Supporting Information

Tannic acid-assisted surface encasing of bismuth nanoparticle on carbon felt for high-performance vanadium redox flow batteries

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Supplementary Figures

Fig. S1 The digital photos of pristine carbon felt (CF) and bismuth nanoparticles-loaded CF (CF-Bi).

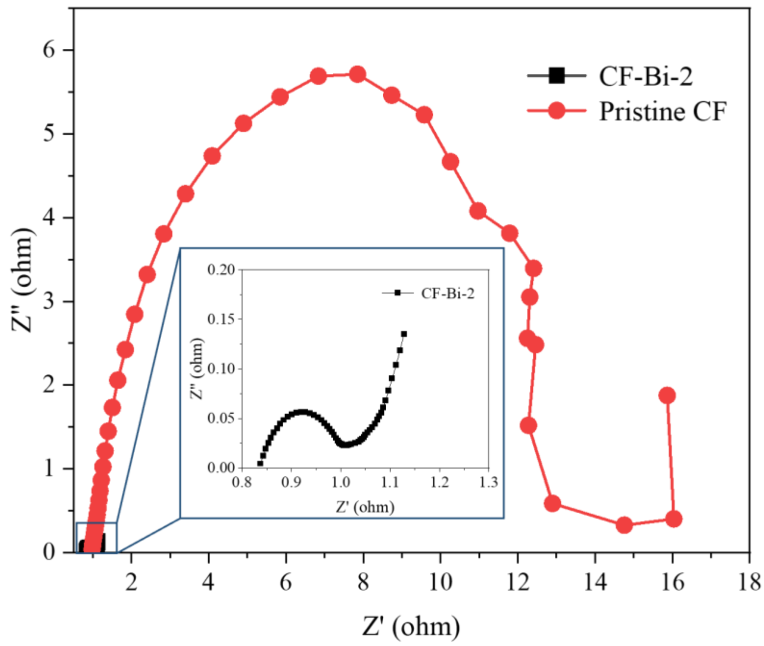

Fig. S2 The electrochemical impedance spectroscopy (EIS) diagrams of the pristine carbon felt and CF-Bi-2.

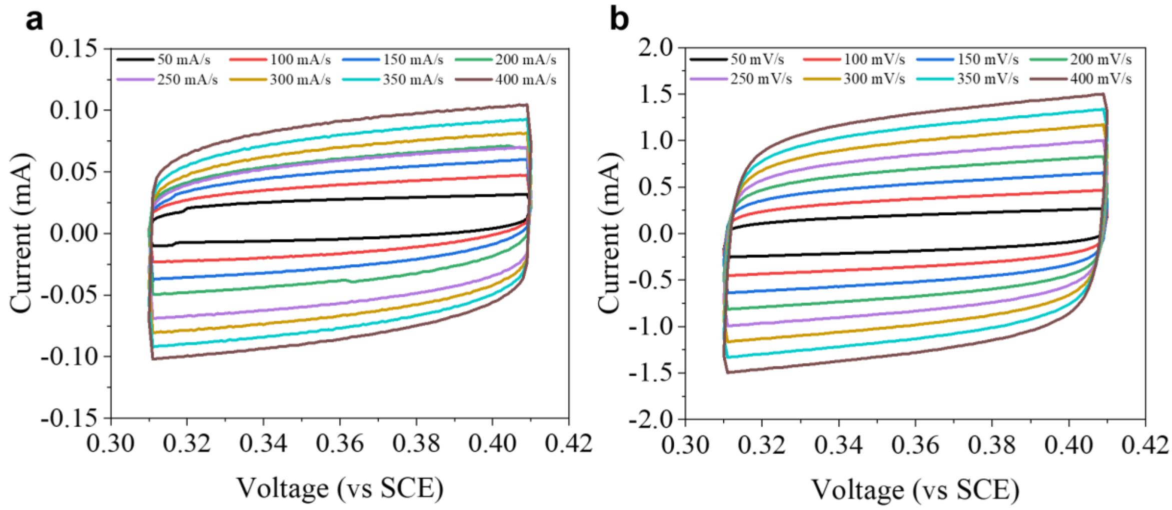

Fig. S3 Cyclic voltammetry curves for determining electrochemical active surface area (ECSA) of (a) Pristine CF and (b) CF-Bi-2.

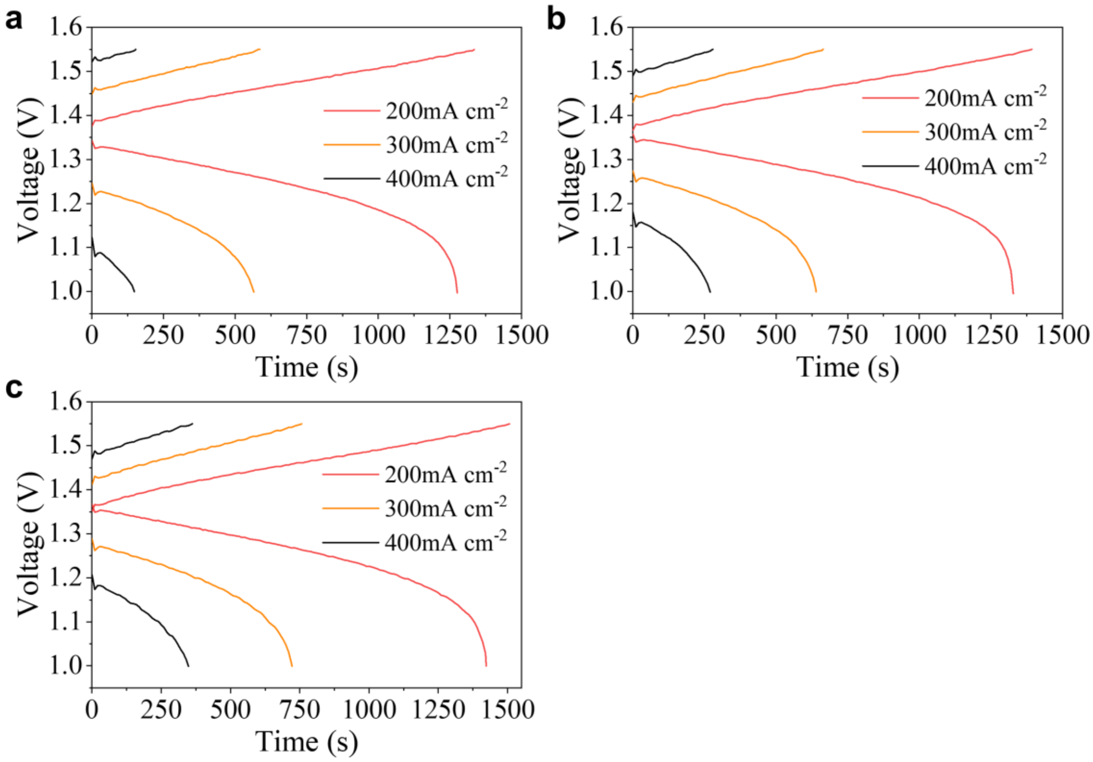

Fig. S4 The charge-discharge curves of pristine CF (a), CF-Bi-1 (b), and CF-Bi-3 (c), in which the mass ratio of $Bi(NO_3)_3 \cdot 5H_2O$/tannic acid is 1.5 and 2.5 for preparation of CF-Bi-1 and CF-Bi-3, respectively.

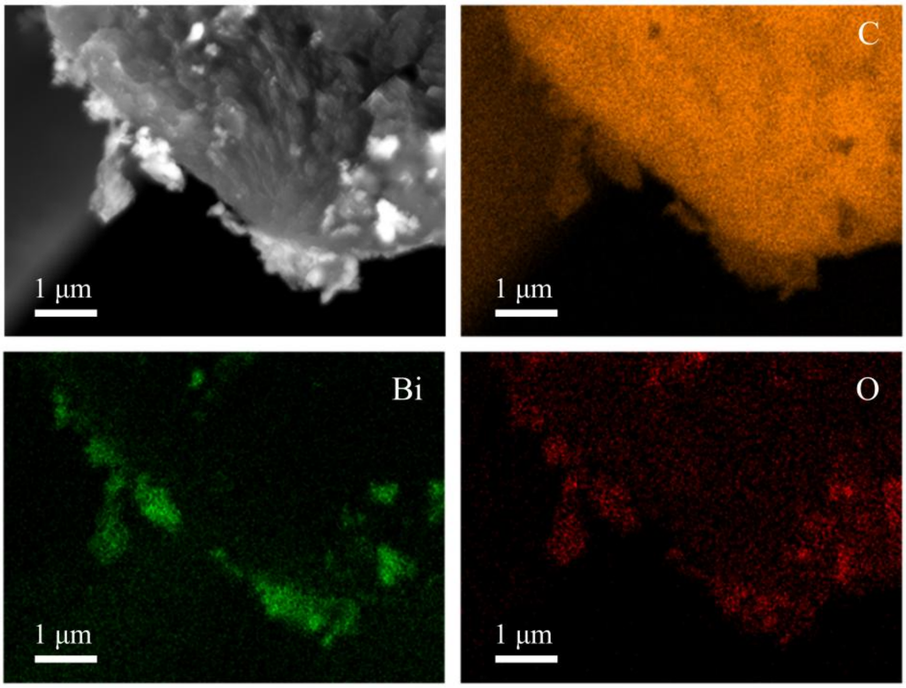

Fig. S5 EDS elemental mapping images of a cross-section view of semi-embedded Bi NPs decorated carbon fiber, in which the Bi NPs decorated carbon felt was synthesized through carbothermal reduction.

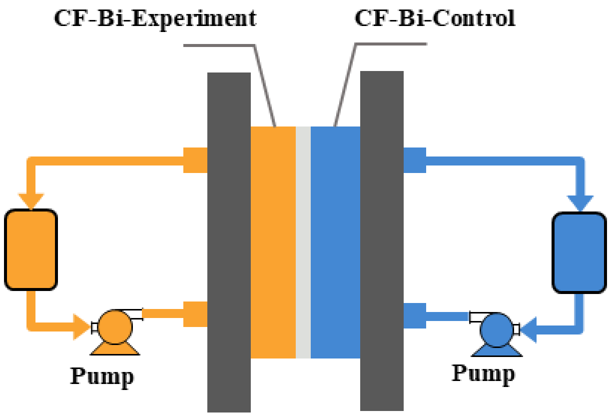

Fig. S6 Schematic diagram of the scouring device. The semi-embedded Bi NPs decorated carbon felt (CF) was synthesized through carbothermal reduction and is referred to as CF-Bi-Control. The encased Bi NPs were prepared via the tannic acid-assisted strategy, which is referred to as CF-Bi-Experiment.

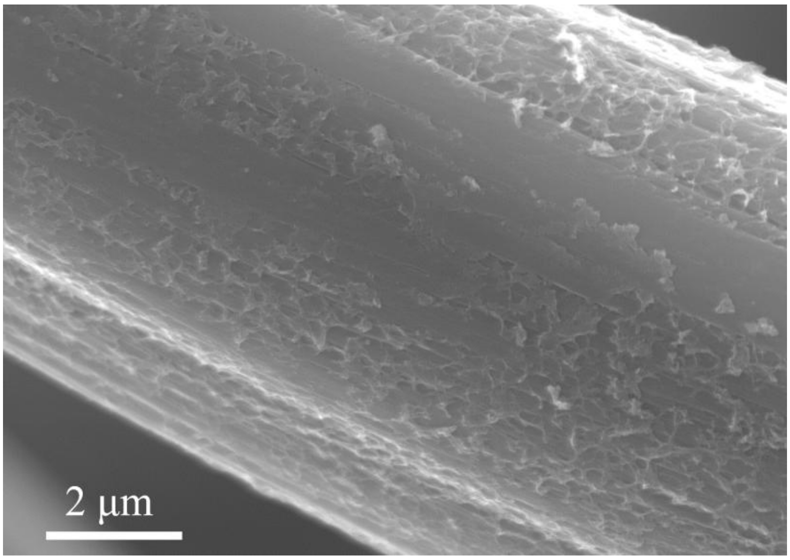

Fig. S7 SEM image of Bismuth nanoparticles after long-term operation

Table S1. Performance comparison between the latest bismuth-based catalytic electrodes and this work.

References	Area (cm^{-2})	Current density ($mA\ cm^{-2}$)	EE (%)	Number of cycles	EE retention (%)
Appl. Energy. **2019**, 240, 226-235.[S1]	~4	480	72.60%	200	NA
Small, **2020.** 16, 1907333.[S2]	~4	480	77.1± 0.2%	1000	98.2%
J. Mater. Chem. A. **2023**, 11, 8700-8709.[S3]	~4	400	70.60%	450	NA
Adv. Mater. **2024**, 36, 2305415.[S4]	~4	400	76.72%	1500	NA
J.Am.Chem.Soc. **2024**, 146, 26024-26033.[S5]		240	81.10%	1500	NA
Electrochim. Acta. **2024**, 473, 143439.[S6]	~9	200	~80.1%	100	NA
Electrochim. Acta. **2025**, 526, 146190.[S7]	~9	200	80.20%	1500	NA
J. Mater. Chem. A. **2025**.[S8]	~16	250	89.7%	1000	NA
This work*	~15	400	72.11%	2000	99.97%

Supplementary References

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