

Supplementary Materials: Three-Dimensional Carbon-Coated LiFePO₄ Cathode with Improved Li-Ion Battery Performance

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Citation: Wang, C.; Yuan, X.; Tan, H.; Jian, S.; Ma, Z.; Zhao, J.; Wang, X.; Chen, D.; Dong, Y. Three-Dimensional Carbon-Coated LiFePO₄ Cathode with Improved Li-Ion Battery Performance. *Coatings* **2021**, *11*, 1137. <https://doi.org/10.3390/coatings11091137>

Academic Editor: Octavian Buiu

Received: 18 August 2021

Accepted: 13 September 2021

Published: 18 September 2021

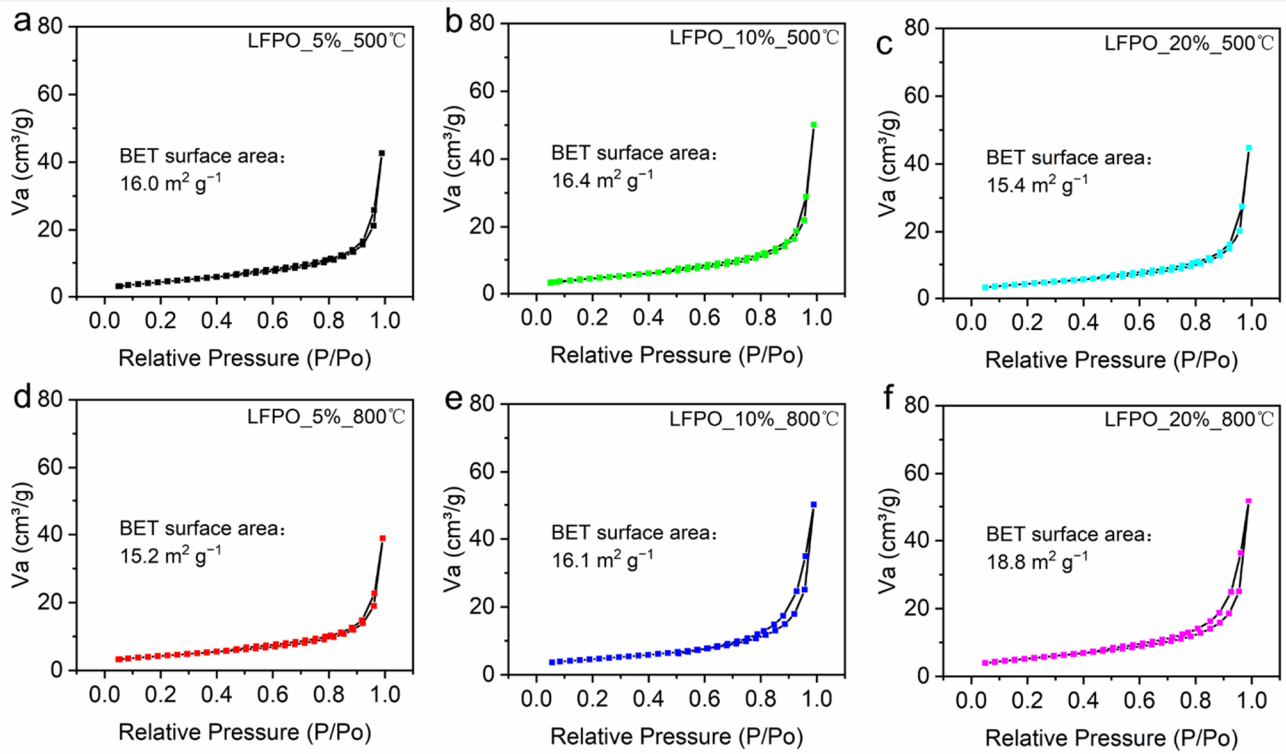
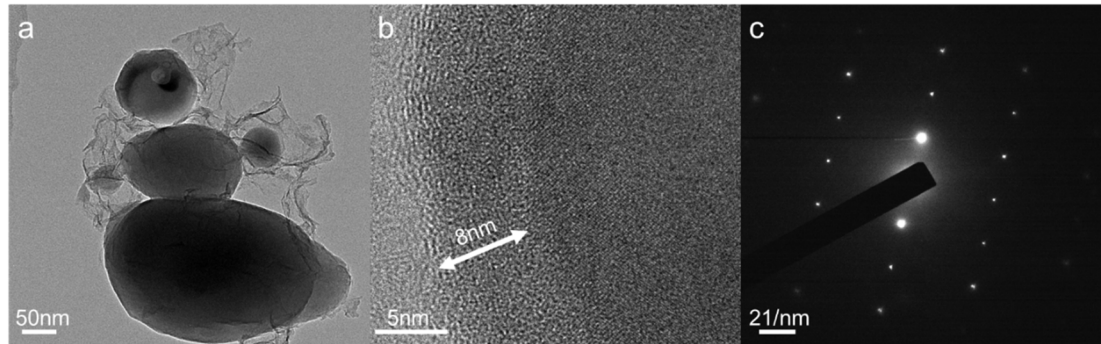
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Table S1. Specific capacity of different cathode materials for lithium-ion batteries.

Cathode Materials	Specific Capacity	Current Density	Ref.
3D porous LiFePO ₄ /graphene	146 m·A·h·g ⁻¹	17 mA·g ⁻¹	[1]
Amorphous FePO ₄ /graphene	156 m·A·h·g ⁻¹	25 mA·g ⁻¹	[2]
LiCoO ₂	180 m·A·h·g ⁻¹	47 mA·g ⁻¹	[3]
Li _x Co ₂ O ₄ coated LiCoO ₂	140 m·A·h·g ⁻¹	3 C	[4]
Mg and P coated LiCoO ₂	120 m·A·h·g ⁻¹	10 C	[5]
LiNi _{0.5} Mn _{0.5} O ₂ coated LiCoO ₂	148 m·A·h·g ⁻¹	1 C	[5]
Carbon-coated LiFePO ₄	109 m·A·h·g ⁻¹	2 C	[6]
LiFePO ₄ /nitrogen-doped carbon networks	161.5 m·A·h·g ⁻¹	0.1 C	[7]
3D carbon-coated LiFePO ₄	157 m·A·h·g ⁻¹	2 C	Our work

**Figure S1.** Nitrogen adsorption-desorption isotherms of (a) LFPO_5%_500 °C, (b) LFPO_10%_500 °C, (c) LFPO_20%_500 °C, (d) LFPO_5%_800 °C, (e) LFPO_10%_800 °C and (f) LFPO_20%_800 °C.**Figure S2.** (a) TEM images of LFPO_15%_800 °C; (b) HRTEM images LFPO_15%_800 °C; (c) the corresponding SAED of LFPO_15%_800 °C.

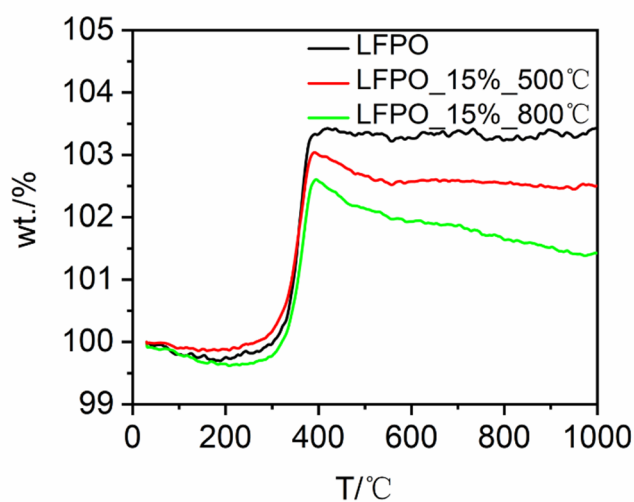


Figure S3. TG curve of LFPO, LFPO_15%_500 °C and LFPO_15%_800 °C.

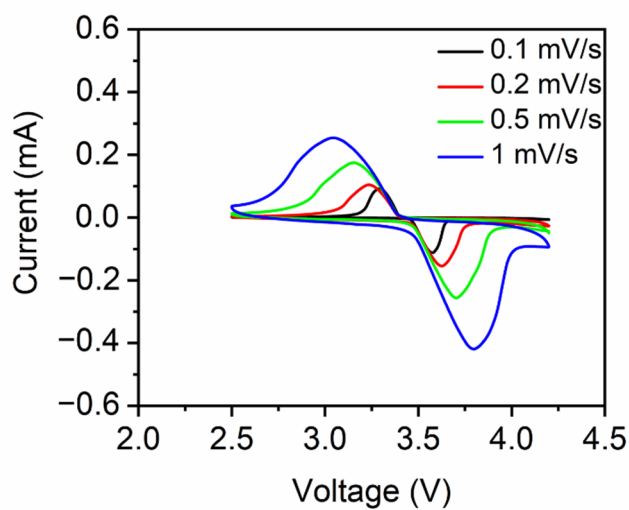


Figure S4. Cyclic voltammograms of LFPO_15%_800 °C at various scan rates from 0.1 to 1.0 mV s⁻¹ in a voltage range of 2.5–4.2 V.

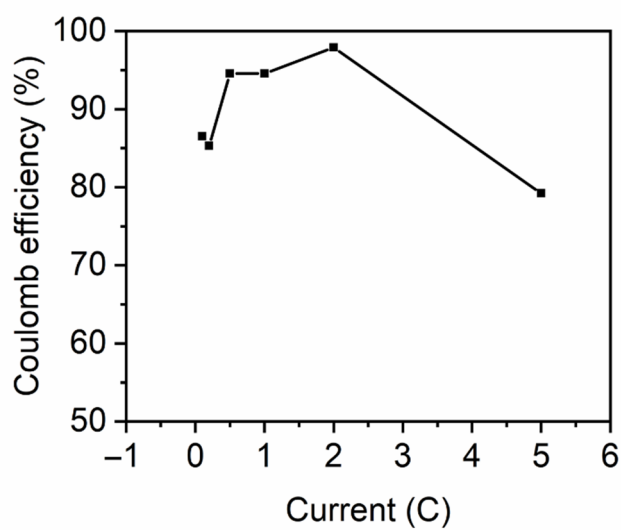


Figure S5. Coulomb efficiency at all C rates.

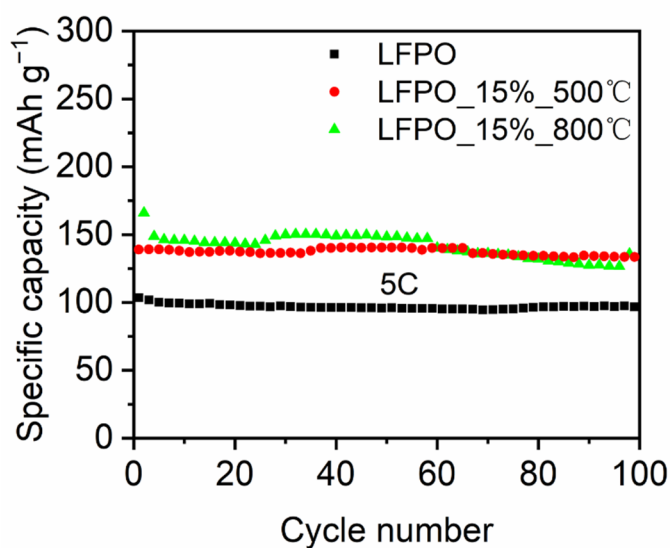


Figure S6. Cyclic performance of LFPO, LFPO_15%_500 °C and LFPO_15%_800 °C at 5 C.

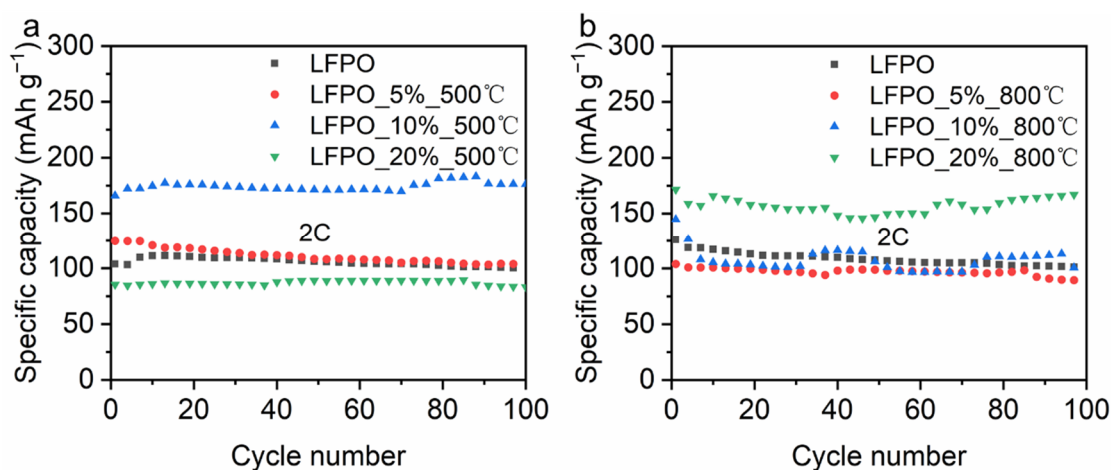


Figure S7. (a) Cyclic performance of LFPO, LFPO_5%_500 °C, LFPO_10%_500 °C and LFPO_20%_500 °C at 2 C; (b) Cyclic performance of LFPO, LFPO_5%_800 °C, LFPO_10%_800 °C and LFPO_20%_800 °C at 2 C.

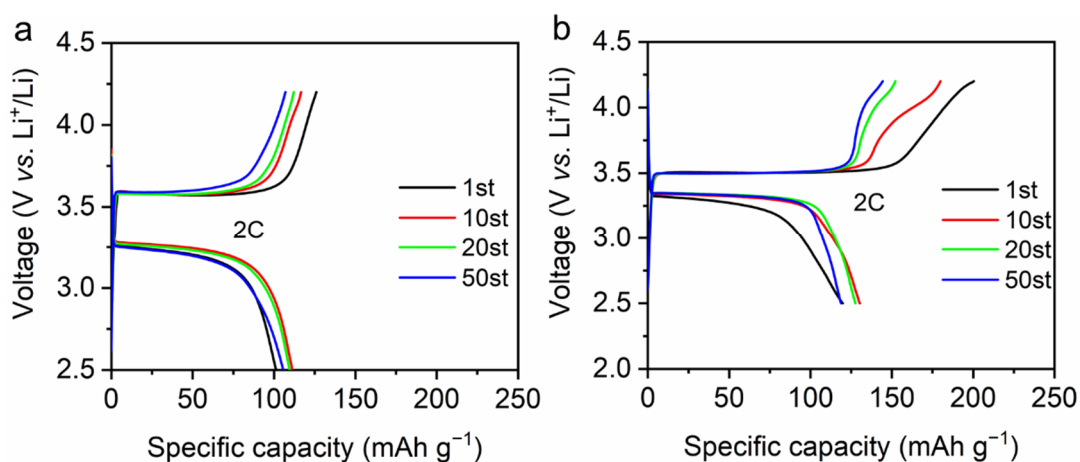


Figure S8. Galvanostatic charge and discharge curves of (a) LFPO and (b) LFPO_15%_500 °C at the current of 2 C.

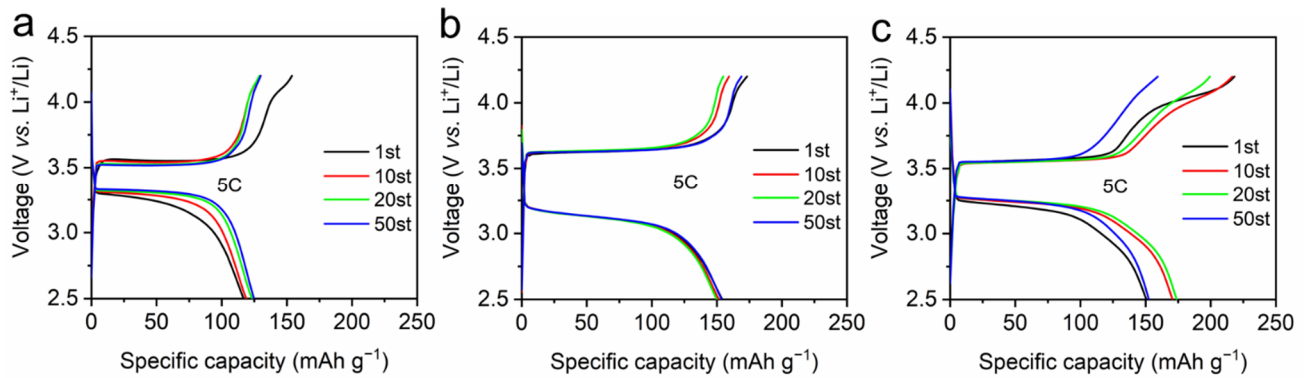


Figure S9. Galvanostatic charge and discharge curves of (a) LFPO, (b) LFPO_15%_500 °C and (c) LFPO_15%_800 °C at the current of 5 C.

Table S2. Fitting data of LFPO, LFPO_15%_500 °C and LFPO_15%_800 °C equivalent circuit components.

Title	R_e	CPE1	R_{ct}	CPE2	R_f	Z_w
LFPO	1.375	0.00302	1.396×10^{12}	2.954×10^{-6}	64.05	0.001849
LFPO_15%_500 °C	1.534	0.002279	4.434×10^5	3.063×10^{-6}	57.13	0.00227
LFPO_15%_800 °C	1.78	0.002339	4.695×10^4	2.746×10^{-6}	49.37	0.004449

Table S3. The definitions of Nomenclature, Greek symbols, subscripts, superscripts, and acronyms.

Symbol	Define
LIB	Lithium-ion battery
HEV	Hybrid electric vehicles
PHEV	Plug-in hybrid electric vehicles
EV	Electric vehicles
LFPO	Lithium iron phosphate
LFPO_15%_500 °C	Lithium iron phosphate was doped with cetyltrimethyl Ammonium Bromide, which accounted for 15% of the mass fraction, and the sintering temperature was 500 °C
1 M	1 mol/L
w%	Volume fraction
GF/A	Type of diaphragm
EIS	Electrochemical impedance spectra
SEI	Solid electrolyte interphase
OCV	Open circuit voltage

Table S4. The definitions of various abbreviations.

Abbreviations	Define
GO	Graphene oxide
CTAB	Cetyltrimethyl Ammonium Bromide
Bis-GMA	Bisphenol A glycidyl dimethacrylate
PAN	Polyacrylonitrile
XRD	X-ray diffraction
FESEM	Field-emission scanning electron microscopy
EDS	Energy dispersive X-ray spectra
BET	Brurauer-Emmerr-Teller
TEM	Transmission electron microscopy
HRTEM	High-resolution transmission electron microscopy
SAED	Selected area electron diffraction
EC	Ethylene carbonate
DMC	Dimethyl carbonate
PVDF	Polyvinylidene fluoride

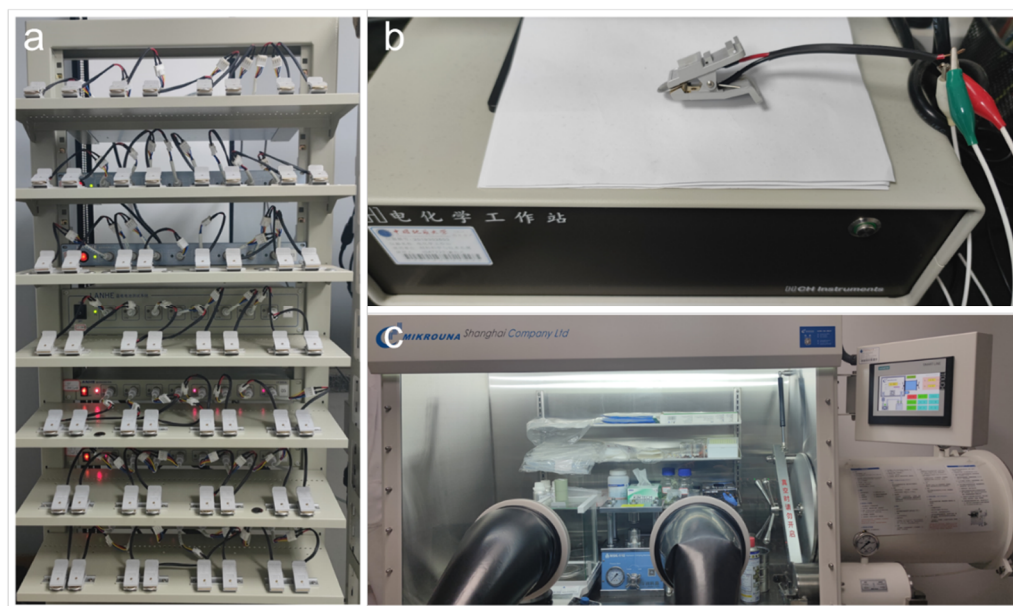


Figure S10. (a) Physical drawing of cyclic performance test, (b) Physical drawing of CV test and EIS test, (c) Physical drawing of the battery assembly.

Table S5. The various technical parameters of the work.

Technical Types	Technical Specifications
nominal voltage	2.5–4.2V
nominal capacity	170 m·A·h·g ⁻¹
anode	Li film
cathode	LiFeO ₄
electrolyte	1 M solution of LiPF ₆ in ethylene carbonate (EC)/dimethyl carbonate (DMC) (EC:DMC = 1:1, w%)
separator	GF/A
battery case	2016
current collector	aluminum foil

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