Electronic Supplementary Information

Scalable synthesis of 3D porous germanium encapsulated in nitrogen doped carbon matrix as an ultra-long-cycle life anode for lithium ion batteries

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Table S1. The elemental component content of the resulting 3D porous Ge/NC.

production	precursor ratio	C content	N content	Ge content
3D porous Ge/NC-1	5:1:1	27.8 wt%	1.2 wt%	69.4 wt%
3D porous Ge/NC-2	5:2:2	54.8 wt%	1.7 wt%	42.8 wt%
3D porous Ge/NC-3	5:3:3	78.5 wt%	2.1 wt %	17.9 wt%

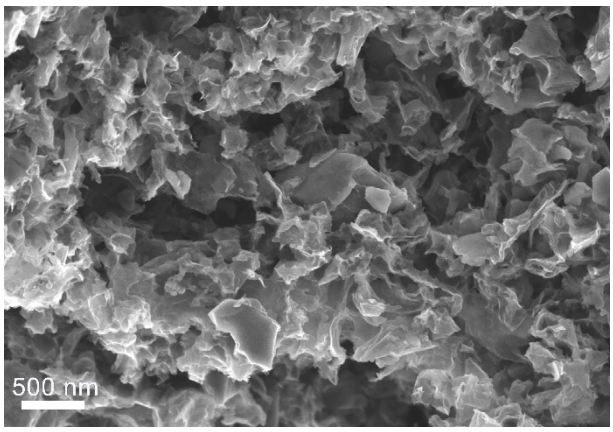

Fig. S1. SEM image of the 3D porous Ge/NC nanocomposites.

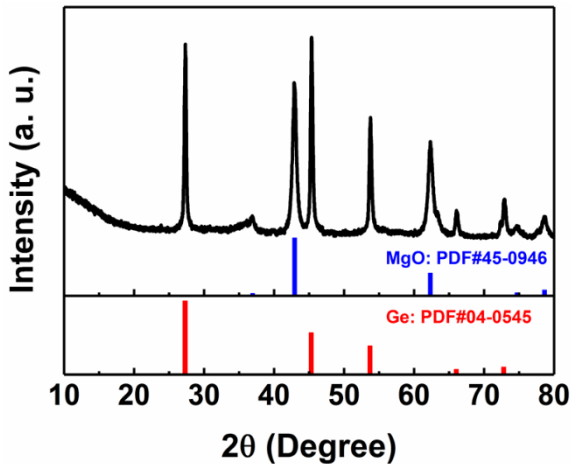

Fig. S2. XRD patterns of the obtained raw product without any washing treatment.

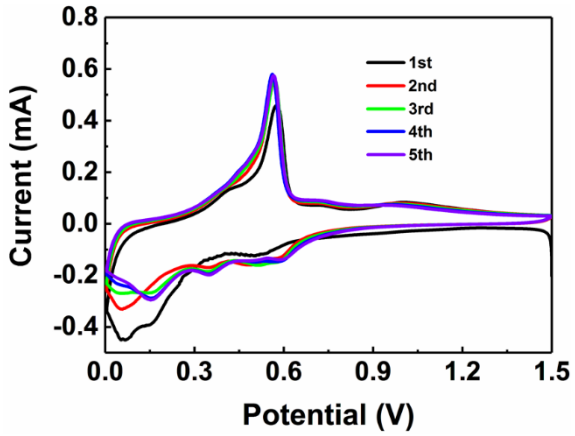

Fig. S3. Cyclic voltammetry curves of the prepared 3D porous Ge/NC anodes between 0.01 and 1.50 V with a scan rate of 0.1 mV s^{-1}.

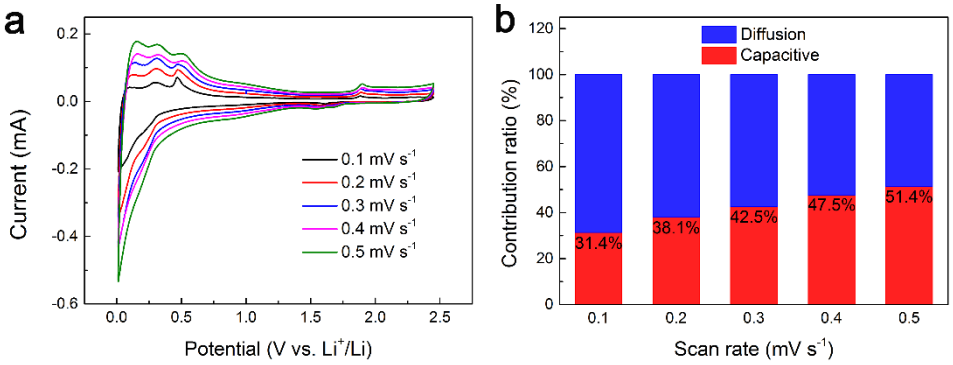

Fig. S4. Electrochemical kinetics behavior of the prepared 3D porous Ge/NC anodes. (a) CV curves at different scan rates from 0.1 to 0.5 mV s^{-1}. (b) Capacity contribution ratios at different scan rates.

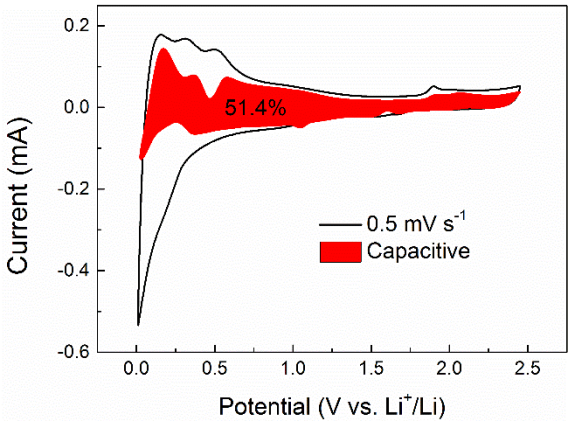

Fig. S5. Capacitance separation at 0.5 mV s^{-1} for the prepared 3D porous Ge/NC anodes.

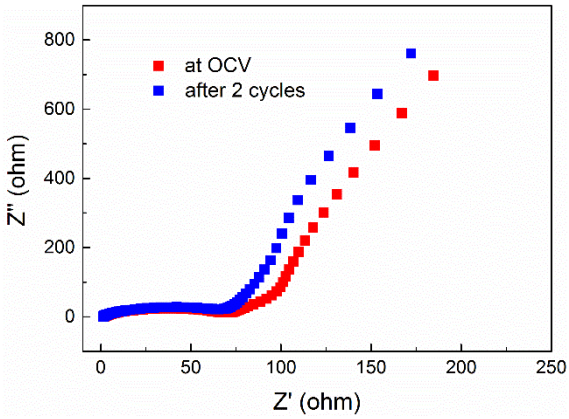

Fig. S6. EIS analysis at the states of open circuit voltage and after 2 cycles of the prepared 3D porous Ge/NC anodes.

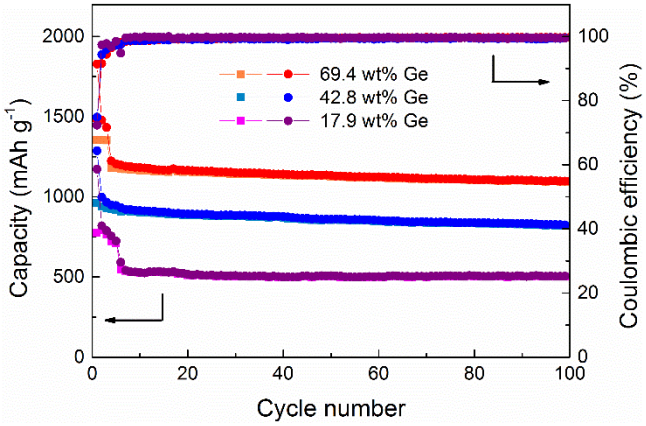

Fig. S7. Cycle performance of the prepared 3D porous Ge/NC electrodes with different Ge content at 0.8 A g^{-1}.

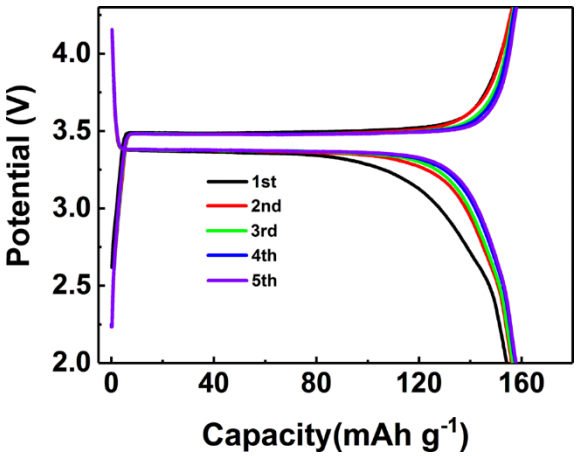

Fig. S8. Typical galvanostatic discharge-charge curves for the first five cycles of the $LiFePO_4$ cathode in the potential range of 2.0-4.3 V versus Li/Li^+ at 170 mA g^{-1}.

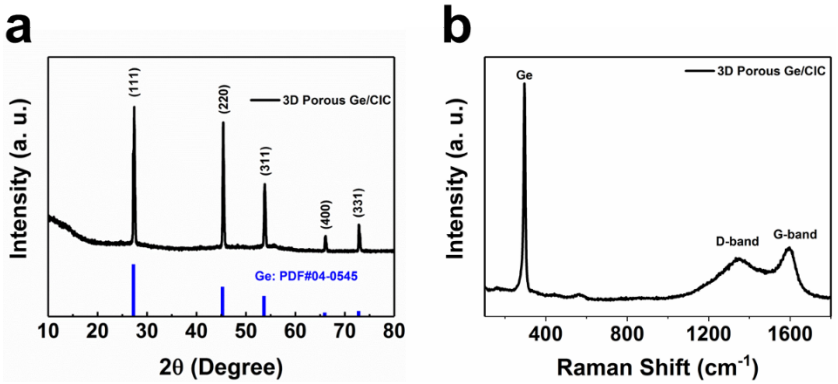

Fig. S9. XRD patterns (a) and Raman spectra (b) of the 3D porous Ge/ClC nanocomposites.

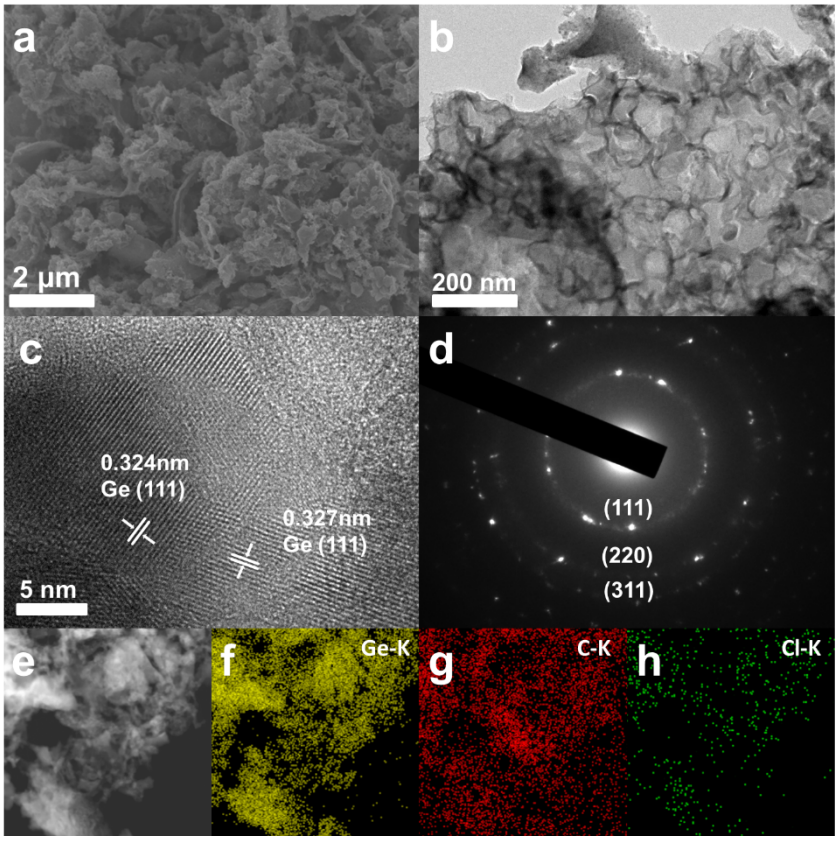

Fig. S10. (a) SEM, (b) TEM, (c) HRTEM, and (d) SAED images of the 3D porous Ge/ClC nanocomposites. The corresponding EDX elemental mapping images of (f) Ge, (g) C and (h) Cl in the selected area (e).

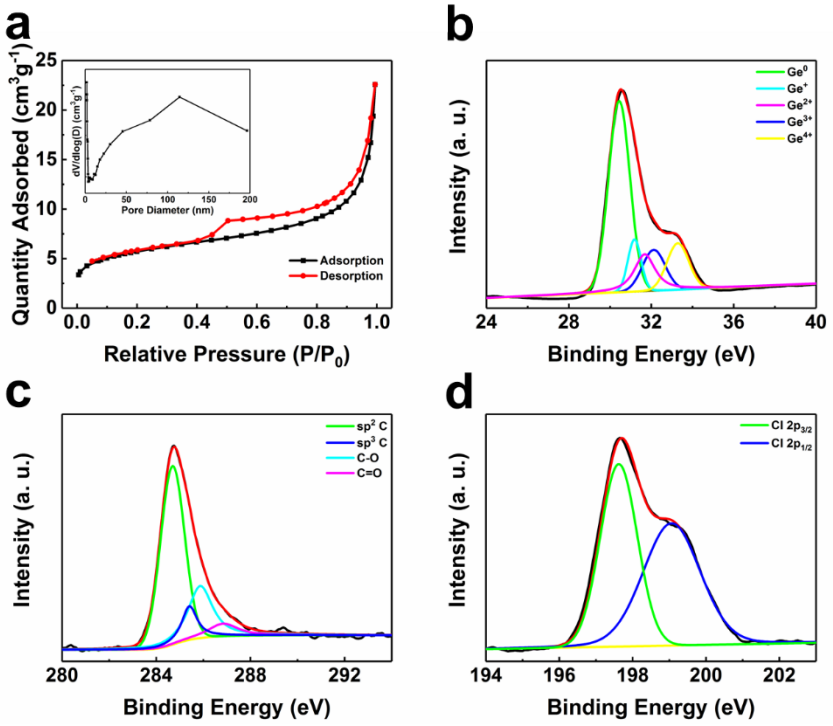

Fig. S11. (a) N_2 adsorption-desorption isotherms, the pore-size distribution calculated from the desorption branch (inset) of the 3D porous Ge/ClC; (b), (c) and (d) are the high resolution XPS spectra of Ge 3d, C 1s and Cl 2p in the 3D porous Ge/ClC nanocomposites.