

High power and stable P-doped yolk-shell structured Si@C anode simultaneously enhancing conductivity and Li⁺ diffusion kinetics

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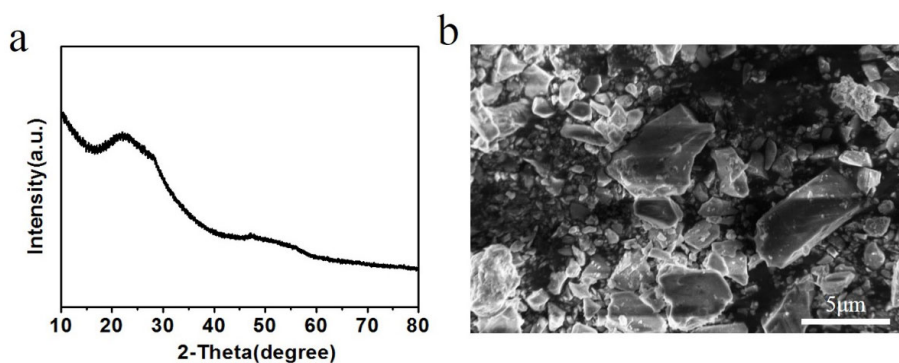


Figure S1 a) XRD and b) SEM image of SiO sample.

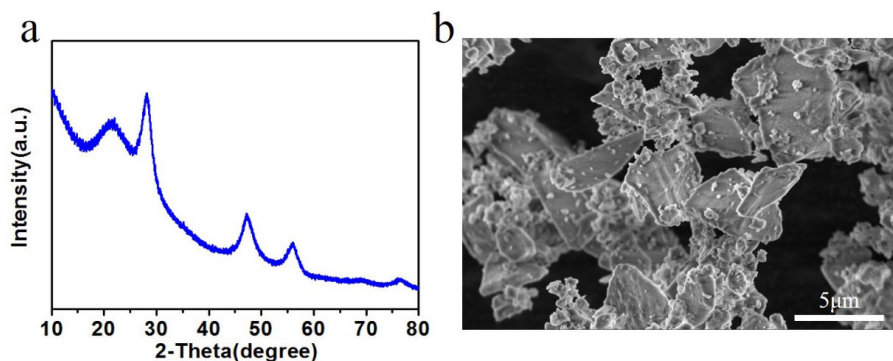


Figure S2 a) XRD and b) SEM image of P-doped Si/SiO₂ sample.

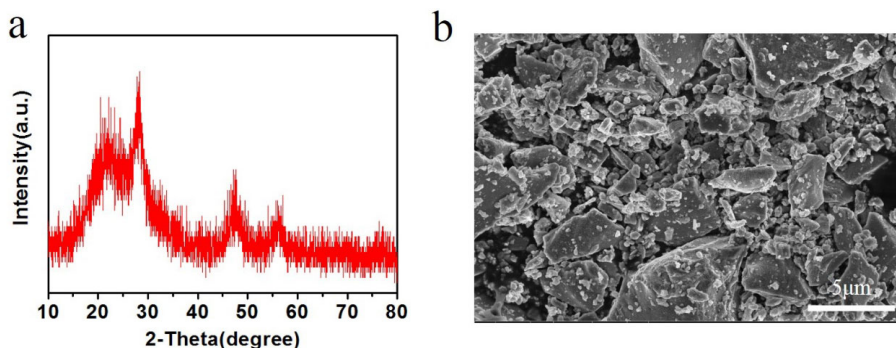


Figure S3 a) XRD and b) SEM image of P-doped Si/SiO₂@C sample.

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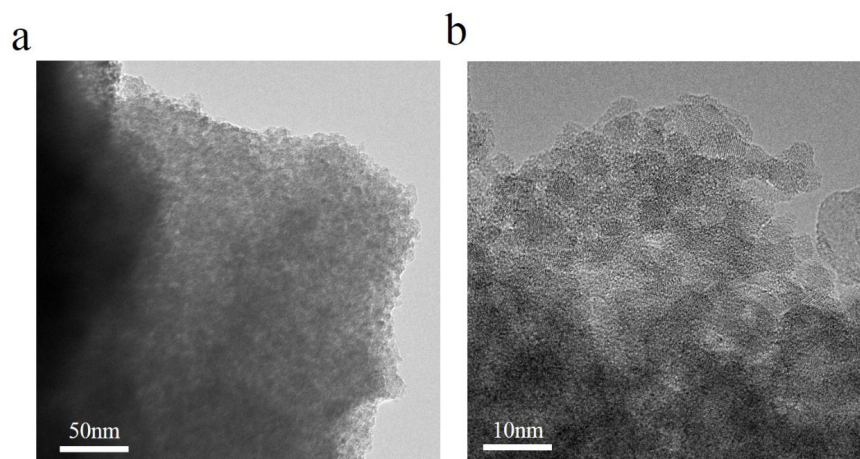


Figure S4 TEM images of SiNP sample.

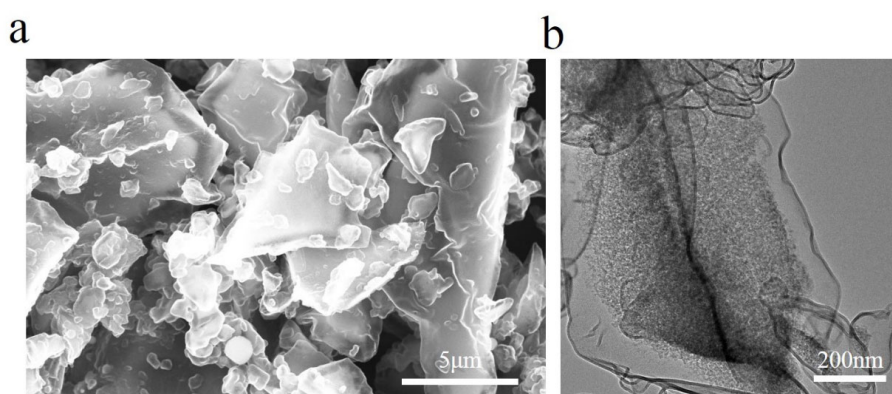


Figure S5 a) SEM and b) TEM images of yolk-shell Si@C sample.

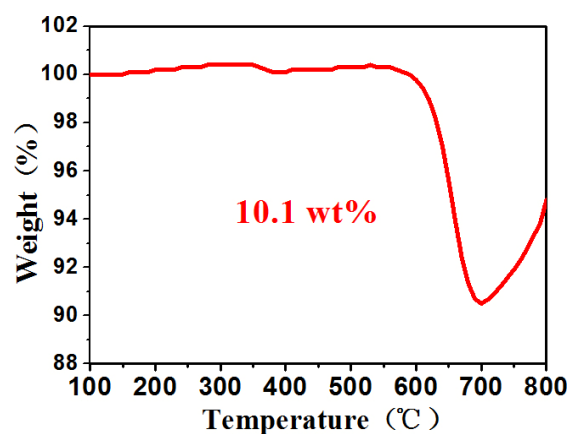


Figure S6 TGA curve of P-doped Si@C material.

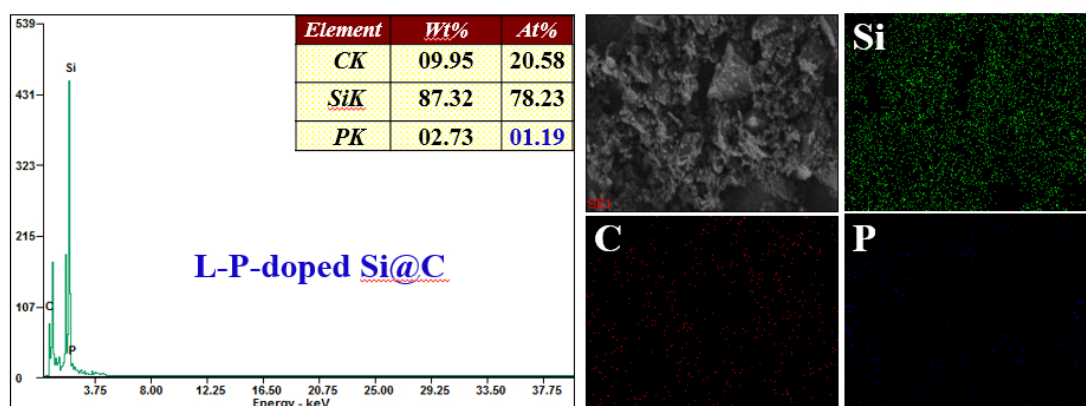


Figure S7 EDS mapping and spectrum of L-P-doped Si@C material.

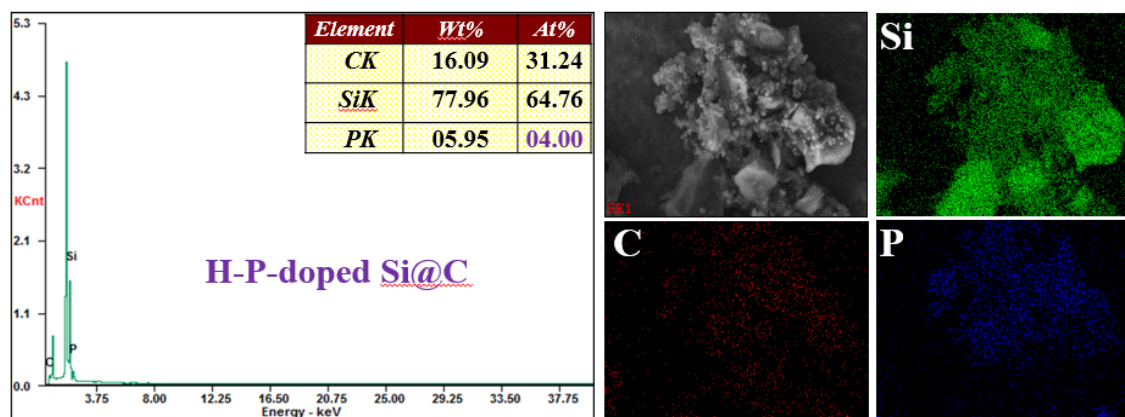


Figure S8 EDS mapping and spectrum of H-P-doped Si@C material.

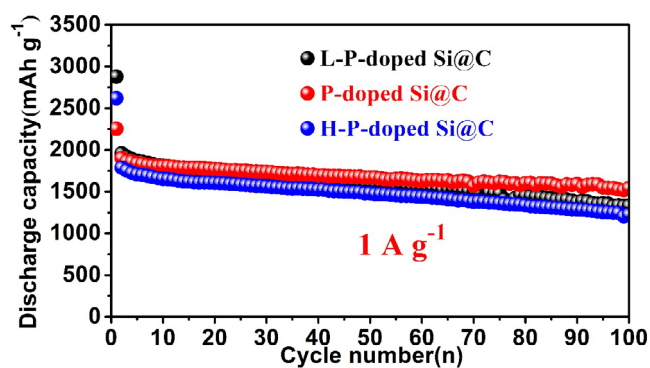


Figure S9 Cycling performances of L-P-doped Si@C (P content of 1.19 atom%), P-doped Si@C and H-P-doped Si@C (P content of 4.00 atom%) electrodes at 1 A g⁻¹.

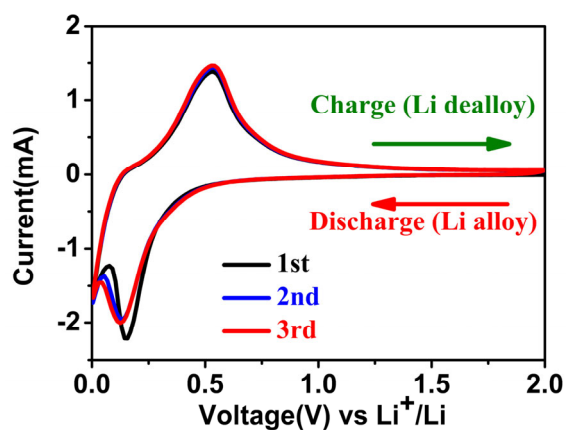


Figure S10 Cyclic voltammetry curves of P-doped Si@C electrode.

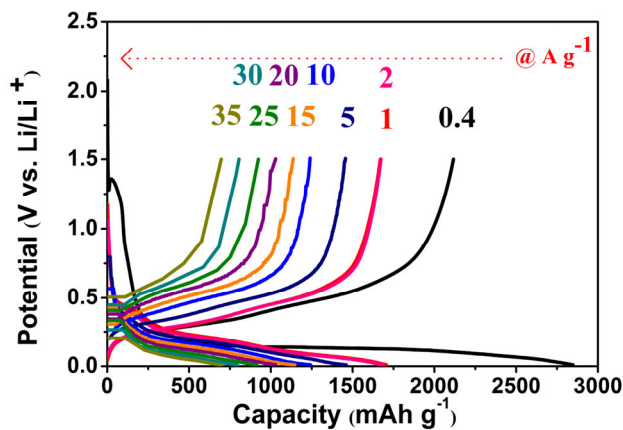


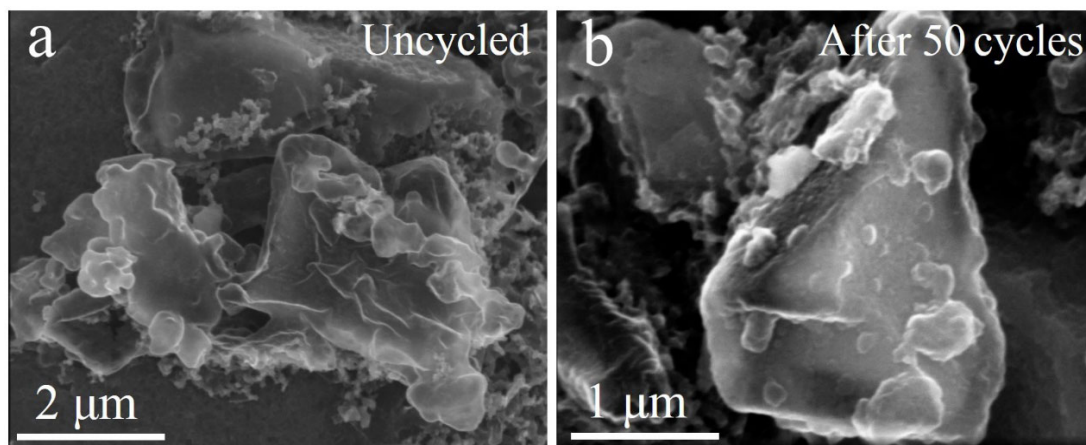
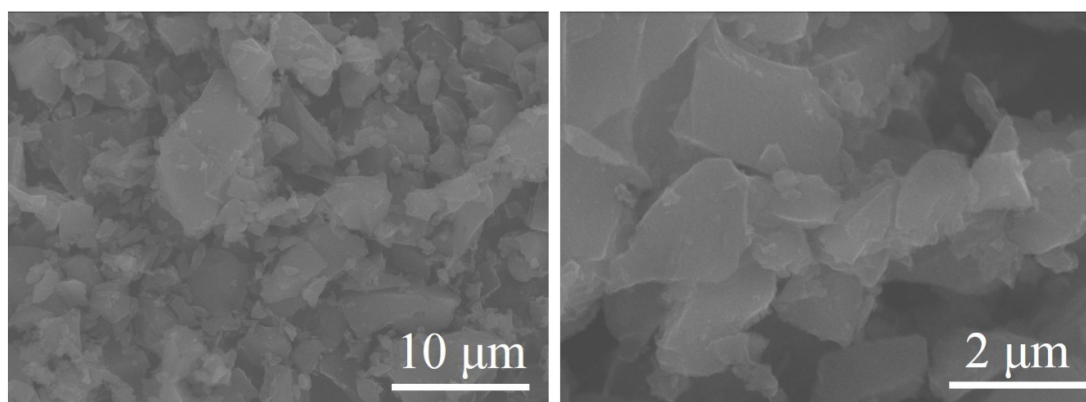
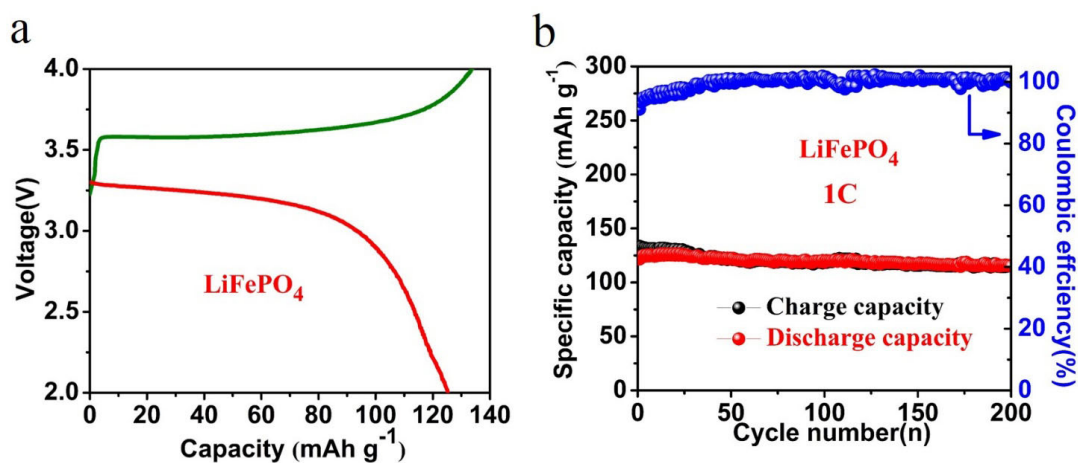
Figure S11 Voltage profiles of P-doped Si@C electrode at a variety of current densities.

Table S1 Conductivity of SiNP, Si@C and P-doped Si@C powder samples.

Sample	SiNP	P-doped Si@C	Si@C
Conductivity (S m^{-1})	6.5×10^{-6}	9.8×10^{-4}	1.7×10^{-4}

$$K = (I/E) * (L/A)$$

where K is the electrical conductivity, I is the current, E is the voltage, L is the material pressed wafer thickness and A is the area of the wafer.

**Figure S12** Morphology characterization of P-doped Si@C electrode: SEM of a) uncycled and b) after 50 cycles.**Figure S13** SEM images of activated carbon particles**Figure S14** a) The first charge–discharge profiles and b) Long-term cycling stability of LiFePO₄ electrode as cathode at 1C = 170 mA g⁻¹ of current density.

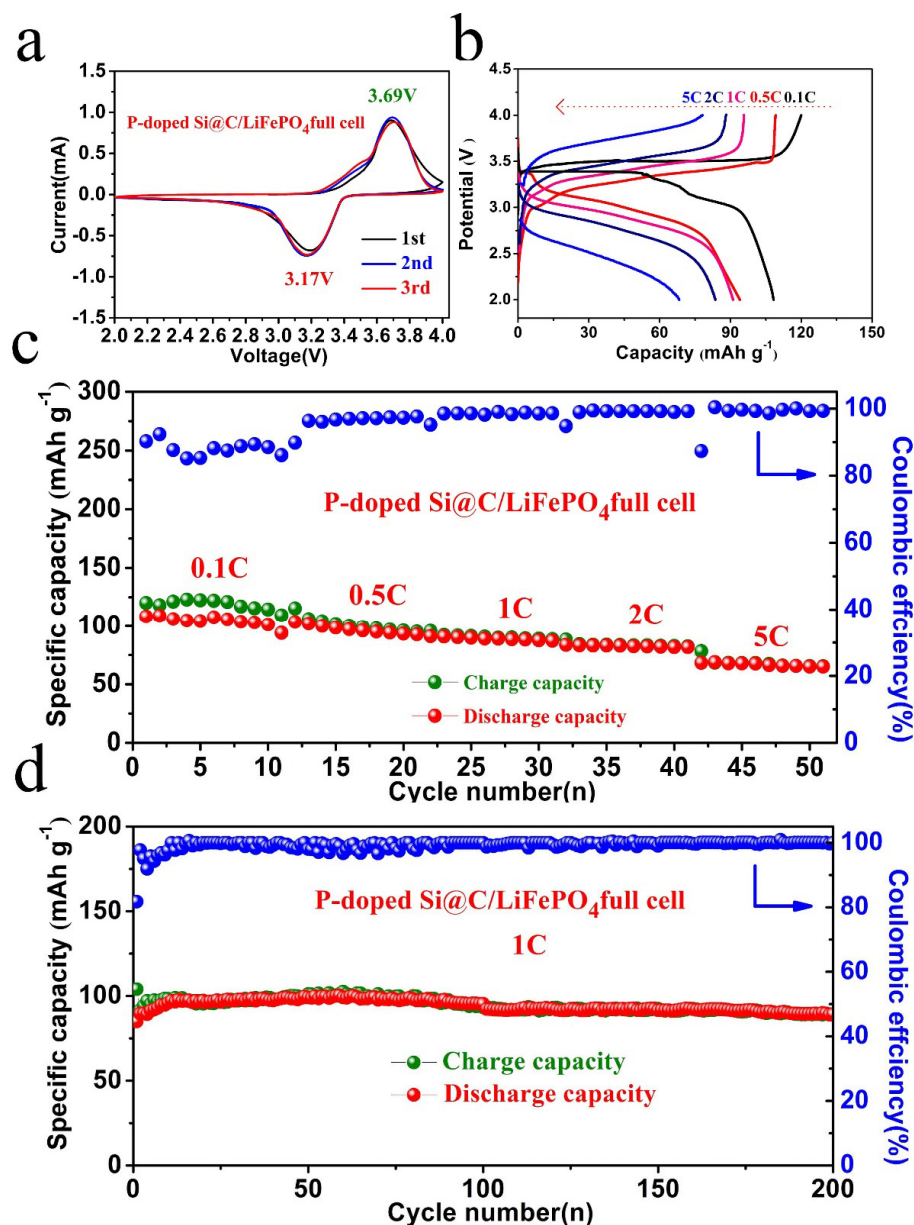


Figure S15 Electrochemical properties of the P-doped Si@C/LiFePO₄ full cells (the first three cycles prelithiation of P-doped Si@C electrode) a) The CV curves. b) The charge-discharge profiles. c) Rate capabilities at different current densities. d) Long-term cycling stability at 1C of current density (1C = 170 mA g⁻¹).