Enhancing electrochemical performance of micron size Ge anode through in-situ surface composite flowerlike Zn_2GeO_4 for Li ion batteries

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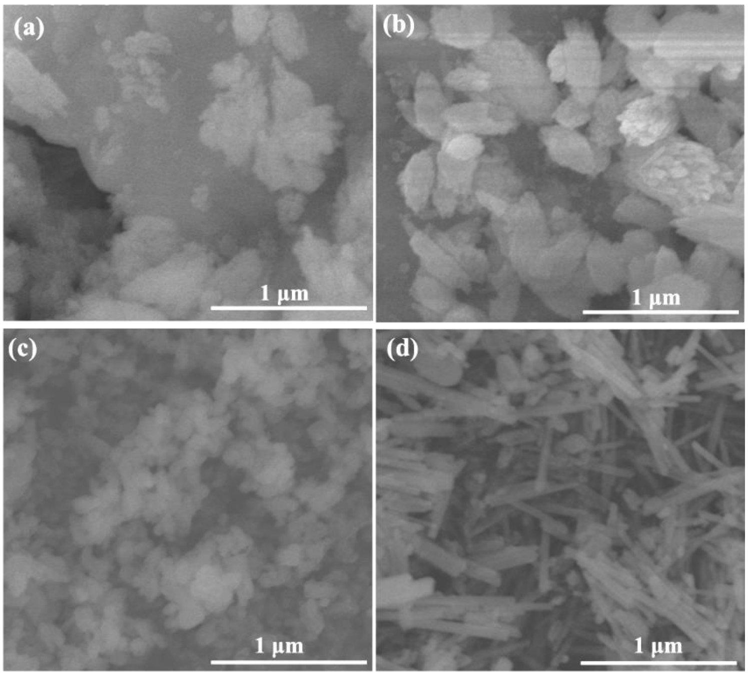

Fig S1 Detailed morphology of samples, in EDTA:water=1:1 solvent system without NaOH(a), in EDTA:water=1:2 solvent system the without NaOH(b), in

EDTA:water=1:1 solvent system the with 1ml NaOH(c), and in EDTA:water=1:1 solvent system the with 2ml NaOH(d).

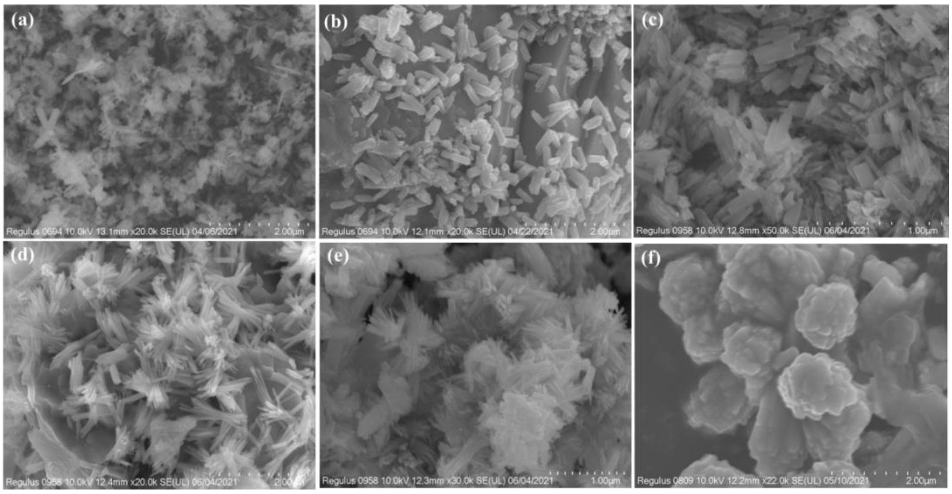

Fig.S2 SEM images of Ge/Zn_2GeO_4 products obtained at different reaction temperatures: (a) 120 ^oC, (b) 140 ^oC, (c) 160 ^oC, (d) 180 ^oC, (e) 200 ^oC, and (f) 220 ^oC.

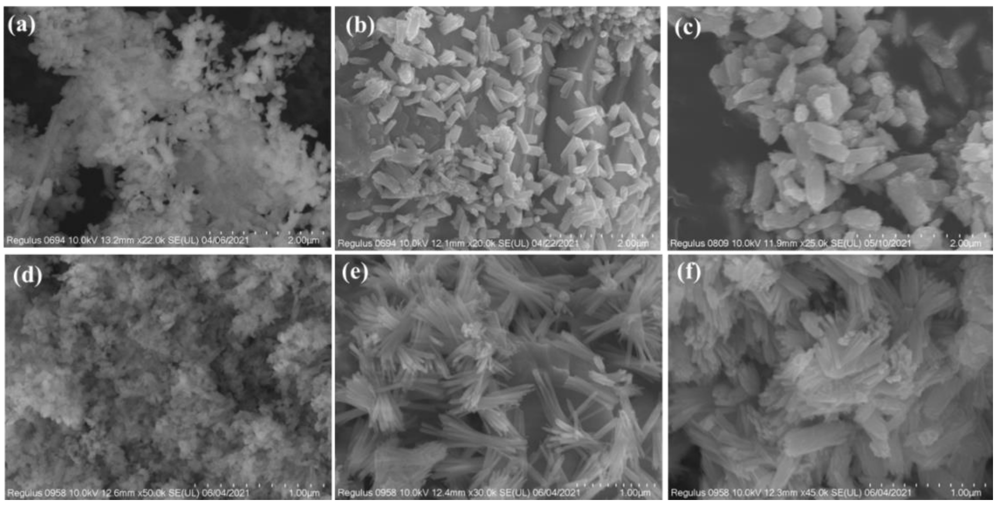

Fig.S3 SEM images of Ge/Zn_2GeO_4-140 ^oC with different reaction times, (a) 12h, (b) 24h, (c) 48h, and Ge/Zn_2GeO_4-180 ^oC with different reaction times, (d) 12h, (e) 24h, (f) 48h.

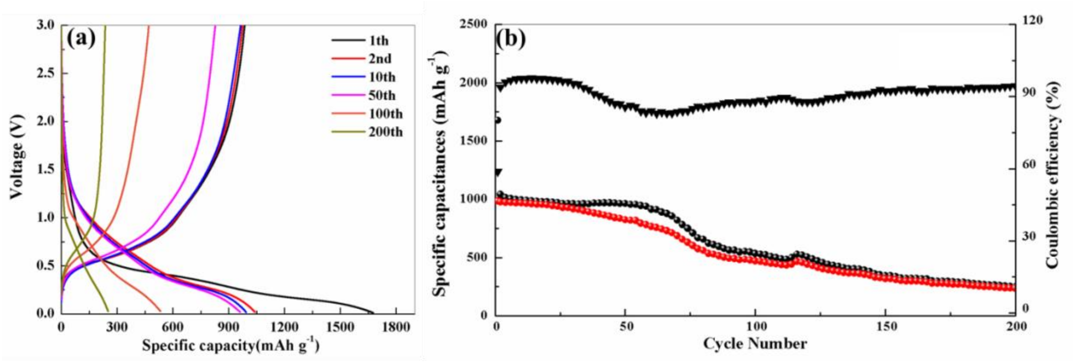

Fig.S4 Galvanostatic charge-discharge profiles for different cycles (a), and cycling performance and Coulombic efficiency (b) of micron Ge electrode.

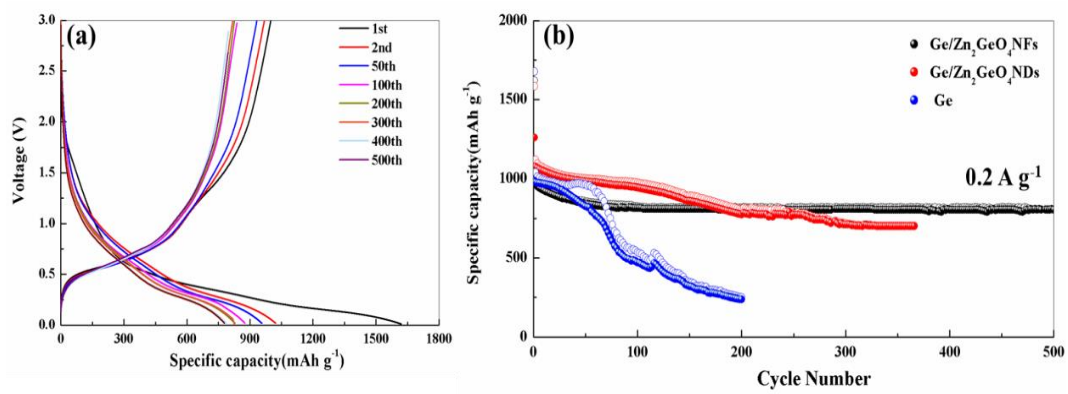

Fig.S5 (a) Galvanostatic charge-discharge profiles for different cycles of Ge/Zn_2GeO_4NFs at 0.2 A g^{-1}, (b) cycling performance of Ge/Zn_2GeO_4NFs, Ge/Zn_2GeO_4NDs, and Ge at 0.2 A g^{-1}.

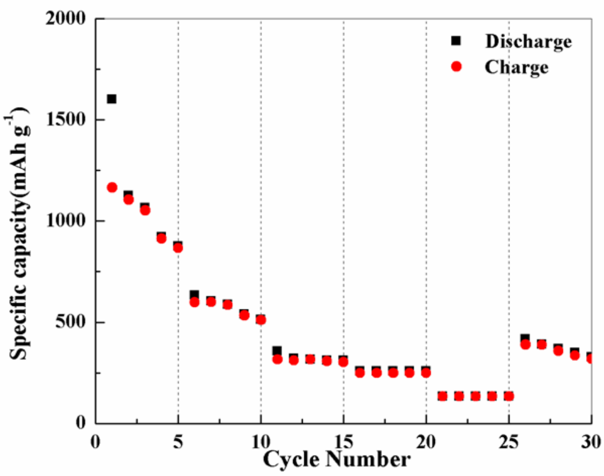

Fig.S6 Rate performance of micron Ge electrode, at current density of 0.2, 0.5,1.0, 2.0, 5.0A g^{-1}

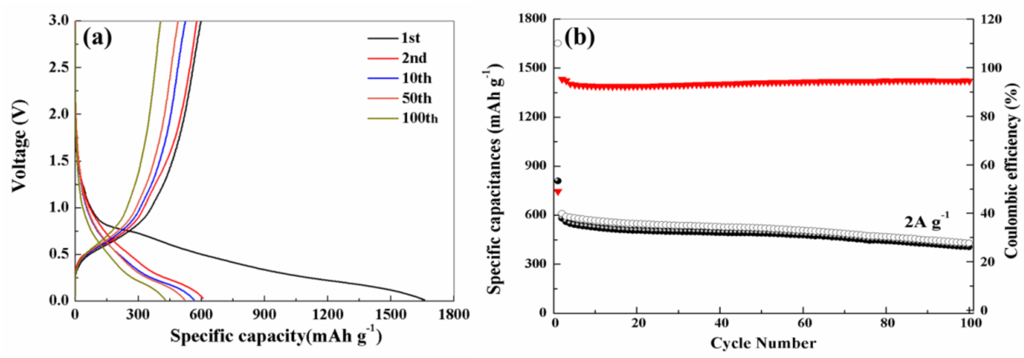

Fig.S7 (a) Galvanostatic charge-discharge profiles for different cycles of Ge/Zn_2GeO_4NFs at 2 A g^{-1}, (b) cycling performance and Coulombic efficiency of Ge/Zn_2GeO_4NFs, at 2 A g^{-1}.

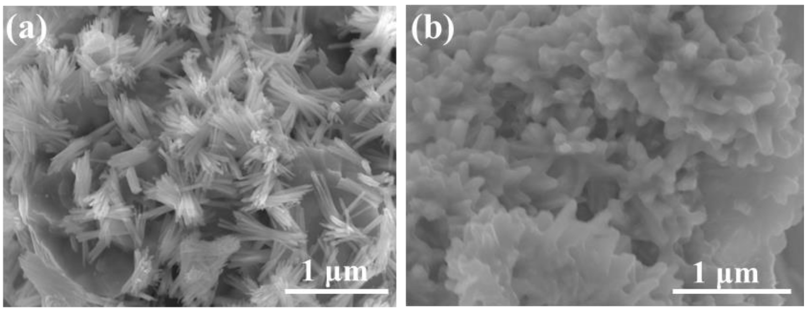

Fig.S8 SEM images of the Ge/Zn_2GeO_4NFs anode before cycle (a) and after the 200th cycle (b) at 0.2 A g^{-1}.

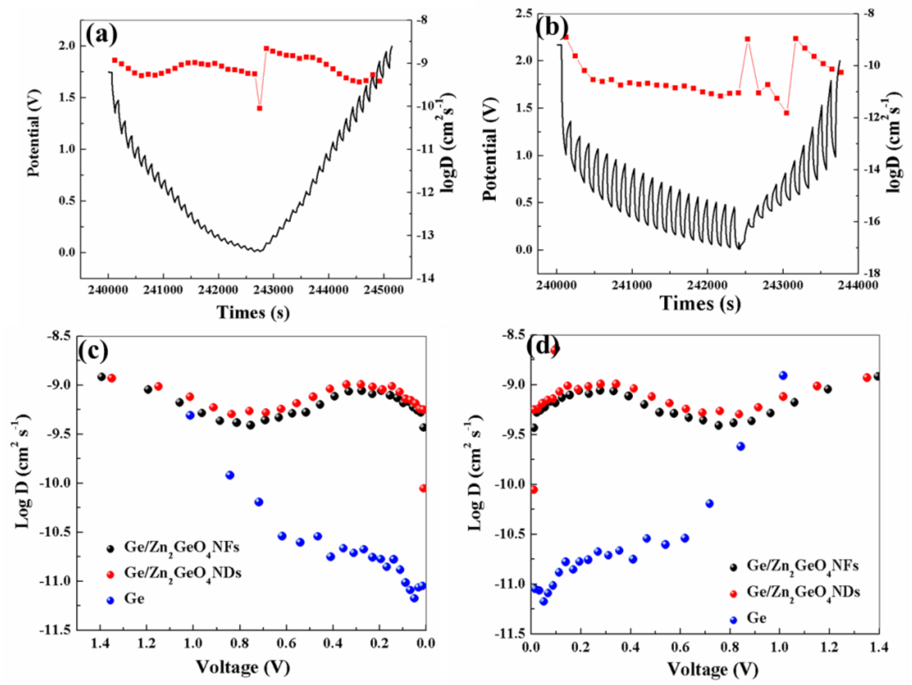

Fig.S9 The GITT curves (voltage vs. time) and (LogD vs. time) for the

Ge/Zn_2GeO_4NDs (a), and Ge (b) anode at room temperature 4th cycle, Li^+ ion diffusion coefficients calculated from the GITT potential profiles as a function of depth of discharge (c), and Li^+ ion diffusion coefficients as a function of state of charge (d).

Table S1. The comparison of electrochemical performance of Ge and Zn_2GeO_4 anodes for LIBs.

Materials	**Cycling performance ($mAh\ g^{-1}$)**	**Rate capability ($mAh\ g^{-1}$)**	**Initial Coulomb efficiency (%)**	**Ref.**
meso-porous Ge anode	1291 after 150 cycles at 0.2 C	673 at 10 C	~65	1
np-$GeSn_5$	974 after 500 cycles at 200 mA g^{-1}	778 at 1500 mA g^{-1},	~65	2
np-Ge	318 after 150 cycles at 200 mA g^{-1}	500 at 1000 mA g^{-1}		2
Ag/np-Ge	953 after 100 cycles at 100 mA g^{-1}	522 at 1000 mA g^{-1}	81.8	3
nanoporous Ge (np-Ge)	1060 after 100 cycles at 0.2 A g^{-1}	844.2 at 5 A g^{-1}		4
Ge asymmetric membrane	850 after 100 cycles at 600 mA g^{-1}	840 at 800 mA g^{-1}	~65	5
porous GeO_2(s)/Ge(c)	1333.5 after 30 cycles at 0.1 A g^{-1}	1024.4 at 0.4 A g^{-1}	60.1	6
Zn_2GeO_4 amorphous nanoparticles	1250 after 500 cycles at 400 mA g^{-1}	610 and 470 at 3.2 A g^{-1} and 6.4 A g^{-1}	34	7
Zn_2GeO_4 nanowires	1220 after 100 cycles,		52.5	8
Mn-doped Zn_2GeO_4 hierarchical nanosheet arrays	1301 after 100 cycles at 100 mA g^{-1}	500 at 2 A g^{-1}	61.3	9
Zn_2GeO_4/RGO composite	1005 after 100 cycles at 0.5 A g^{-1}	515 at 5 A g^{-1}	63.2	10
Zn_2GeO_4 ultrathin nanosheets	794 after 500 cycles at 200 mA g^{-1}	537 at 2 A g^{-1}	~59	11

Zn_2GeO_4 Nanorods	616 after 100th cycles at 400 mA g^{-1}	~500 at 5C	54	12
Ge/Zn_2GeO_4 NFs	816 after 200th cycles at 0.2 A g^{-1}	567 at 2 A g^{-1}	62	This work

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