Supplementary information

Zn regulated Bi nanosheet for improving electrochemical CO_2 reduction to formate over a wide potential window

Pin Gao[a], Lan Kang[a], Chao Wen[a], Fanjiao Kong[a], Lin Tao[a], Lihui Dong[a,b], Minguang Fan[a,b], Huibing He[a,b], Bin Li[a,b,*], and Zhengjun Chen[a,*]

[a]Guangxi Key Laboratory of Electrochemical Energy Materials, Guangxi Colleges and Universities Key Laboratory of Applied Chemistry Technology and Resource Development, School of Chemistry and Chemical Engineering, Guangxi University, Nanning 530004, PR China

[b]Guangxi Key Laboratory of Petrochemical Resource Processing and Process Intensification Technology, Guangxi University, Nanning 530004, PR China

Corresponding Authors

*E-mail addresses: binli@gxu.edu.cn (B. Li), zjchen@gxu.edu.cn (Z. Chen).

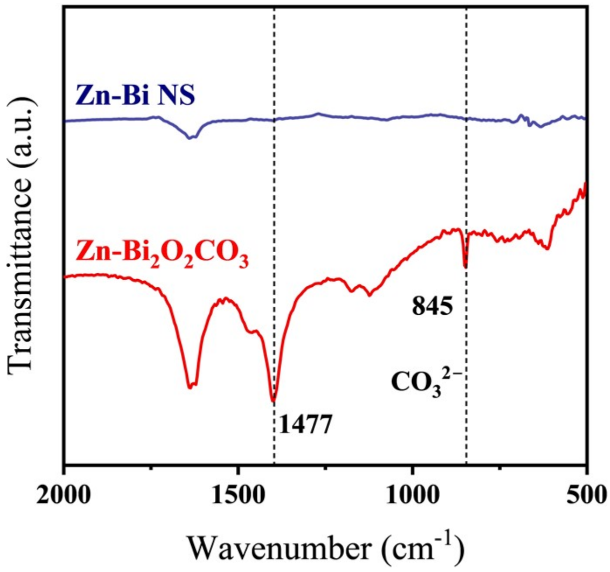

Fig. S1 FT-IR spectrum of Zn-Bi NS and Zn-$Bi_2O_2CO_3$ NS.

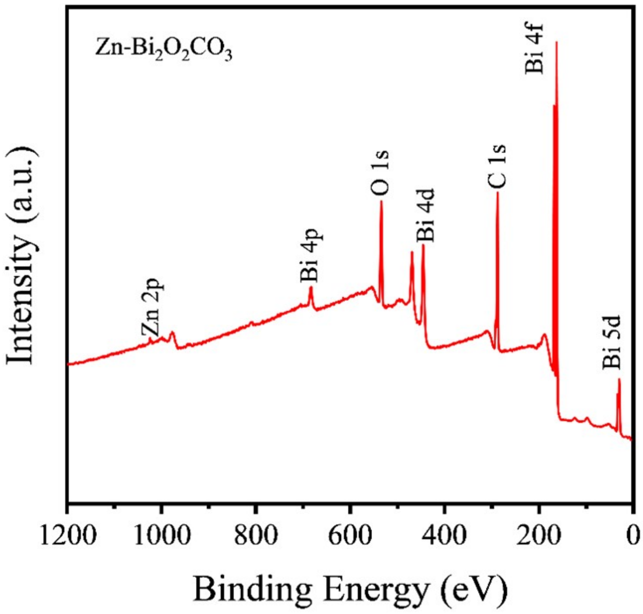

Fig. S2 The XPS survey spectrum of the Zn-$Bi_2O_2CO_3$ catalyst.

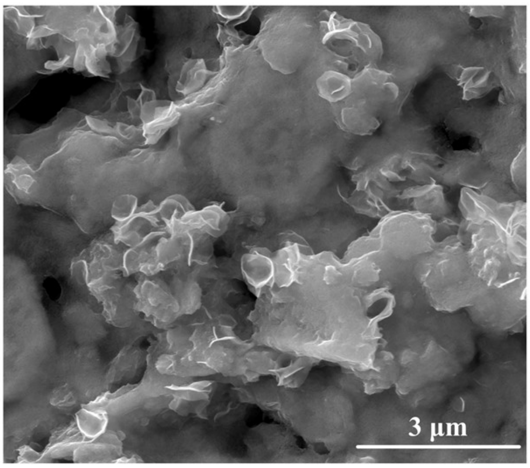

Fig. S3 SEM image of Bi NS catalysts.

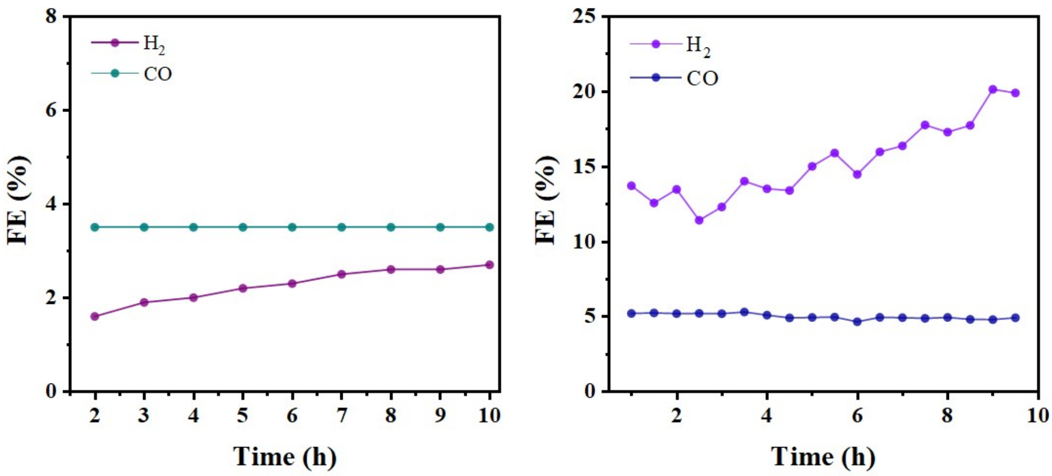

Fig. S4 H_2 and CO FEs of (a) Zn-Bi NS and (b) Bi NS at -1.0 V vs. RHE with the time change.

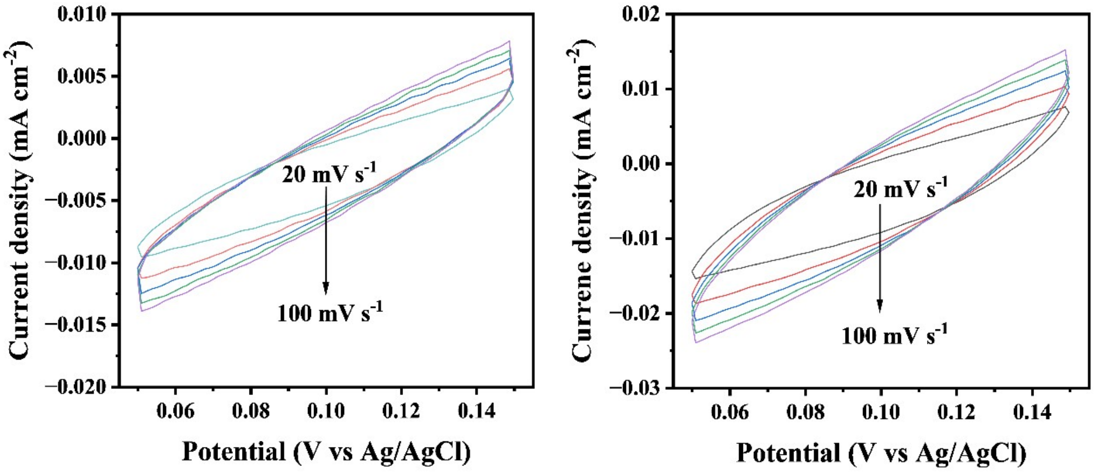

Fig. S5 CV measured at different scan rates from 20 to 100 mV s^{-1} for (a) Bi NS and (b) Zn-Bi NS catalysts.

Table S1. Comparison of the CO_2RR performance of Bi-based electrocatalysts.

Catalysts	Electrolyte	Potential window FE＞90%	Potential at FEmax V vs. RHE	FEmax (%) of formate	J_{HCOOH} (mA cm^{-2})	Ref.
Bi(B)	0.1 M $KHCO_3$	-0.6 to -1.2	-0.90	95%	≈16	1
Bi(Te)$_2$/NCNSs	0.1 M $KHCO_3$	-0.8 to -1.2	-0.90	98%	50	2
Ce-Bi@CeBiO$_x$	0.5 M $KHCO_3$	-1.5 to -1.7V (V vs. SCE)	-1.7V (V vs. SCE)	96%	15.2	3
BiIn$_5$-500@C	0.5 M $KHCO_3$	-0.76 to -0.96	-0.86	97.5%	19.98	4
Bi-OAm	0.5 M $KHCO_3$	-0.8 to -0.96	-0.90	97.1%	32.1	5
Bi-Sb/CP	0.5 M $KHCO_3$	-0.9 to -1.3 (＞80%)	-0.90	88.30%	10	6
Cu$_1$Bi$_2$	0.5 M $KHCO_3$	-0.8 to -1.2 (＞80.18%)	-0.90	96.57%	10.72	7
In$_{16}$Bi$_{84}$ NS	0.5 M $KHCO_3$	-0.84 to -1.54	-0.94	≈100%	14.1	8
LD-Bi	0.5 M $KHCO_3$	-0.87 to -1.17	-0.97	97.4%	27	9
Sn$_{0.8}$Bi$_{0.2}$@Bi-SnO$_X$	0.5 M $KHCO_3$	-0.67 to -0.92	-0.88	95.8	20.9	10
Sn-doped Bi	0.5 M $KHCO_3$	-0.8 to -0.97	-0.93	95.5%	30	11
Au$_2$Bi/Bi NPs	0.5 M $KHCO_3$	---	-0.9	78.9%	11.1	12
S-Bi/Ag	0.5 M $KHCO_3$	-0.8 to -1.1	-1.0	94.7%	28.1	13
Bi-Cu$_2$S	0.1 M $KHCO_3$	-1.0 to -1.2	-1.0	92.4%	18.2	14
Zn-Bi NS	0.5 M $KHCO_3$	-0.8 to -1.2	-1.2	94.6%	40.5	This Work

References

1 X. Chen, H. Chen, W. Zhou, Q. Zhang, Z. Yang, Z. Li, F. Yang, D. Wang, J. Ye and L. Liu, *Small*, 2021, **17**, e2101128.

2 R. X. Cui, Q. Yuan, C. Zhang, X. Yang, Z. R. Ji, Z. L. Shi, X. Q. Han, Y. Y. Wang, J. Q. Jiao and T. B. Lu, *ACS Catal.*, 2022, **12**, 11294-11300.

3 D. H. Zhuo, Q. S. Chen, X. H. Zhao, Y. L. Jiang, J. Lu, Z. N. Xu and G. C. Guo, *J. Mater. Chem. C*, 2021, **9**, 7900-7904.

4 Y. Y. Guan, X. R. Zhang, Y. X. Zhang, T. N. V. Karsili, M. Y. Fan, Y. Y. Liu, B. Marchetti and X. D. Zhou, *J. Colloid Interface Sci.*, 2022, **612**, 235-245.

5 H. Z. Zheng, G. L. Wu, G. H. Gao and X. X. Wang, *Chem. Eng. J.*, 2021, **421**, 129606.

6 C. Yang, Y. Hu, S. Li, Q. Huang and J. Peng, *ACS Appl. Mater. Interfaces*, 2023, **15**, 6942-6950.

7 H. X. Li, X. Yue, J. Che, Z. Xiao, X. B. Yu, F. L. Sun, C. Xue and J. H. Xiang, *ChemSusChem.*, 2022, **15**, e202200226.

8 D. Tan, W. Lee, Y. E. Kim, Y. N. Ko, M. H. Youn, Y. E. Jeon, J. Hong, J. E. Park, J. Seo, S. K. Jeong, Y. Choi, H. Choi, H. Y. Kim and K. T. Park, *ACS Appl. Mater. Interfaces*, 2022, **14**, 28890-28899.

9 Y. Wang, H. Gong, Y. Wang and L. Gao, *J. Colloid Interface Sci.*, 2022, **611**, 246-254.

10 Q. Yang, Q. Wu, Y. Liu, S. Luo, X. Wu, X. Zhao, H. Zou, B. Long, W. Chen, Y. Liao, L. Li, P. K. Shen, L. Duan and Z. Quan, *Adv. Mater.*, 2020, **32**, 2002822.

11 L. Peng, C. Chen, R. He, N. Xu, J. Qiao, Z. Lin, Y. Zhu and H. Huang, *EcoMat*, 2022, **4**, e12260.

12 Z. Zhu, Z. L. Yu, W. Y. Gao, X. Su, L. W. Chen, Y. C. Hao, S. Q. Wu, D. Liu, X. T. Jing, H. Z. Huang and A. X. Yin, *ChemSusChem.*, 2022, **15**, e202200211.

13 J. Z. Liu, Y. H. Li, Y. T. Wang, C. Q. Xiao, M. M. Liu, X. D. Zhou, H. Jiang and C. Z. Li, *Nano Res.*, 2022, **15**, 1409-1414.

14 X. Han, T. Y. Mou, S. K. Liu, M. X. Ji, Q. Gao, Q. He, H. L. Xin and H. Y. Zhu, *Nanoscale Horiz.*, 2022, **7**, 508-514.