Electronic Supplementary information (ESI)

N doped carbon coated V2O5 nanobelt arrays growing on carbon cloth toward enhanced performance cathode for lithium ion batteries

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Experimental Section

Materials

The carbon cloth was purchased from Tianjin Kermel Chemical reagent Co. Ltd. (Tianjin, China). All other reagents were analytically pure, and used without further purification.

Preparation of V_2O_5 nanobelt arrays

The experimental details were as follows. Clean carbon cloth 3×5 cm in size was used as the substrate. 0.5 mmol of V_2O_5 powder (Alfa Aesar) was dissolved in 35 mL of deionized water under magnetical stirring for 0.5 h in air, and 3 mL of 35% H_2O_2 (Alfa Aesar) was added under continuously stirring for 10 min. After that, 5 mg $NH_4H_2PO_4$ (Alfa Aesar) was dissolved into the above solution. The resulting solution was transferred into a 50 mL Teflon-lined stainless steel autoclave. The autoclave was heated to 180 °C for 5 h inside a conventional oven. Subsequently, the sample was washed with distilled water and ethanol and then dried at 60 °C. All the as-prepared samples were annealed at 400 °C for 2h in flowing argon at a ramping rate of 5 °C min^{-1}. The weights of the V_2O_5 nanobelt arrays were measured by a micro-balance (Mettler Toledo, New Classic MS) with an accuracy of 0.01 mg. The weights of all the V_2O_5 arrays were around 2 mg.

Preparation of N doped carbon coated V_2O_5 nanobelt arrays

50 mg dopamine was dissolved in 100 mL of deionized water contained 10 mM tromethamine. After that, V_2O_5 array was immersed into the above solution for 5h. Subsequently, the samples were annealed at 450 ℃ for 1 h in flowing argon at a ramping rate of 5 °C min^{-1}.

Characterization

The resulting sample was characterized by field emission scanning electron microscopy (FESEM, Hitachi Su8010), X-ray diffraction (XRD, Rigaku D/Max-γB), transmission electron microscopy (TEM, FTI, Tecnai F20, 300 kV), X-ray photoelectron spectroscopy (XPS) measurements were carried out

using a spectrometer with Mg Kα radiation (ESCALAB 250, Thermo Fisher Scientific Co.). In addition, nitrogen physiorption experiments were measured on a Micromeritics ASAP 2020 system, and specific surface areas and pore size distribution of samples were determined by the Brunauer-Emmett-Teller (BET).

V_2O_5 nanobelt arrays growing on carbon cloth was used directly as the working electrode without binders and conductivity agents, 1 M $LiPF_6$ in ethylene carbonate (EC), dimethyl carbonate (DMC) (1:1 in volume) was used as the electrolyte, and two porous polypropylene membranes as a separator. The cells were assembled in an argon-filled glove box with high-purity argon gas (99.9995% purity). Electrochemical measurements were carried out by using coin (CR2025) testing cells, which were performed on a NEWARE battery program-control test system between 2.01 and 4.0 V at room temperature. Cyclic voltammogram (CV) tests were recorded on the electrochemical workstation (CHI, 660d) between 4.0 V and 2.01 V at a sacn rate of 0.2 mV s^{-1}. Electrochemical impedance spectroscopy (EIS) measurements were performed on a PAR-STAT 2273 electrochemical systems in the frequency range mainly from 100 kHz to 10 mHz with an AC signal amplitude of 5 mV.

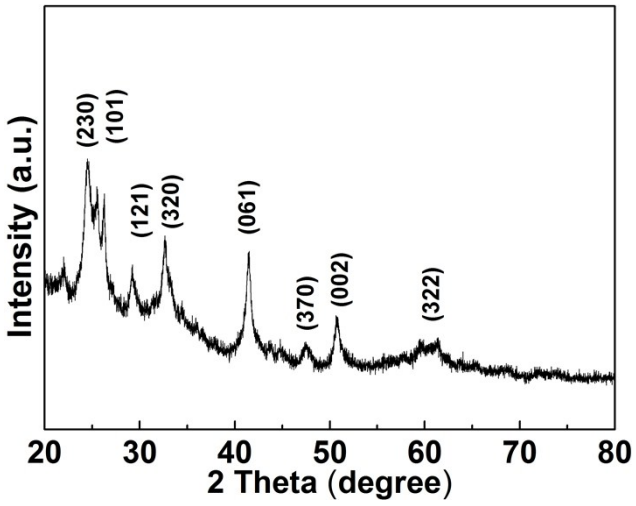

Figure S1 The XRD pattern of the prepared precursor sample scraped from the as-prepared $V_3O_7{\cdot}H_2O$ growing on carbon cloth.

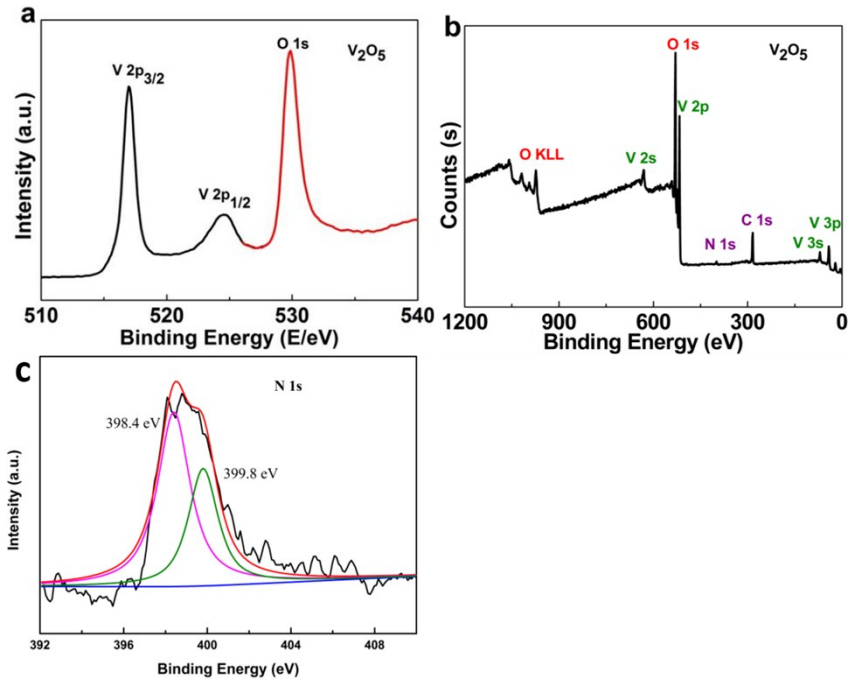

Figure S2 The corresponding XPS spectra of V_2O_5: (a,c) the O 1s, V 2p and N 1s bands, (b) XPS wide-scan survey.

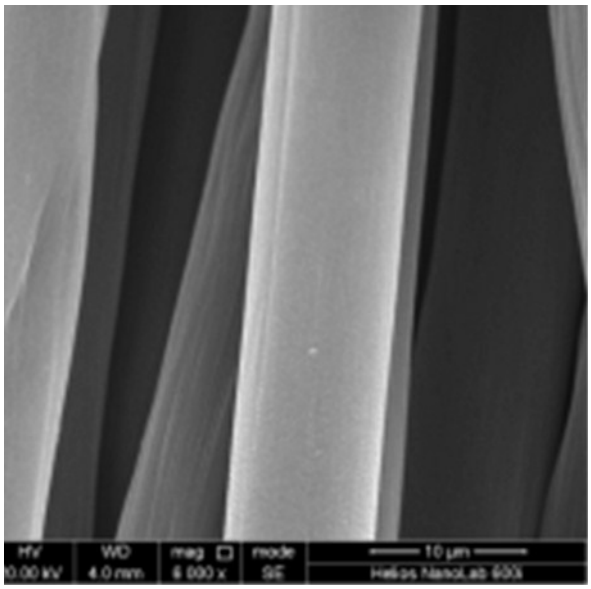

Figure S3 SEM image of carbon cloth.

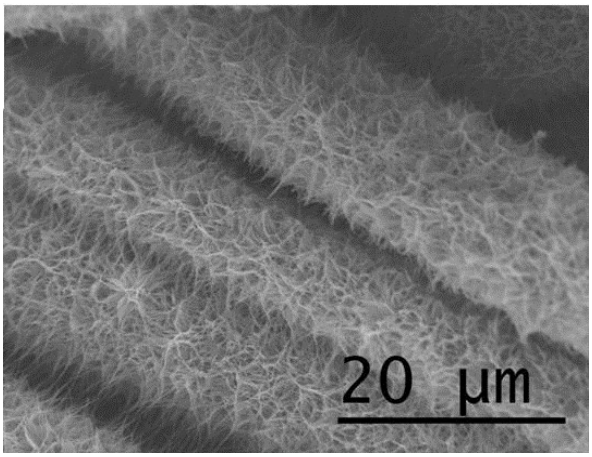

Figure S4 SEM image of sample V_2O_5@N-C.

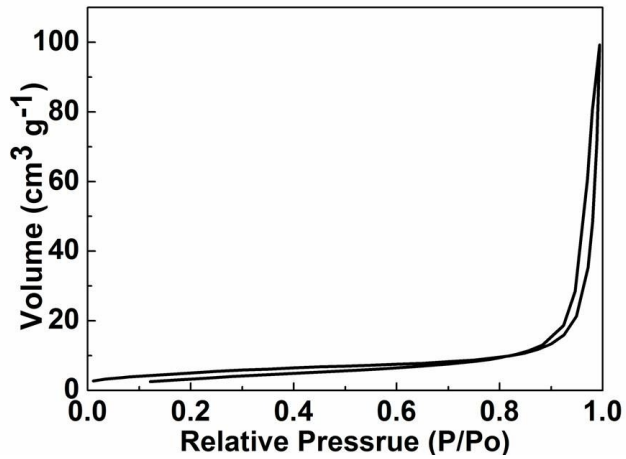

Figure S5 N_2 adsorption/desorption isotherm of the V_2O_5@N-C nanobelt arrays growing on the carbon cloth.

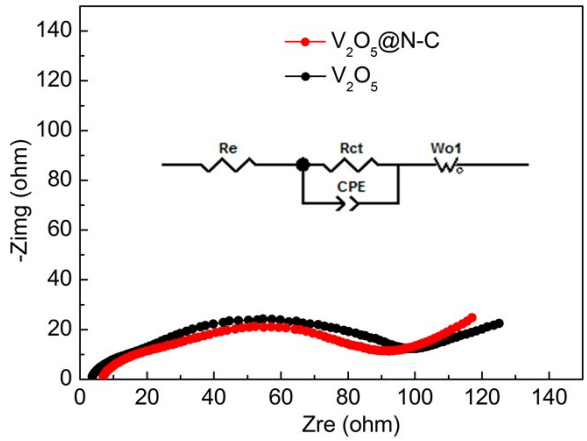

Figure S6 Nyquist plots of electrode materials.