Supplementary Information (SI) for ChemComm.

Supporting Information

Tannic Acid-Derived Carbon-Coated Bi Nanodiscs for High-Performance Sodium-Ion Batteries

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Experimental Section

2.1 Preparation of Bi_2O_3 precursor

All chemicals were commercially purchased and used without further purification. In a typical experimental procedure, $Bi(NO_3)_3 \cdot 5H_2O$ (0.364 g, 0.75mmol) was dissolved in 1 mol/L HNO_3 solution (5 mL), urea (0.6 g) and ethylene glycol (25 mL) were then added to the solution. After stirring of 30 min, the mixture was transferred into a Teflon-coated stainless-steel autoclave (50 mL) and kept 150 ^oC for 12 h. The obtained product was centrifuged, washed twice with deionized water and dried.

2.2 Preparation of Bi@TAC composite

Typically, Bi_2O_3 precursors (0.5 g) was dispersed in 30 ml buffer solution, and added with equal weight tannic acid (TA) and stirred for 12h, and dried to obtain Bi_2O_3@TA. The Bi_2O_3@TA composite was placed in a tube furnace and heated at 700 ^oC for 2 h under the N_2 gas flow (heating ramp: 5 ^oC min^{-1}). Then, the furnace was naturally cooled to room temperature, and the Bi@TAC composite was obtained. As a comparison, the pure Bi sample synthesis process was referred to the previous literature.

2.3 Structural characterization

The morphological information was measured using scanning electron microscopy (SEM, Hitachi 4800) and transmission electron microscopy (TEM, JEOLJEM-F200). The X-ray diffraction (XRD) was performed using Rigaku Ultima IV with Cu Kα radiation. FT-IR spectra were recorded on BRUKER-EQUINOX-55 IR spectrometer. Thermal gravimetric analysis (TGA) was carried out at a rate of 10 ^oC /min in air atmospheric using Netzsch TGA 209 F1. Raman spectra were collected using Renishaw in Via Replanex Raman system with a 532 nm Nd:YAG excitation source. X-ray photoelectron spectroscopy (XPS) on Thermo Scientific K-Alpha with a monochromatic Al K α X-ray source (1486.6 eV) was conducted to detect the surface element valence state. N_2 adsorption/desorption analysis was performed on Micromeritics ASAP 2460 instrument.

2.4 Electrochemical measurement

The CR2025 type coin cells were assembled in a glove box filled with high-purity Ar (O_2 and H_2O levels < 0.1 ppm) to evaluate the sodium storage property. The anode slurry was prepared by mixing 70% Bi@TAC, 20% acetylene black and 10% polyvinylidene fluoride (PVDF) with N-methyl-2-pyrrolidone (NMP). Then, the slurry was coated on Cu foil and dried in a vacuum at 110 ^oC for 8 hours. The average active materials mass loading was around 1.0 mg cm^{-2} for anode. A solution of 1M $NaPF_6$ in dimethoxyethane (DME) and glass fiber (Whatman) were used as the electrolyte and separator. Additionally, metallic sodium was used as the counter electrode for the half-cell. Galvanostatic charge-discharges and cyclic voltammetry (CV) curves of Bi@TAC anode were measured at room temperature in the voltage range of 0.01-1.5 V. Electrochemical impedance spectroscopy (EIS) measurements were carried out on an electrochemical workstation (Chenhua CHI660c, Shanghai, China).

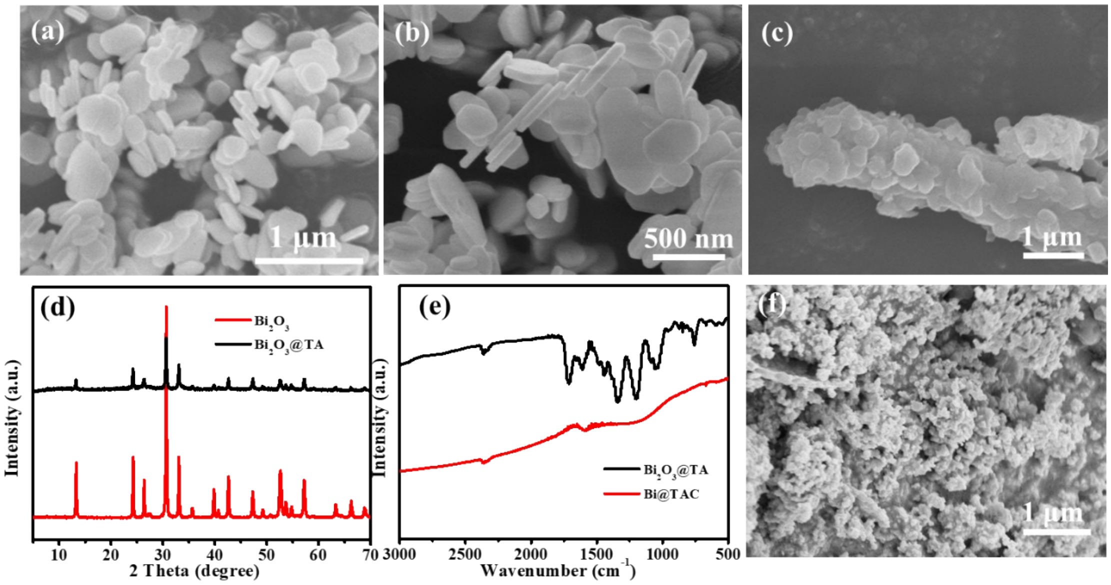

Fig. S1 SEM images of (a, b) Bi_2O_3, (c) Bi_2O_3@TA, (d) XRD and (e) IR spectra of Bi_2O_3@TA and Bi_2O_3@TAC, (f) SEM image of pure Bi.

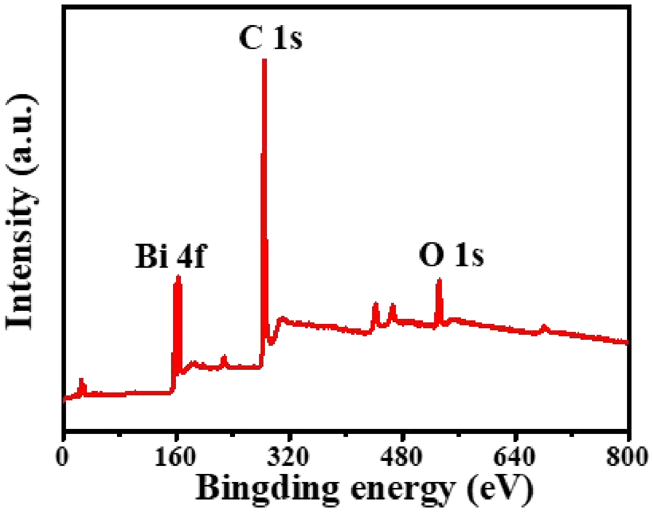

Fig. S2 XPS survey spectrum of the Bi@TAC composite.

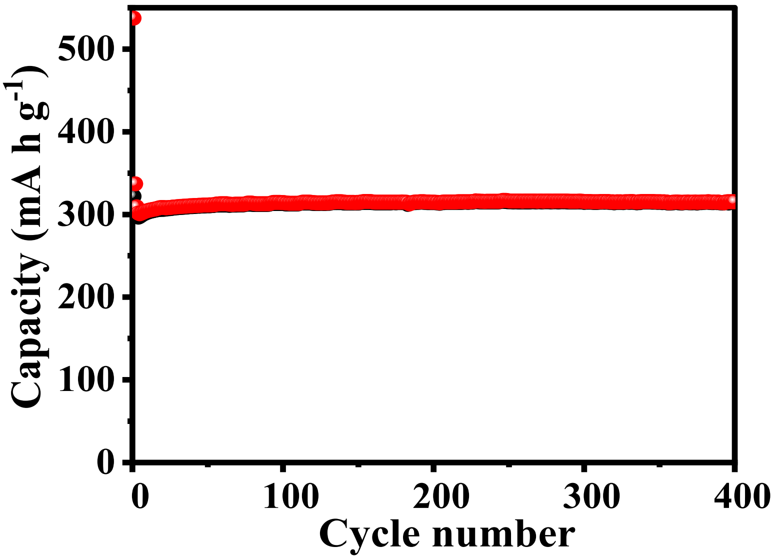

Fig. S3 The cycling performance at 0.5 A g^{-1} of pure Bi.

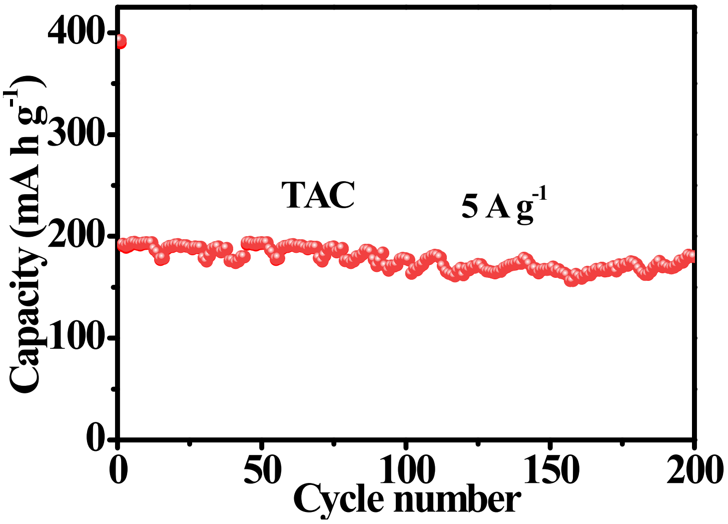

Fig. S4 The cycling performance at 5 A g^{-1} of TAC.

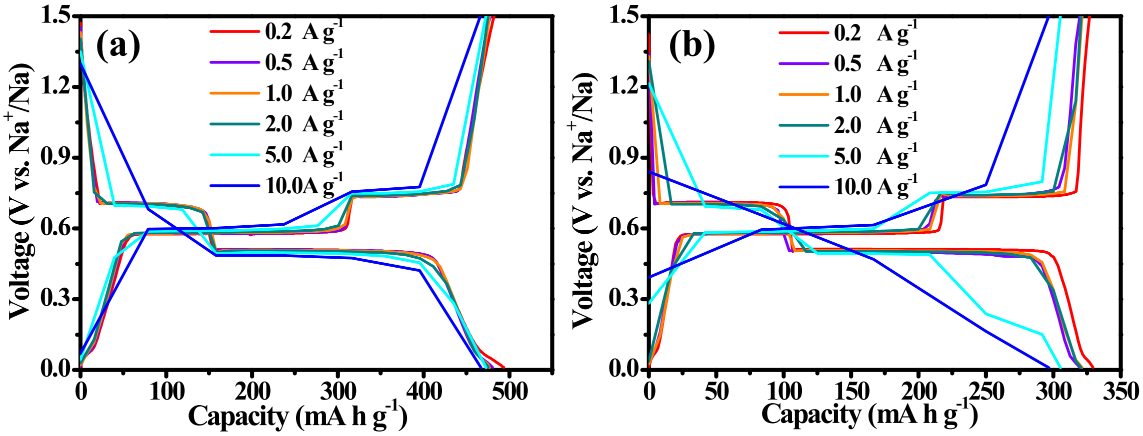

Fig. S5 Charge-discharge curves of (a) the Bi@TAC and (b) pure Bi at different current densities.

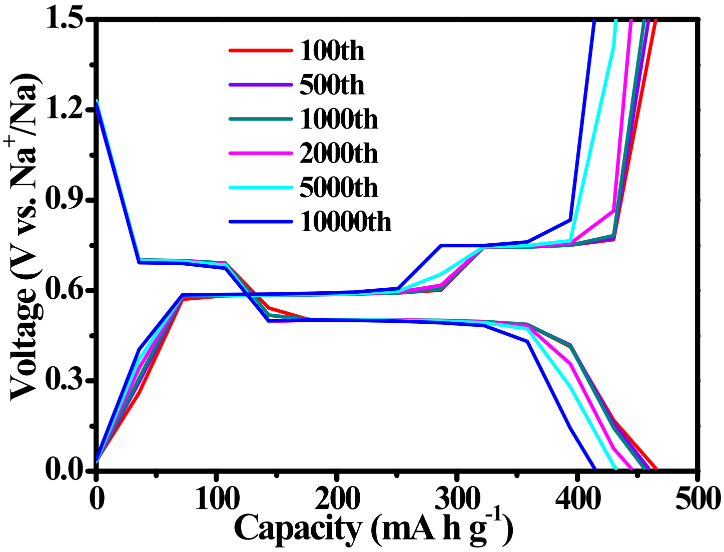

Fig. S6 Selected charge/discharge curves of Bi@TAC at 5.0 A g^{-1}.

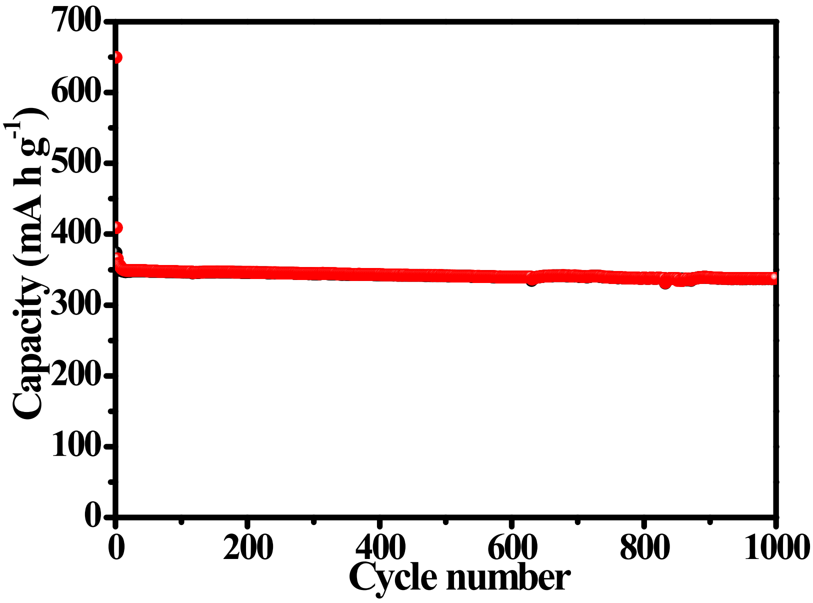

Fig. S7 The long-term cycling performance of Bi@TAC with a high mass loading of 4.0 mg cm^{-2} at 5.0 A g^{-1}.

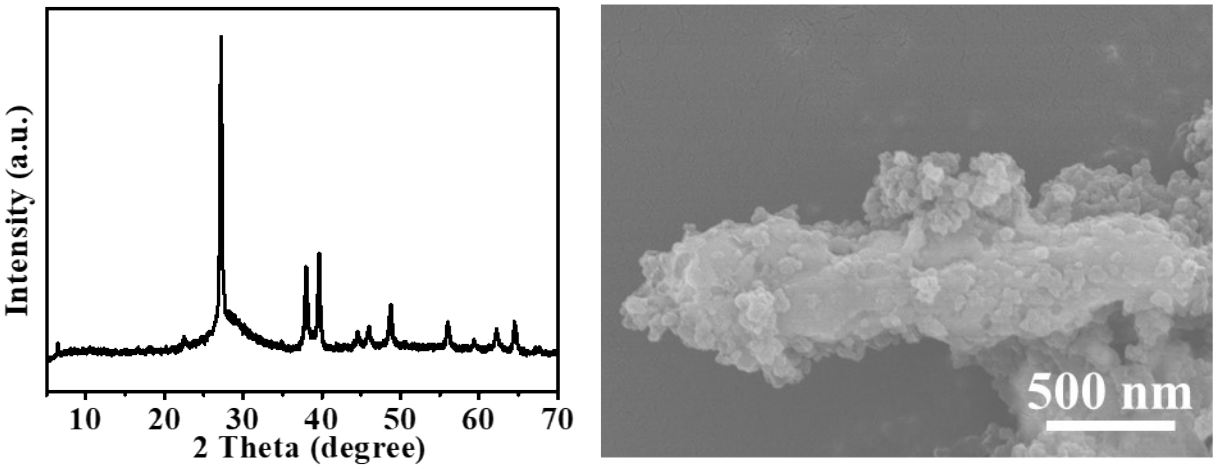

Fig. S8 the XRD pattern and SEM image of Bi@TAC after 1000 cycles.

Table S1. Comparison of the electrochemical properties of Bi-based anode materials for SIBs

Materials	Voltage window	Current rate (A g^{-1})	Capacity (mA h g^{-1})	Cycle number	References
Bi@TAC	**0.01-1.5**	**0.5** **5.0**	**462.3** **414.8**	**400** **10000**	**Our work**
Bi@C⊂CFs	0.01-1.5	1.0 5.0	325 305	1000 5000	*Adv. Mater.,* 2022, 2202673
Bi@LNPC	0.01-1.5	1.0 10.0	325.4 282.6	4000 13000	*Rare Metal,* 2023,**43,** 1037
Bi@NC	0.01-1.5	1.0 5.0	403.2 394.0	200 1000	*J. Energy Storage.,* 2021, **99**, 113395
Bi@N-C	0.01-1.5	1.0 10.0	300 235	400 2000	*Adv. Funct. Mater.,* 2019, **29**, 1809195
HTO@Bi-TAF	0.1-3.0	1.0 2.0	226.9 205.1	2000 1000	*J.Colloid Interface Sci.,* 2024, **679**, 624
Bi@C-NSA	0.01-1.5	0.05 1.0	343.7 315.7	200 1500	*Adv. Energy Mater.,* 2024, 2401833
Bi NS/CNTs	0.01-1.5	0.10 1.0	383.7 311.6	200 1000	*J. Power Sources.,* 2022, **540**, 231639
Bi_2O_3/Bi@CSs-35	0.01-1.5	1.0 5.0	360.5 345.7	200 4000	*Chem. Eng. J.,* 2024, **498**, 155545
Bi@NC	0.01-1.5	0.20 2.0	384.8 326.9	400 5000	*J. Mater. Chem. A.,* 2021, **9**, 22048