Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A

Supporting Information

Fabrication of high tap density $LiFe_{0.6}Mn_{0.4}PO_4$/C microspheres by a double carbon coating–spray drying method for high rate lithium ion batteries

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Table S1: Crystallographic parameters of the high tap density $LiFe_{0.6}Mn_{0.4}PO_4$/C microspheres selected from the Rietveld refinement results

Space group	Pnma					
Type	**Atom**	**x**	**y**	**Z**	**Occupancy**	**B(Å^2)**
Li +1	Li1	0.0000(0)	0.0000(0)	0.0000(0)	1.064	3.46
Fe+2	Fe1	0.2818(5)	0.2500(3)	0.9736(3)	0.604	2.95
Mn+2	Mn1	0.2819(2)	0.2500(3)	0.9736(2)	0.398	2.80
P	P1	0.0935(4)	0.2500(2)	0.4119(3)	1.004	2.06
O -2	O1	0.1012(2)	0.2500(5)	0.7344(6)	0.981	2.24
O -2	O2	0.4567(3)	0.2500(3)	0.2071(7)	1.004	3.18
O -2	O3	0.1647(5)	0.0445(1)	0.2816(2)	1.002	2.87
Cell parameters	a: 10.3618(2) Å b: 6.0360(5) Å c: 4.7070(4) Å V: 294.395(4) Å^3					
wRp	8.59%					
Rp	6.50%					
CHI^2	1.144					

Table S2: The discharge capacities and capacity retention ratios for $LiFe_{0.6}Mn_{0.4}PO_4$/C at different current densities

Discharge rate	$LiFe_{0.6}Mn_{0.4}PO_4$/C microspheres		$LiFe_{0.6}Mn_{0.4}PO_4$/C nanoparticles	
	Discharge capacity	Ratio $Q_{nc}/Q_{0.1C}$	Discharge capacity	Ratio $Q_{nc}/Q_{0.1C}$
0.1C	163.7	100%	160.2	100%
1.0C	153.3	93.6%	146.2	91.3%
5.0C	143.8	87.8%	131.4	82.0%
10C	135.2	82.6%	123.3	77.0%
20C	126.0	77.0%	106.3	66.3%

Table S3: The discharge capacity and energy density data of the micro-spherical and nano $LiFe_{0.6}Mn_{0.4}PO_4/C$ at different rates

Sample	Index	0.1C	1C	5C
nanoparticles (0.82g·cm^{-3})	capacity (mAh·g^{-1})	163.7	153.3	143.8
	Energy density (Wh·kg^{-1})	588.2	538.0	486.0
	Energy density (Wh·L^{-1})	482.3	441.2	398.5
microspheres (1.4g·cm^{-3})	capacity (mAh·g^{-1})	160.2	146.2	131.4
	Energy density (Wh·kg^{-1})	572.5	502.4	438.3
	Energy density (Wh·L^{-1})	801.5	703.4	613.6

Table S4: The discharge capacity and energy density of the $LiFe_{0.6}Mn_{0.4}PO_4/C$ microspheres after long-term cycling

Index	Before cycle		After cycle	
	Discharge capacity	Energy density	Discharge capacity	Energy density
2C(100th cycle)	139.9 mAh·g^{-1}	477.4 Wh·kg^{-1}	138.3 mAh·g^{-1}	473.5 Wh·kg^{-1}
5C(200th cycle)	129.8 mAh·g^{-1}	429.5 Wh·kg^{-1}	128.4 mAh·g^{-1}	420.8 Wh·kg^{-1}

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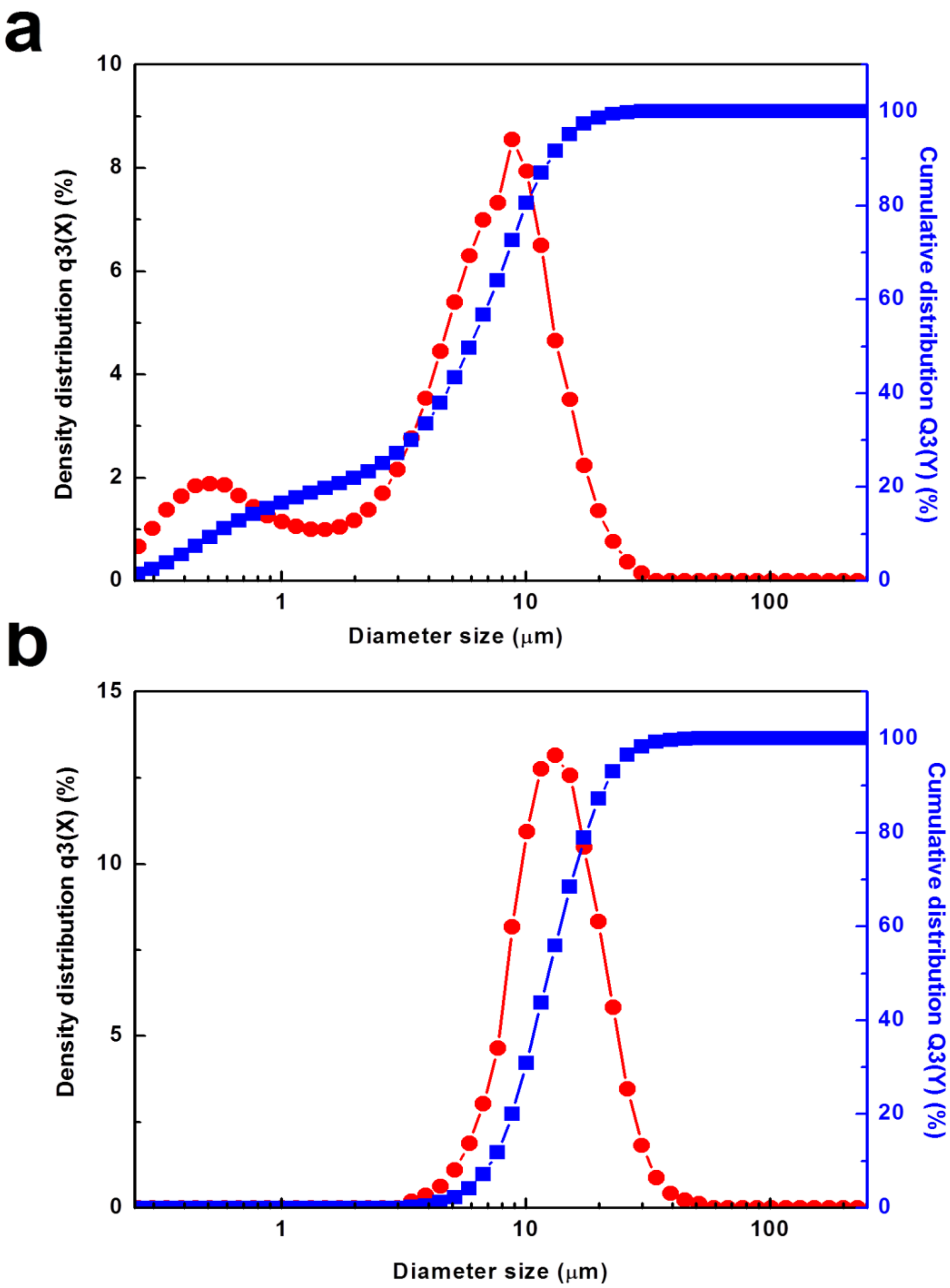

Fig.S1 (a) The particle size distribution profiles for the $LiFe_{0.6}Mn_{0.4}PO_4/C$ nanoparticles; (b) The particle size distribution profiles for the $LiFe_{0.6}Mn_{0.4}PO_4/C$ microspheres.

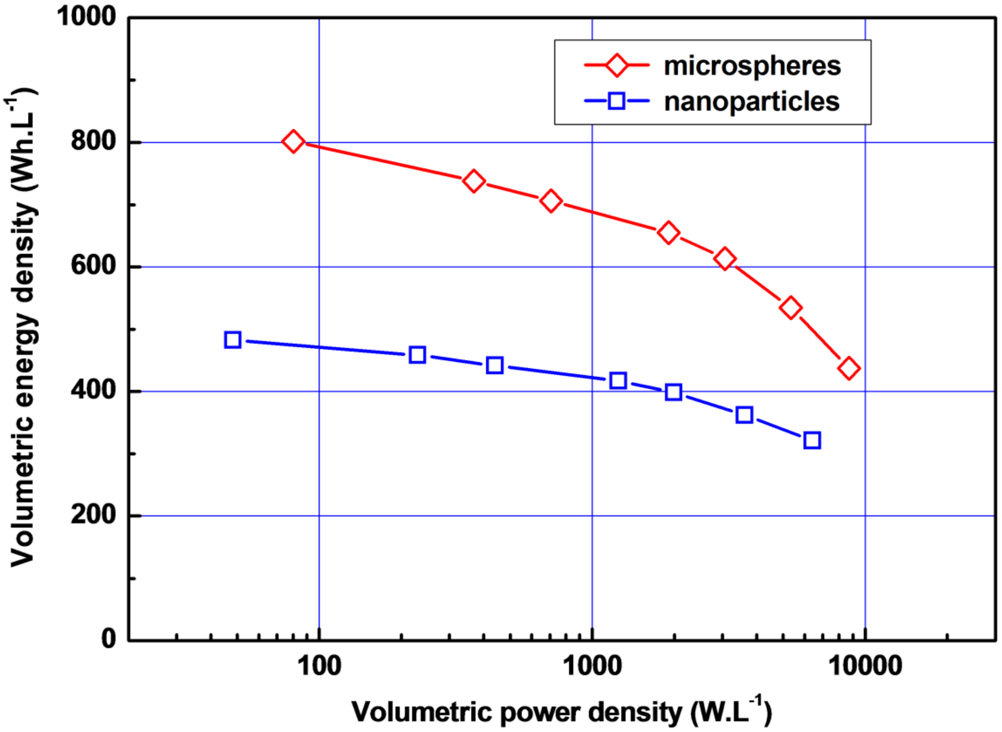

Fig.S2 Ragone plot of volumetric energy density vs. volumetric power density.

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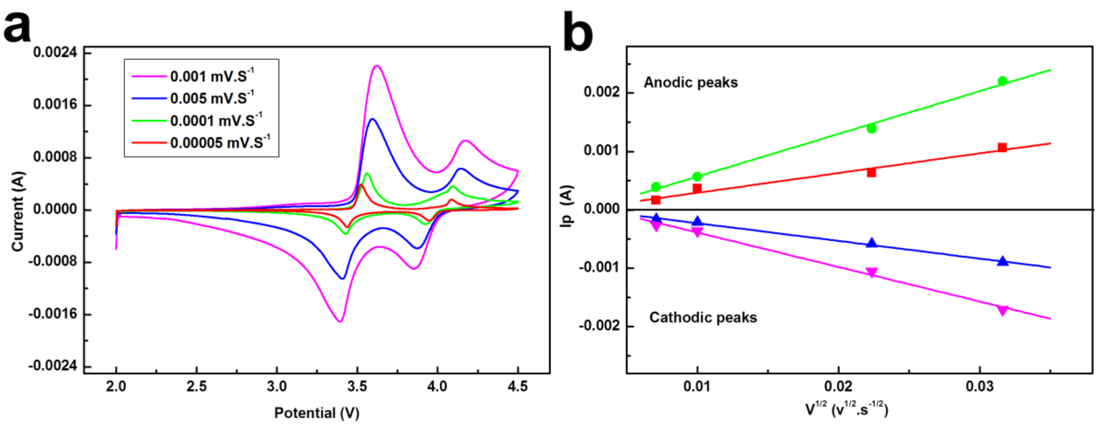

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State	Peaks	Ds(cm²·s⁻¹)
Charge	A_{Fe}	1.2E-12
	A_{Mn}	5.6E-13
Discharge	C_{Fe}	7.6E-12
	C_{Mn}	4.5E-13

Fig.S3 (a) CV curves of the $LiFe_{0.6}Mn_{0.4}PO_4$/C microspheres at various scanning rates between 2.0 and 4.5 V; (b) the relationship between the peak current (Ip) and the square root of scan rate ($v^{1/2}$); (c)The diffusion coefficients of lithium-ion in the spherical $LiFe_{0.6}Mn_{0.4}PO_4$/C electrode calculated from CV curves.