Supporting Information

Low-temperature Carbon Coating of Nanosized $Li_{1.015}Al_{0.06}Mn_{1.925}O_4$ and High-density Electrode for High-power Li-ion Batteries

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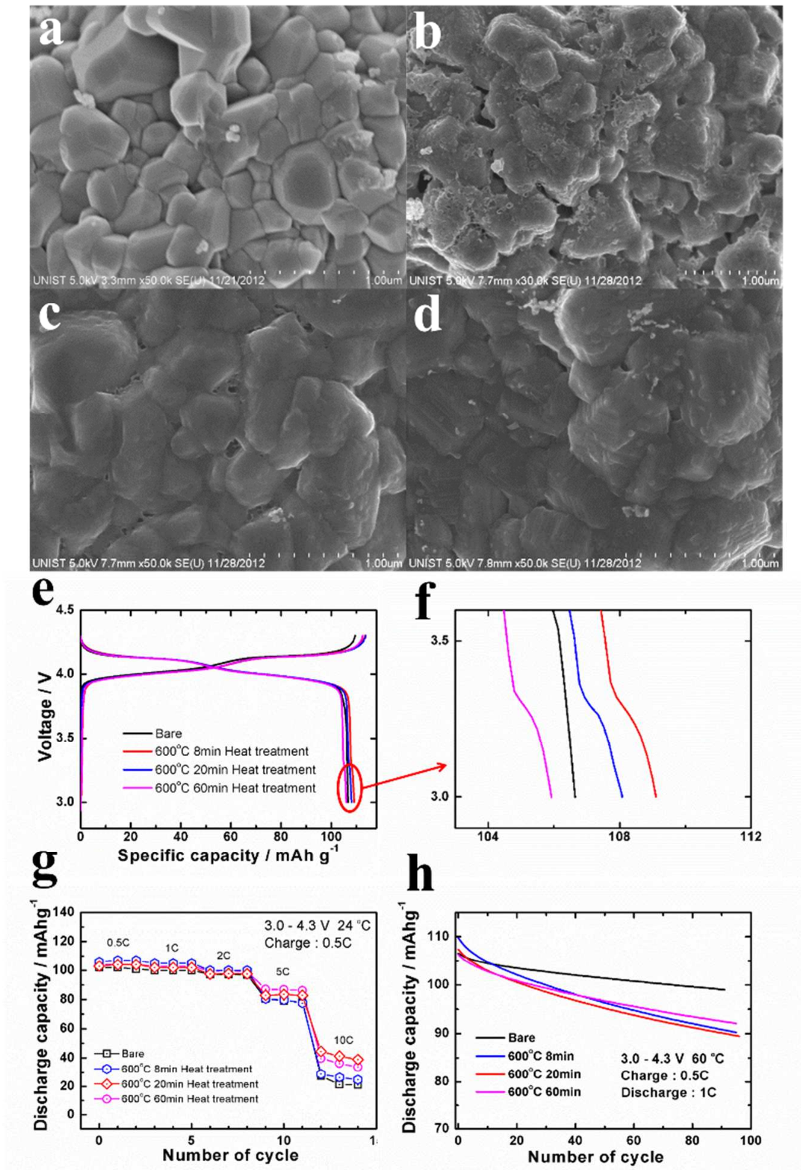

Figure S1. The carbon coating on the spinel cathode material was carried out by using sucrose-carbonization method. The coating amount of sucrose was 10 wt%. SEM images of (a) bare (b) heated at 600 ^{o}C for 8min and quenched at room temperature to minimize oxygen defects after sucrose coating, (c) 20min and (d) 60min. As can be seen in 1st cycle profiles (e) and (f), the plateau related to oxygen deficiency between 3.2 and 3.4V can be found. (g) The carbon layers can help increase rate capability slightly. However, (h) the cycling performance became worse than bare electrode due to structural instability.

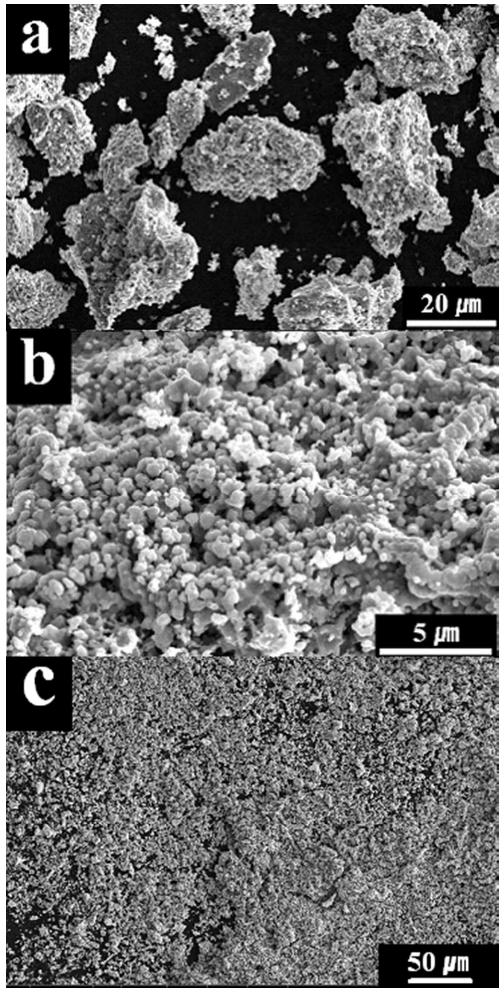

Figure S2. SEM images of (a) LMO synthesized via sol-gel reaction, (b) magnified image of (a), (c) LMO after ball-milling

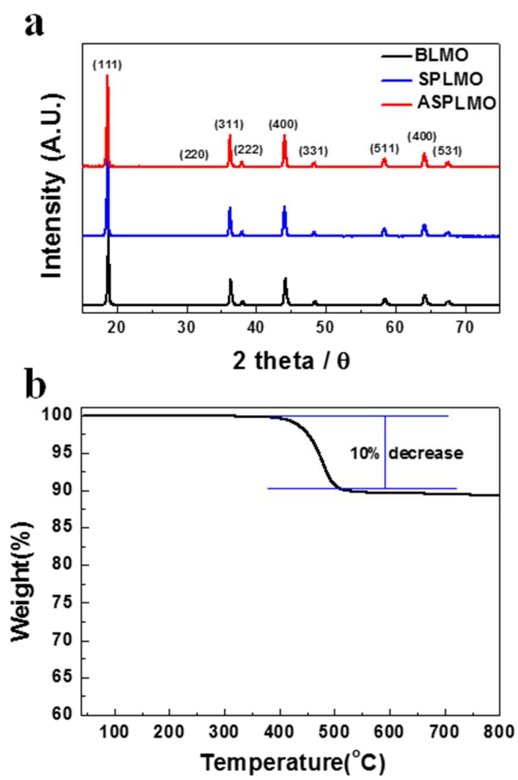

Figure S3. (a) Powder XRD patterns of BLMO, SPLMO and ASPLMO. (b) TGA results of ASPLMO with scan rate of 5 °C min^{-1}.

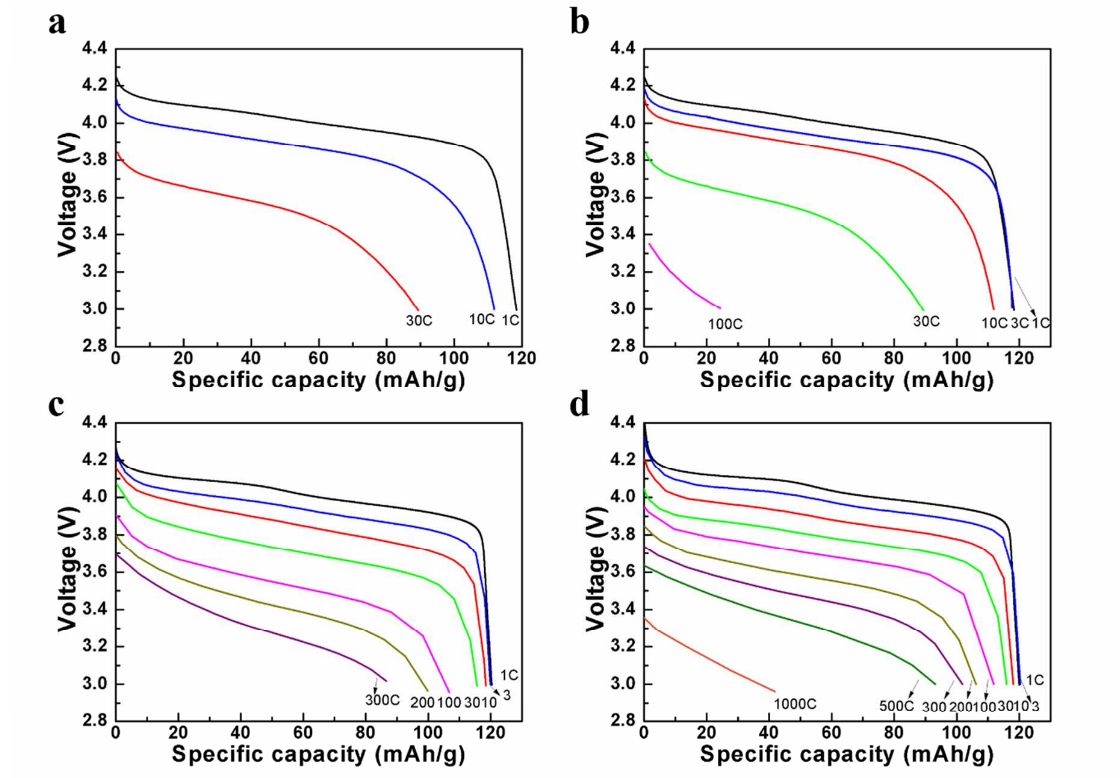

Figure S4. Discharge voltage profiles of (a) LMO, (b) BLMO, (c) SPLMO and (d) ASPLMO.

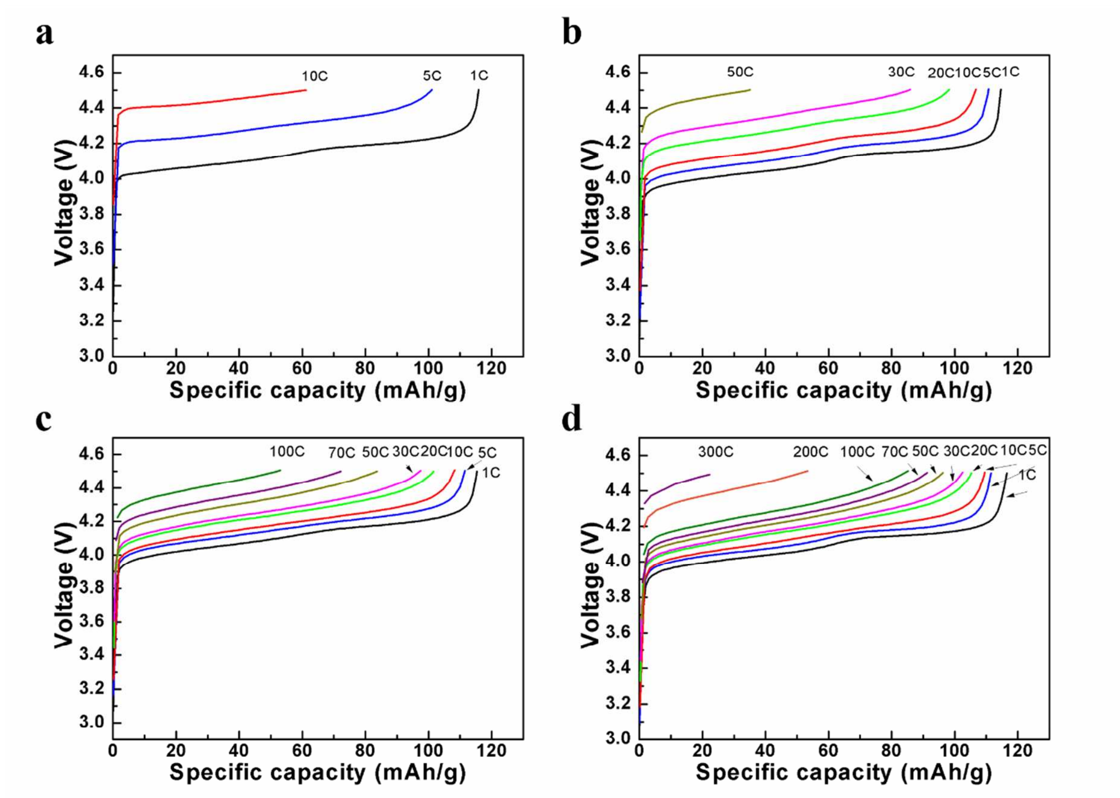

Figure S5. Charge voltage profiles of (a) LMO, (b) BLMO, (c) SPLMO and (d) ASPLMO.

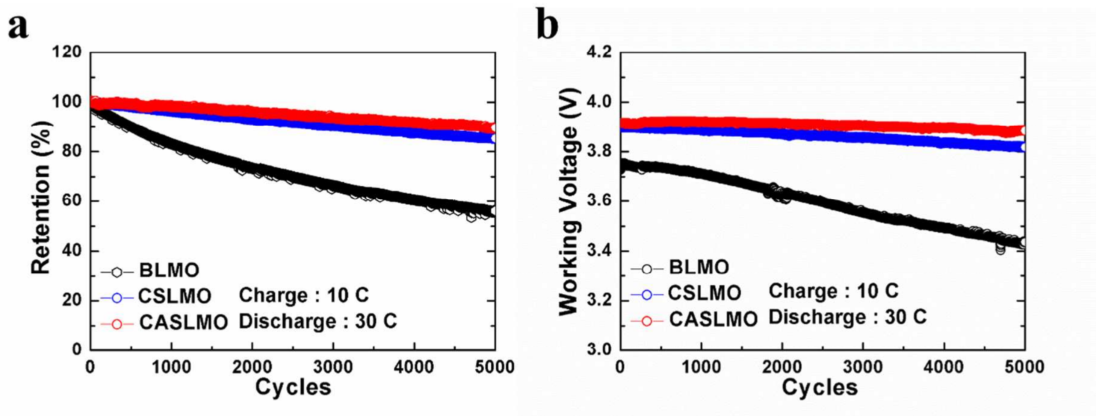

Figure S6. (a) Cycling retention and (b) Working voltage of BLMO, SPLMO and ASPLMO during continuous charge and discharge. The working voltages were calculated by using following equation. Energy density Wh/capacity Ah = working voltage V

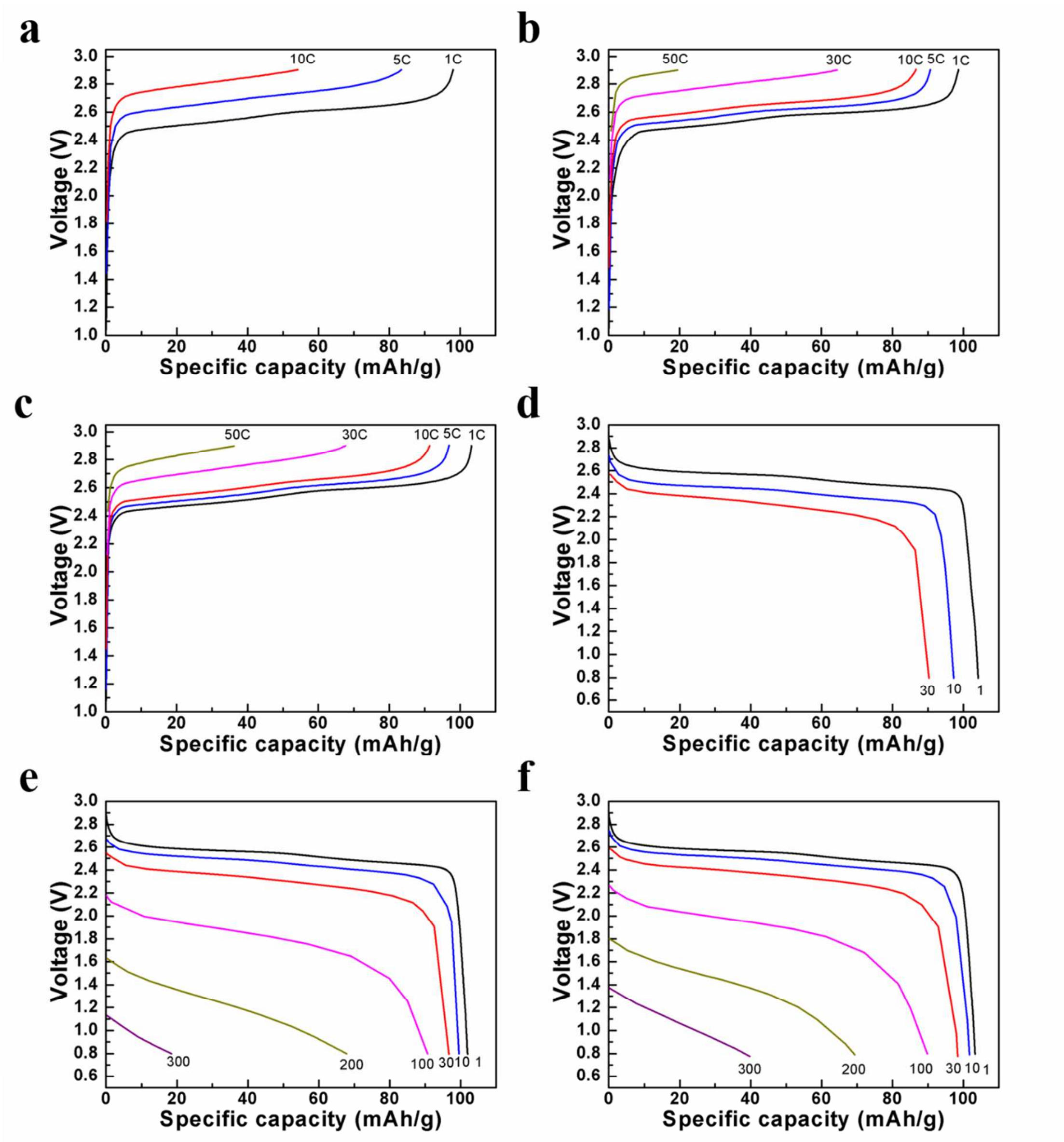

Figure S7. Charge profiles of (a) BLMO, (b) SPLMO and (c) ASPLMO, and discharge profiles of (d) BLMO, (e) SPLMO and (f) ASPLMO.

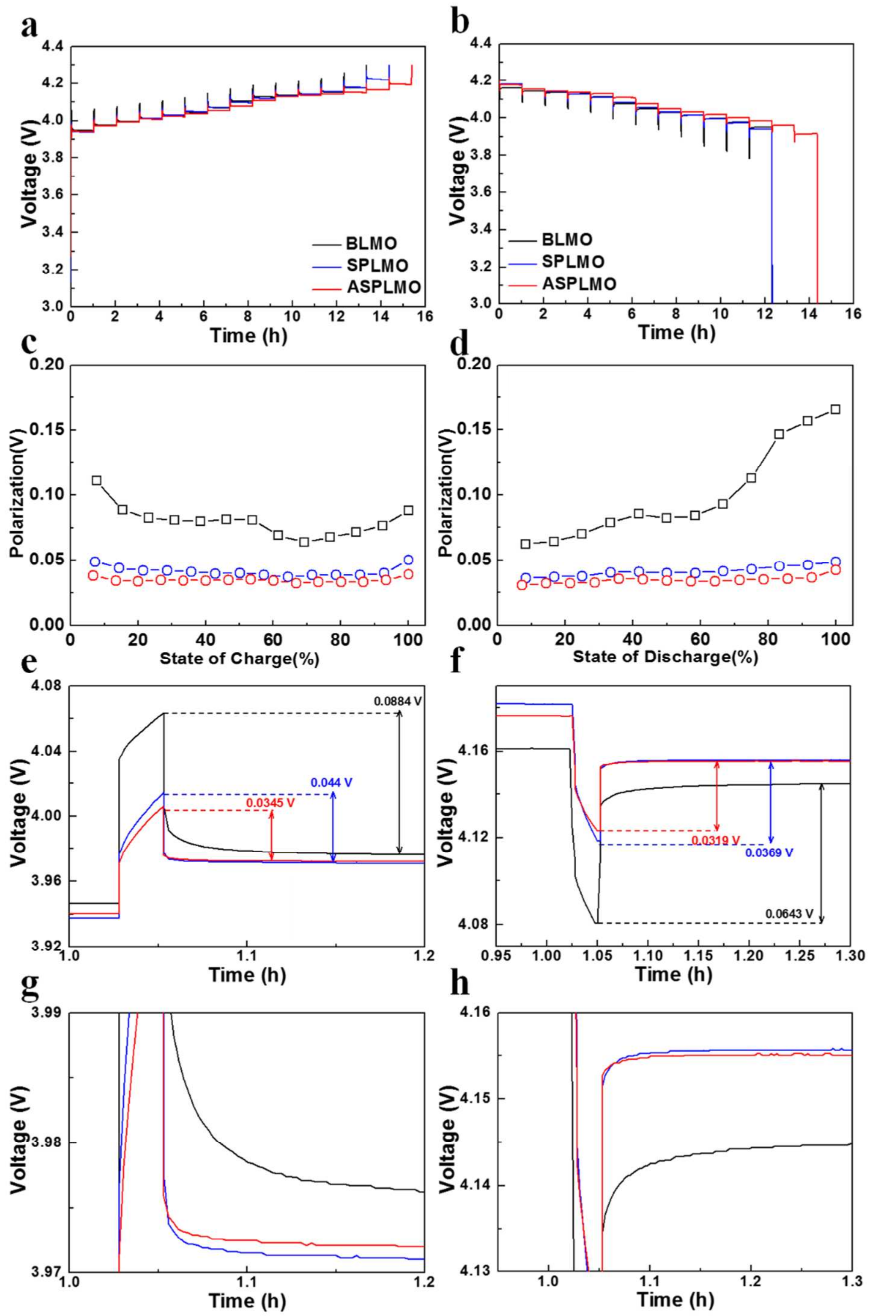

Figure S8. GITT potential responses during (a) charge and (b) discharge, polarization of BLMO, SPLMO and ASPLMO during (c) charge and (d) discharge. (e and f) expended images of the regions in (a and b), respectively. (g and h) expended images of the regions in (e and f), respectively.

Table S1. Representative rate performance of nanosized class materials from literature. AM, CM and BD are active material, conductive material and binder, respectively.

Material specification	Electrode composition (AM:CM:BD)	Particle Size	Practical capacity (mAh/g)	Performance	Refs
This work	80:10:10	Micron	119 (0.1C)	96.2% at 30C 92.7% at 100C 77.8% at 500C	-
$LiMn_2O_4$ Nanowires	75:17:8	Nano	116 (1C)	69% at 20C 50% at 30C	(1)
$LiMn_2O_4$ Nanoparticles	75:20:5	Nano	116 (0.1C)	81.1% at 100C	(2)
$LiMn_2O_4$ Nanoparticles	85:10:5	Nano	125 (0.5C)	96.8% at 10C 81.6% at 20C	(3)
$LiMn_2O_4$ Nanorods	70:20:10	Nano	127 (1C)	63% at 30C	(4)
$LiMn_2O_4$ Nanocones	70:20:10	Nano	127 (0.1C)	92.2% at 30C 77.5% at 50C	(5)
$LiMn_2O_4$ Nanorods	70:20:10	Nano	114 (0.5C)	88% at 10C 79.8% at 20C	(6)
$LiMn_2O_4$ Microcube	80:10:10	Micron	120 (0.1C)	84% at 10C 78.4% at 20C	(7)

References

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