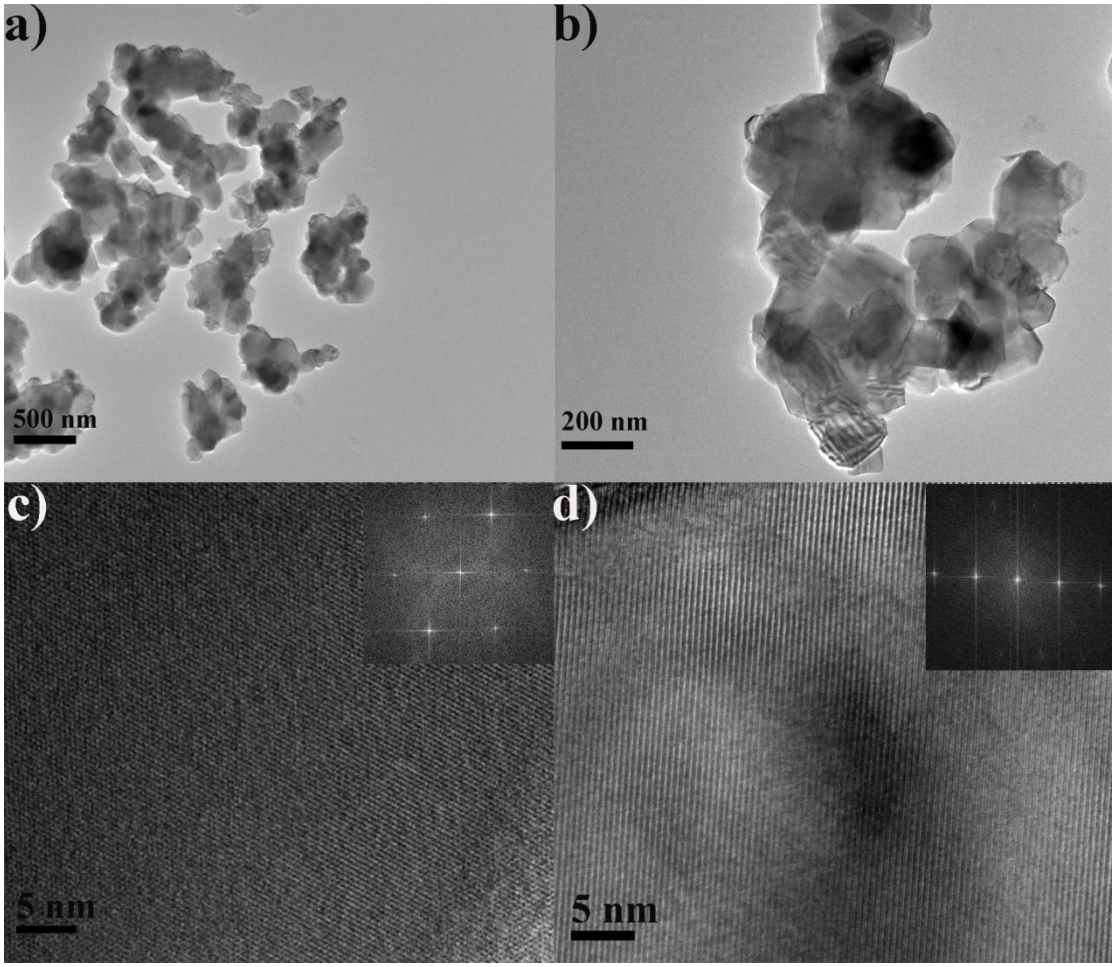

Figure S7. (a) Low-magnification TEM image of LMR. (b) High-magnification TEM image of LMR. (c) and (d) HRTEM images and corresponding Fast Fourier Transform images of LMR.

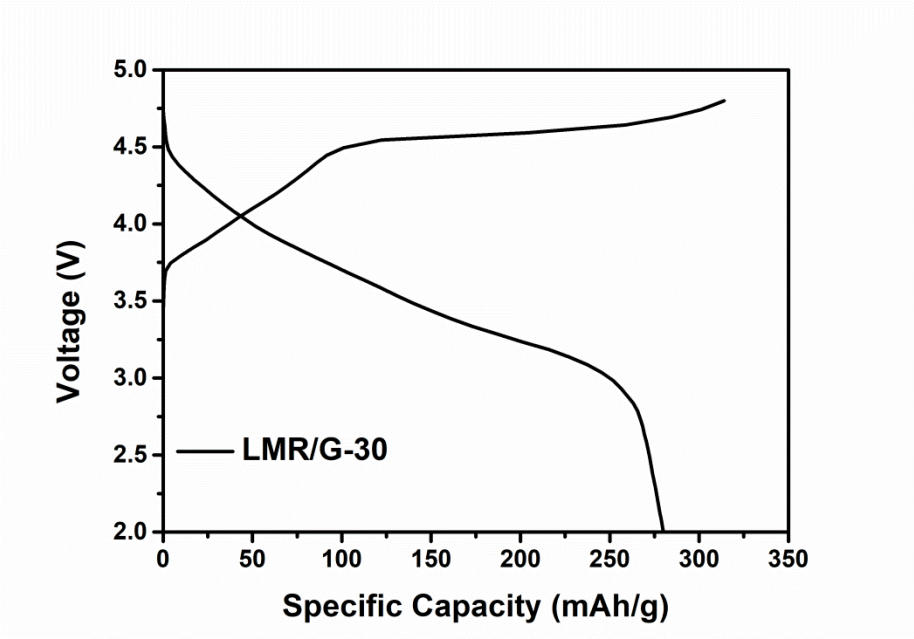

Figure S8. Charge and discharge curve of LMR/G-30 during the first cycle at 0.1 C.

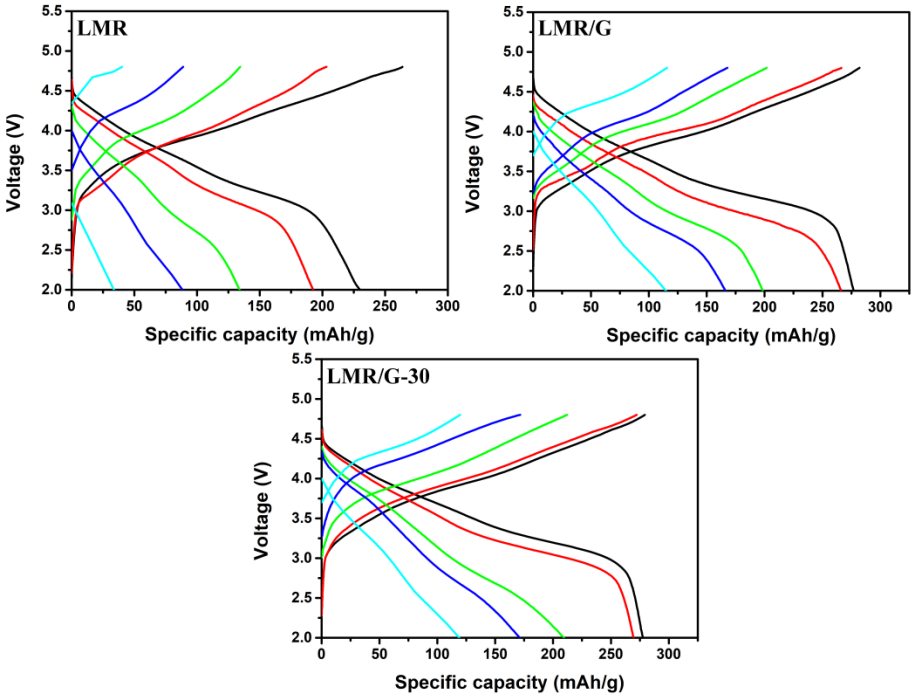

Figure S9. Voltage profiles of LMR, LMR/G and LMR-30 at different current densities.

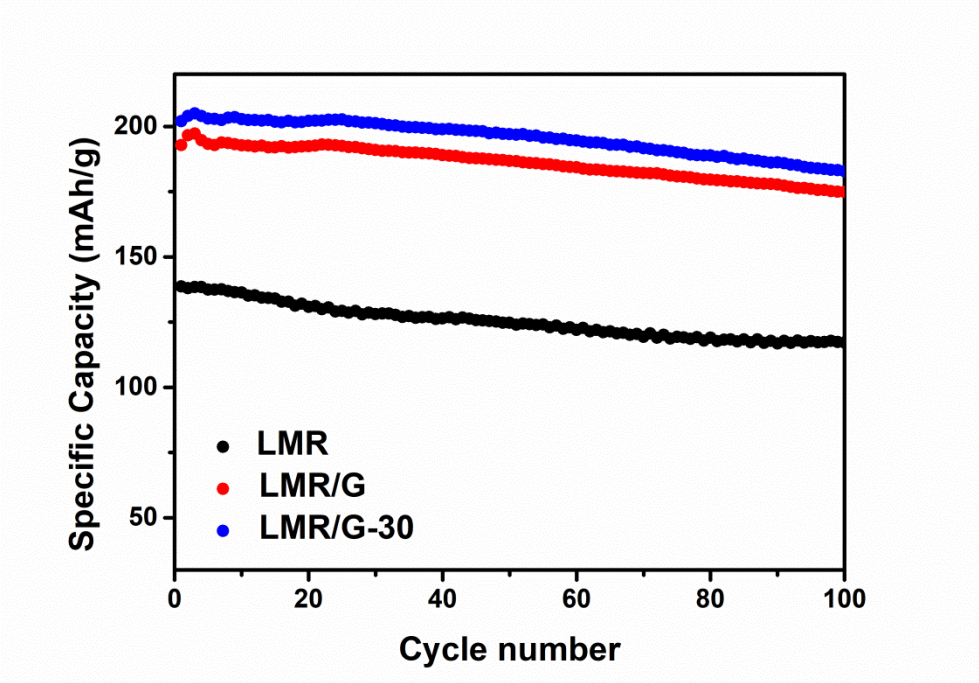

Figure S10. Discharge capacities of all samples at 1 C during 100 cycles.

Table S1. Summary of the initial coulombic efficiencies (ICE) at the current density of 25 mA/g in comparison to literatures reported LROs samples.

Preparation method	ICE before modified	ICE before modified	Ref.
Ultrasonic method Mixing graphene and carbon nanotube with $Li_{1.2}Mn_{0.534}Ni_{0.133}Co_{0.133}O_2$	76.3%	82%	[1]
Ultrasonic method Mixing graphene with AlF_3 coated $Li_{1.2}Mn_{0.53}Ni_{0.13}Co_{0.13}O_2$	70%	69%	[2]
In situ method Mixing graphene oxide with molten metal salts followed by annealing	72%	75%	[3]
Mechanical method Wrapped $Li[Li_{0.190}Mn_{0.540}Co_{0.143}Ni_{0.127}]O_2$ with $AlPO_4$@reduced graphene oxide by stirring	76%	81%	[4]
In our work	72%	90%	

Table S2. Discharge capacities of LMR, LMR/G and LMR/G-30 at 0.1 C, 0.2 C, 1 C, 2 C and 5 C.

	0.1 C (mAh/g)	0.2 C (mAh/g)	1 C (mAh/g)	2 C (mAh/g)	5 C (mAh/g)
LMR	239	195	136	88	34
LMR/G	278	266	198	165	115
LMR/G-30	280	271	209	172	121

Table S3. Fitting results of the EIS data for LMR, LMR/G and LMR/G-30

	R_e (Ω)	R_{SEI} (Ω)	R_{ct} (Ω)
LMR	4	153	197
LMR/G	4	21	51
LMR/G-30	4	26	41

Notes and references

[1] HUANG Y L, HOU X H, MA S M, et al. Template GNL-assisted synthesis of porous Li1.2Mn0.534Ni0.133Co0.133O2: towards high performance cathodes for lithium ion batteries [J]. Rsc Adv, 2015, 5(32): 25258-65.

[2] CHEN D R, TU W Q, CHEN M, et al. Synthesis and performances of Li-Rich@AlF3@Graphene as cathode of lithium ion battery [J]. Electrochim Acta, 2016, 193(45-53.

[3] ZHAO Y J, WANG Y, JI C W, et al. Electrochemistry and structure of Li-rich cathode composites: Li1.26Fe0.22Mn0.52O2 in situ integrated with conductive network-graphene oxide for lithium-ion batteries [J]. Rsc Adv, 2016, 6(38): 31762-8.

[4] KIM I, KNIGHT J, CELIO H, et al. Enhanced electrochemical performances of Li-rich layered oxides by surface modification with reduced graphene oxide/AlPO4 hybrid coating [J]. J Mater Chem A, 2014, 2(23): 8696-704.