Supporting information

Electrochemically induced amorphous VO_x/N doped carbon porous spheres cathode for advanced aqueous zinc-ion battery

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Detailed calculation processes of Zn^{2+} transfer coefficient

The Zn^{2+} diffusion is measured based on the analysis of impedance and according to Equations (1) and (2):

$$D_{Zn^{2+}} = R^2T^2 / 2n^4F^4{\sigma_w}^2A^2C^2 \qquad (1)$$

$$Z^{'} = R + \sigma_w w^{-1/2} \qquad (2)$$

EIS was employed to calculate the Zn^{2+} transfer coefficient to study the effect of crystallinity on potassium storage performance. In Equations (1) and (2), R, T, n, F, A, C, and σ_w are the gas constant (8.314 J mol^{-1} K^{-1}), the absolute temperature (301.15 K), the number of electrons per molecule during oxidation (2), the Faraday's constant (96485 C mol^{-1}), the surface area of the electrode (1.13 cm^2), the Zn^{2+} concentration in the electrode material (3.0 mol L^{-1}), and the Warburg coefficient, respectively.

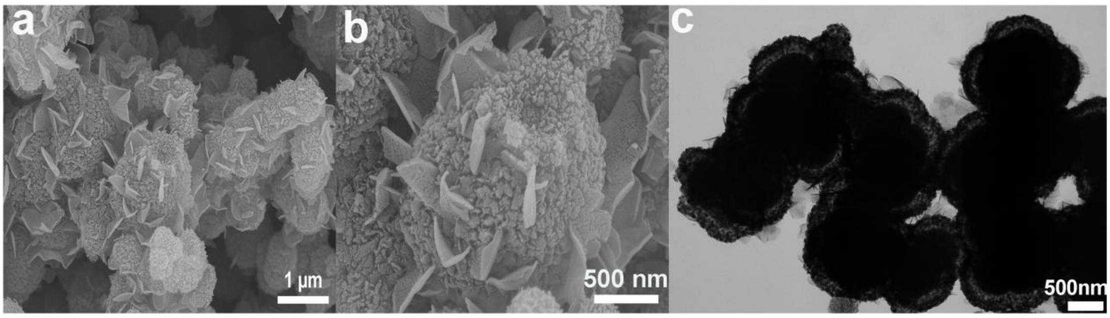

Fig.S1 (a,b) SEM images for V_2O_3/NC-3h porous spheres at different magnifications. (c) TEM image for V_2O_3/NC-3h porous spheres

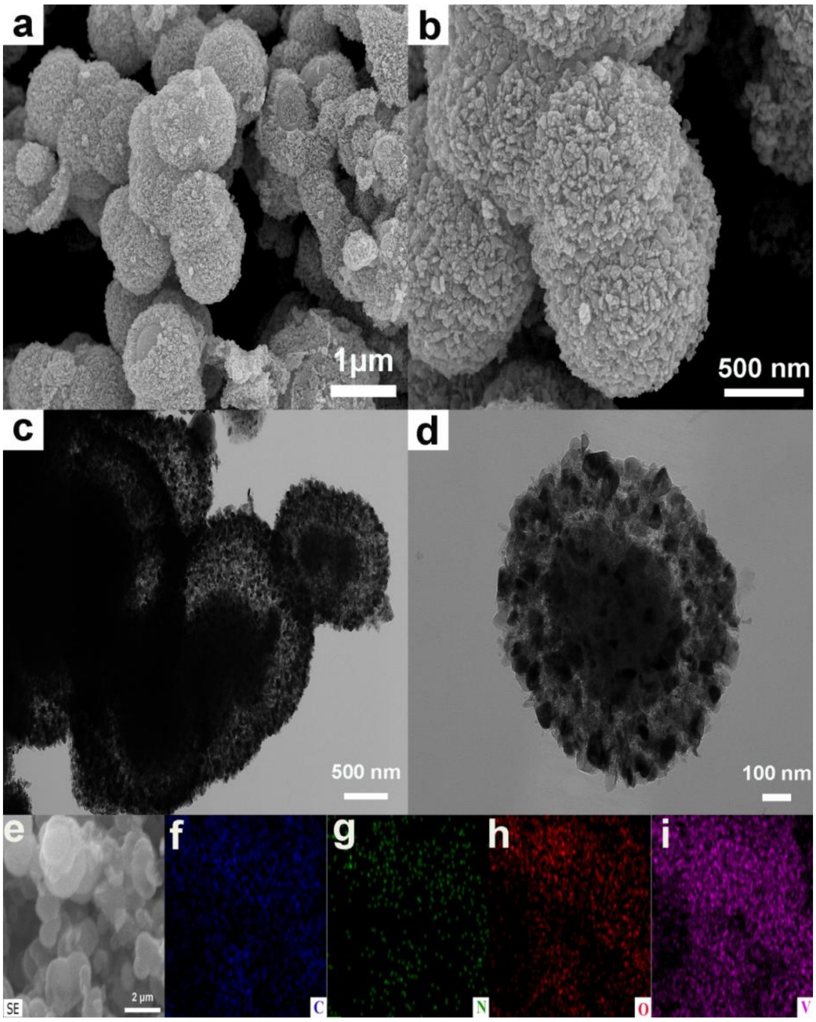

Fig. S2 (a,b) SEM images for V_2O_3/NC-6h porous spheres at different magnifications. (c,d) TEM images for V_2O_3/NC-6h porous spheres at different magnifications. (e) EDS mapping for V_2O_3/NC-6h porous spheres.

Table S1. The electrochemical performances for V-related oxides/carbon composites with different morphologies fabricated using different strategies in ZIBs.

Morphology	**Synthesis method**	**Capacity retention (mAh g^{-1})**	**Referance**
Graphene/VO_2 composite	Freeze-drying/high temperature reduction	240 (1000 cycles) at 4 A g^{-1}	[15]
V_2O_3/carbon composite	Ball-milling route	84(2000 cycles) At 5 A g^{-1}	[29]
V_2O_5/3D nanocarbon	Atomic layer deposition	133(800 cycles) At 5 A g^{-1}	[30]
3D spongy VO_2-graphene	Hydrothermal/chemical reduction	267(5000cycles) At 10A g^{-1}	[31]
Network C@V_2O_5	Chitosan-assisted hydrothermal process	250(2000 cycles) At 0.5A g^{-1}	[41]
V_2O_5@PEDOT/CC	Solvothermal reaction/thermal treatment	223(2000cycles) At 5A g^{-1}	[42]
Hydrated V_2O_5/PPy	Hydrothermal/chemical polymerization	165(5000 cycles) At 10A g^{-1}	[44]
VO_x/NC porous spheres	Electrochemically inducing V_2O_3/NC porous spheres	233(2000 cycles) At 5A g^{-1}	This work