Hierarchical Sandwich-like Structure of Ultrafine N-Rich Porous Carbon Nanospheres Grown on Graphene Sheets as Superior Lithium-Ion Battery Anodes

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<u>Supporting Information:</u>

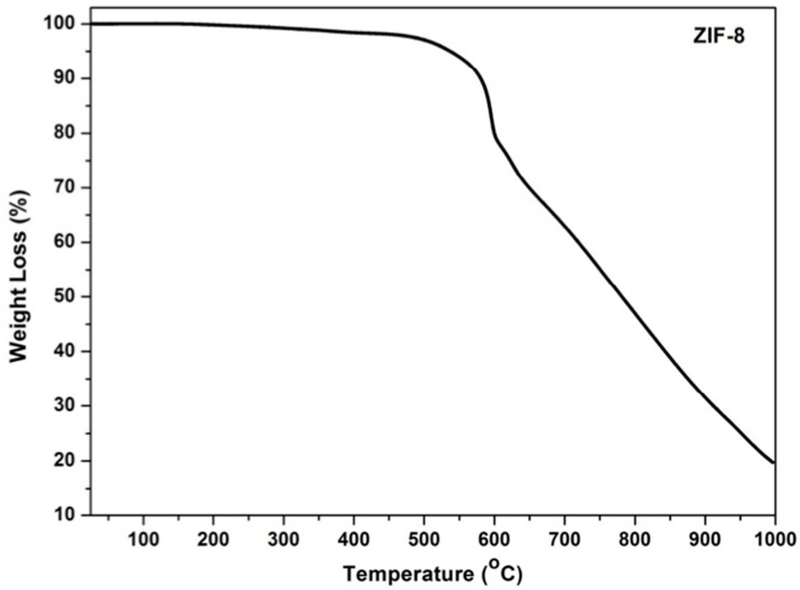

Figure S1. TGA curve of the ZIF-8 sample which reveals decomposition occurs at around 550 ^{o}C, indicating a high thermal stability of pristine ZIF-8. The weight loss of pristine ZIF-8 from 550 to 1000 ^{o}C is mainly due to evaporation of Zn and transformation of organic linkers into porous carbon.

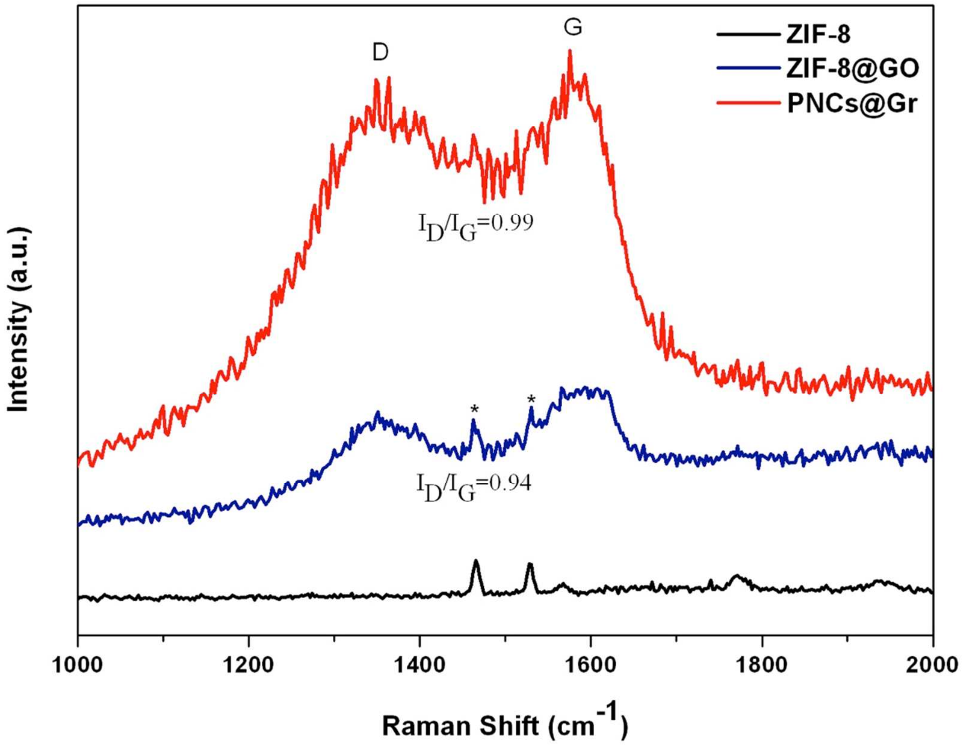

Figure S2. Raman Spectra of pristine ZIF-8, ZIF-8@GO and sandwich-like PNCs@Gr. Raman spectra of ZIF-8@GO and sandwich-like PNCs@Gr reveal two dominant peaks at 1352 and 1590 cm^{-1}, corresponding to D band and G band of graphitic carbon materials, which are absent in the Raman spectra of pristine ZIF-8. For ZIF-8@GO, the peaks marked by aster are from ZIF-8.

Table S1. Comparisons between electrochemical performance of Co_3O_4 QDs@SWCNT in the present work and those of reported Co_3O_4-based electrode materials for applications in LIBs.

Anode materials	Current density (mA g^{-1})	Cycle number	Specific capacity (mAh g^{-1})	Ref.
PNCs@Gr	500	100	1070	Our work
	1000	200	948	
	5000	400	530	
N-doped graphene sheets	50	30	872	Ref.1
Hollow carbon nanospheres (HCNS)	37	50	630	Ref.2
Micro-sized porous carbon spheres	100	100	507	Ref.3
N-rich porous carbon (OHC)	100	100	1178	Ref.4
	1000	100	591	
Porous carbon	100	70	660	Ref.5
Porous carbon microspheres (HPCM)	50	70	480	Ref.6
CNT-CNF	100	70	1150	Ref.7
N-doped graphene	50	50	1136	Ref.8
HN-CNT	100	100	397	Ref.9
PMC-650	100	100	1365	Ref.10

Table S2. Comparisons between electrochemical performance of PNCs@Gr in the present work and those of recently reported MOF-derived anode materials for LIBs.

Anode materials	Current density (mA g^{-1})	Cycle number	Specific capacity (mAh g^{-1})	Ref.
PNCs@Gr	500	100	1070	Our work
	1000	200	948	
	5000	400	530	
Co-doped ZnO@C (CZO@C)	100	50	725	Ref.11
ZIF-8@chitosan	50	50	750	Ref.12
Co_3O_4/N-PC	100	100	892	Ref.13
MWCNTs/Co_3O_4	100	100	813	Ref.14
ZnO@ZnO/C NRAs on carbon cloth	500	100	699	Ref.15
CuO nanostructure derived from Cu-MOF	100	40	538	Ref.16
ZnO QDs@porous carbon	75	50	1200	Ref.17
Spindle-like mesoporous Fe_2O_3	200	50	911	Ref.18
Porous TiO_2 derived from MIL-125	840	200	155	Ref.19

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