Supporting Information

Multi-shelled $LiMn_{1.95}Co_{0.05}O_4$ Cages with Tunable Mn Oxidation State for Ultra-High Lithium Storage

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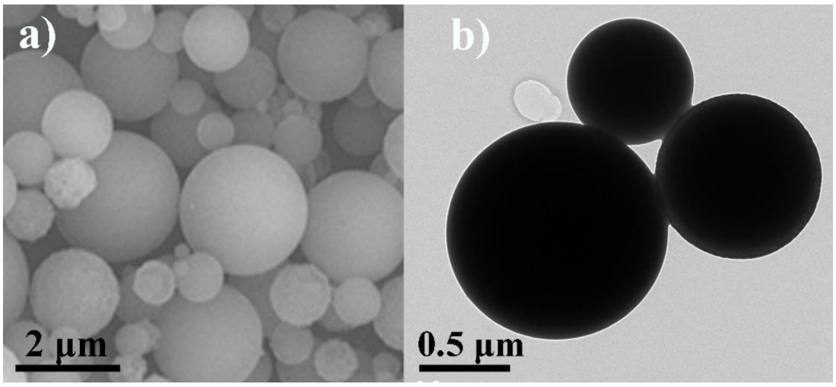

Fig. S1 (a) SEM images and (b) TEM images of filled particles as the intermediate product of multi-shelled $LiMn_{1.95}Co_{0.05}O_4$ cages (ms-LMCO) before thermal treatment

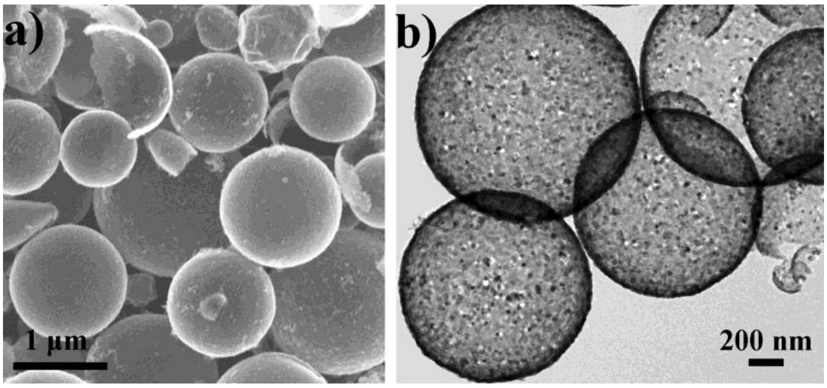

Fig. S2 (a) SEM images and (b) TEM images of a hollow structure of LMO cages (h-LMO) without sucrose

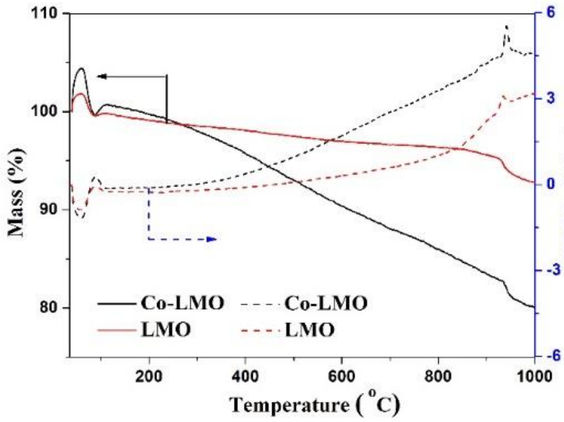

Fig. S3 TG curves of pristine multi-shelled $LiMn_2O_4$ cages(ms-LMO) and ms-LMCO

Table S1 Summary of specific capacity and cycle stability of $LiMn_2O_4$-based materials in literature

Composition	Initial capacity ($mAh\ g^{-1}$) and (C)		Capacity retention cycles and ($mAh\ g^{-1}$)		References
Ms-LMCO	154.4	1.35	500	136.7	This work
$LiMn_2O_4$@Carbon	110	20	400	99	[1]
$LiMn_2O_4$	137	1	1000	109.6	[2]
$Li_{0.81}Mn_2O_4$/CNT	140.4	1	1000	98.7	[3]
Graphene/$LiMn_2O_4$	140	0.5	50	126	[4]
$LiMn_2O_4$@C	138.5	0.1	100	135.3	[5]
$LiMn_{1.90}Mg_{0.05}Si_{0.05}O_4$	136.2	0.5	100	130.8	[6]
$LiMn_2O_4$@Carbon	134.6	0.1	100	129.2	[7]
$LiAl_{0.05}Ni_{0.05}Mn_{1.9}O_4$	133	0.5	400	109	[8]
$LiMn_2O_4$@$LiNbO_3$	131.9	0.5	100	120.6	[9]
$LiMn_2O_4$	130	0.1	200	113	[10]
$LiMn_2O_4$@Cu	143	1	100	127	[11]
Graphene /$LiMn_2O_4$	139	1	100	120.9	[12]
$LiMn_2O_4$@ZrO_2	136	1	100	111.2	[13]
$Li_{1.09}Mn_{1.83}Al_{0.08}O_4$@$AlPO_4$	108	0.5	200	84.3	[14]
$LiNi_{0.5}Mn_{1.5}O_4$	124	2	200	121	[15]
$LiMn_2O_4$	105	10	500	94.5	[16]
$LiMn_2O_4$	100	5	100	80	[17]
$LiMn_2O_4$	131.8	1	200	126.5	[18]
$LiNi_{0.35}Mn_{1.65}O_{4-\delta}$-$LiNi_{0.5}Mn_{1.5}O_4$	145.1	1	300	140.0	[19]

Table S2 Peak voltages of ms-LMO and ms-LMCO at scan rate of 0.2 mV s^{-1}

samples	Voltage (V vs. Li/Li$^+$)			
	O^1_x	O^2_x	R^1_d	R^2_d
Pristine ms-LMO cages	4.09	4.22	3.91	4.04
Ms-LMCO cages	4.08	4.20	3.91	4.05

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