Electronic Supplementary Information (ESI)

Sb nanoparticles decorated N-rich carbon nanosheets as anode materials for sodium ion batteries with superior rate capability and long cycling stability

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Experimental Section

Preparation of Sb-N/C composites

All reagents are of analytic grade and were used without further purification. In a typical preparation, 2.0 g $SbCl_3$ was dissolved in 150 mL of ethanol with vigorous agitation; 10.0 g urea and 1.0 g citric acid were dissolved in 50 mL of distilled water. Then the two solutions were mixed with continuous agitation at 75 °C for 3 h until the formation of a gel; then, the gel was transferred to an oven to keep 100 °C overnight. The as-prepared precursor was heated at two-step high temperatures of 350 °C for 4 h and 650 °C for 10 h in an Ar atmosphere. The obtained products were stored for further characterization. As a reference, N/C nanosheets were also obtained under the same condition without the addition of $SbCl_3$.

Characterization

The as-prepared samples were characterized by X-ray diffraction (XRD) (Rigaku

D/Max III diffractometer with Cu Kα radiation, λ =1.5418 Å), field emission scanning electron microscope (FESEM) with energy-dispersive X-ray spectroscopy (EDS) (Hitachi S-3500N), transmission electron microscope (TEM), high-resolution transmission electron microscopy (HRTEM) (FEI Tecnai G2F-20) and X-ray photoelectron spectroscopy (XPS) .

Electrochemical measurements

In test cells, sodium metal was used as the counter and reference electrode. The working electrodes were composed of the active material, polyvinylidene fluoride (PVDF), and acetylene black (AB) with the weight ratio of 15:3:2. The electrode was prepared by casting the slurry onto copper foil with a doctor blade and drying in a vacuum oven at 110 °C overnight. The average weight of the working electrodes was 1.0~2.0 mg. The electrolyte was 1 mol L^{-1} $NaClO_4$ dissolved in a 1:1 mixture of ethylene carbonate (EC) and propylene carbonate (PC). The cells were assembled in a glove box filled with high-purity argon. Charge/discharge measurements were performed between the potential range of 0.01 and 3.00 V (vs. Na/Na^+) under a LAND-CT2001A instrument at 25 °C. The capacity of Sb-N/C is based on the net weight of Sb+N/C, and the capacity of N/C is based on the net weight of N/C. Cyclic voltammetry (CV) was performed at a scanning rate of 0.1 mV s^{-1} between 0.01 and 3.00 V at 25 °C.

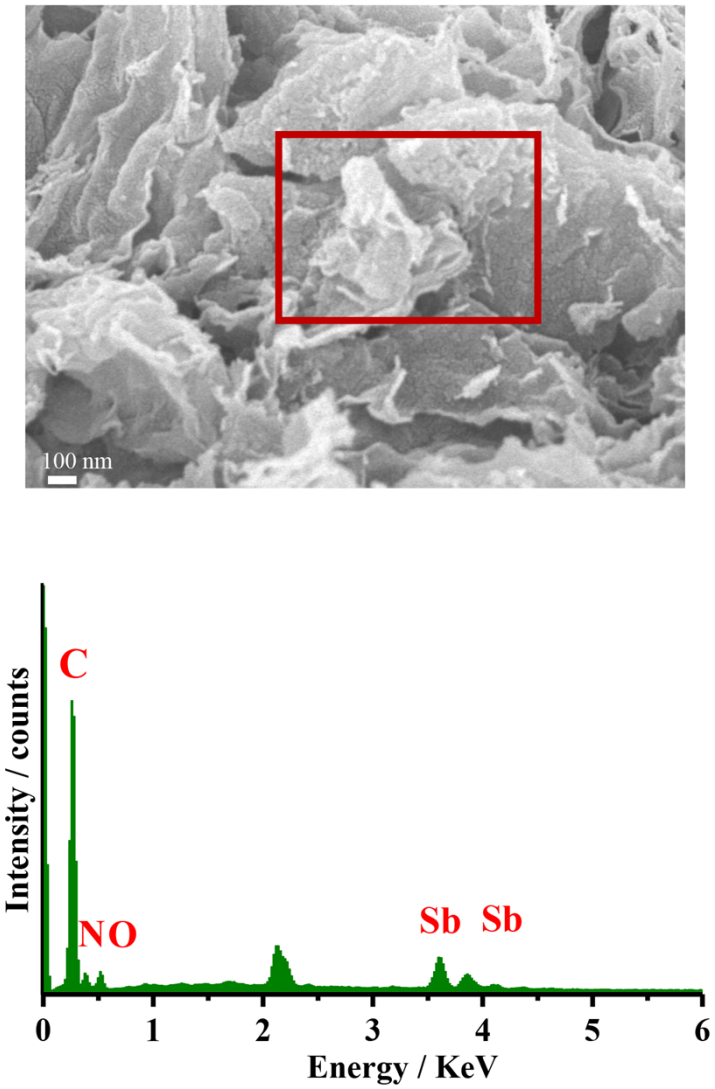

Fig. S1 EDS of the corresponding zone in SEM.

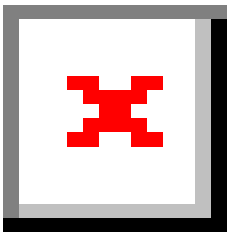

Fig. S2 The corresponding EDS maps of the Sb.

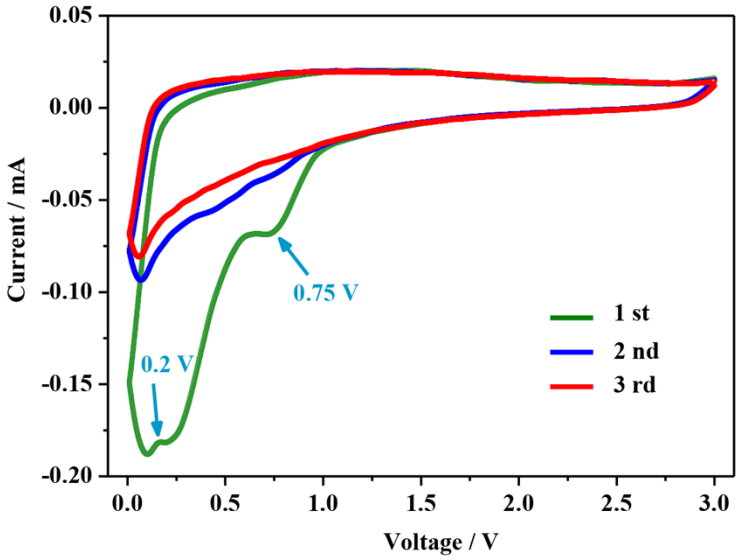

Fig. S3 CV curves of the N/C electrode.

Table S1. Comparison of our sample with previously published Sb/C-based anode materials for sodium ion batteries in terms of synthesis route, Sb content and rate capability.

Electrodes	Synthesis route	Sb content	Rate Capacity (mA h g^{-1})/ Current density (A g^{-1})
Sb-N/C	**Sol-gel**	**15.6wt%**	**220/2.0**
(This work)			**142/10**
Sb-C fibers[1]	Electrospun	54wt%	~184/2.0
			~88/6.0
Sb-C fiber[2]	Electrospun	38wt%	~337/3.0
Sb-rGO[3]	Solvothermal	90.5wt%	~192/3.3
			~100/6.6
Sb-CNT[4]	Wet milling	75.3wt%	~225/2.0
Sb-C[5]	Wet milling	70wt%	~309/2.0

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