

Supporting Information

Co(OH)₂ nanosheets decorated La-CoP nanorods array for alkaline electrocatalytic hydrogen evolution reaction

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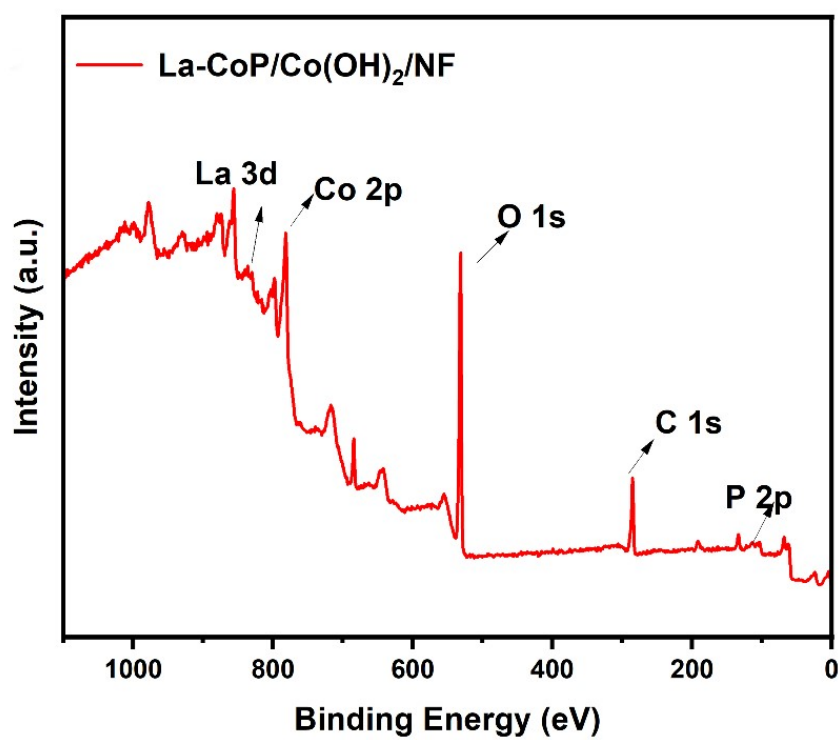


Fig. S1 XPS total spectra of La-CoP/Co(OH)₂/NF.

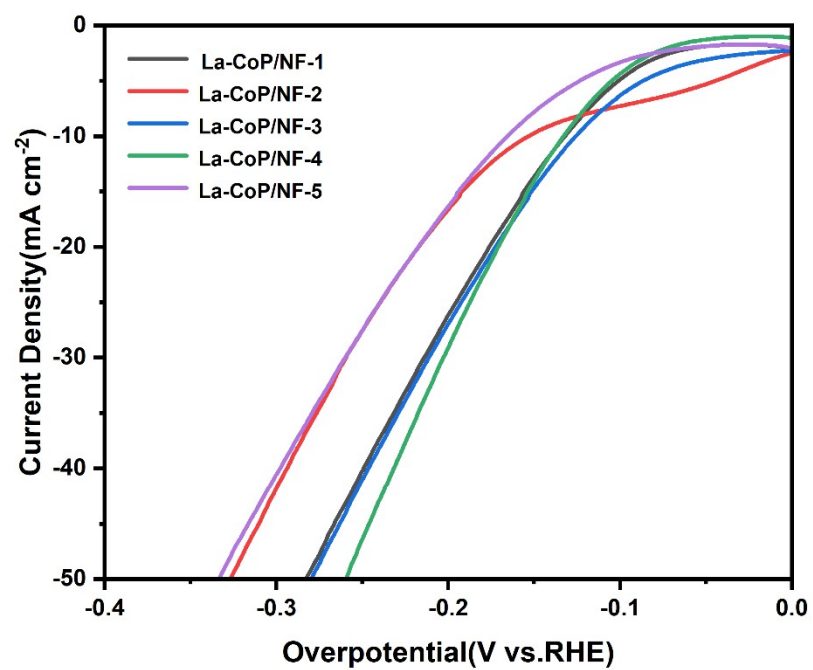


Fig. S2 Polarization curves of different La contents in 1 M KOH.

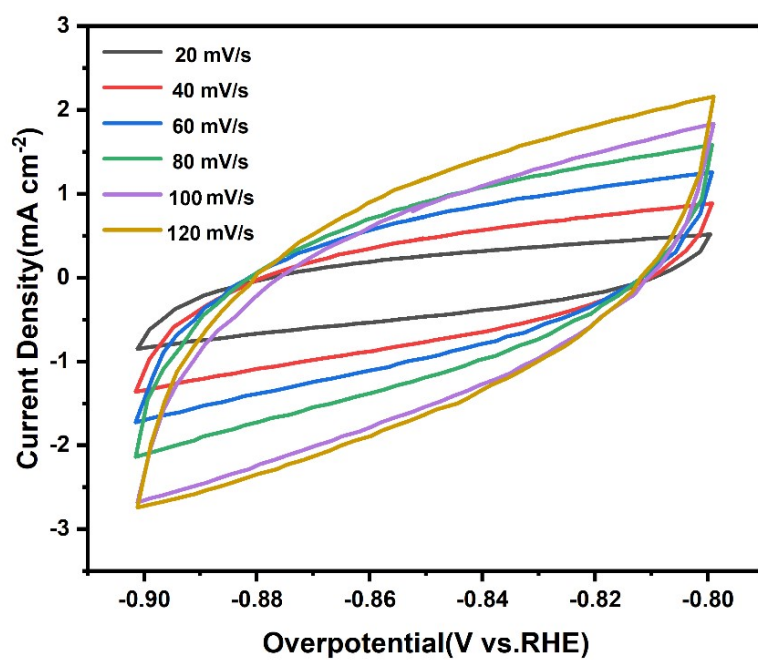


Fig. S3 CV curve of La-CoP/Co(OH)₂/NF in the range of -0.8 V to -0.9 V under alkaline conditions.

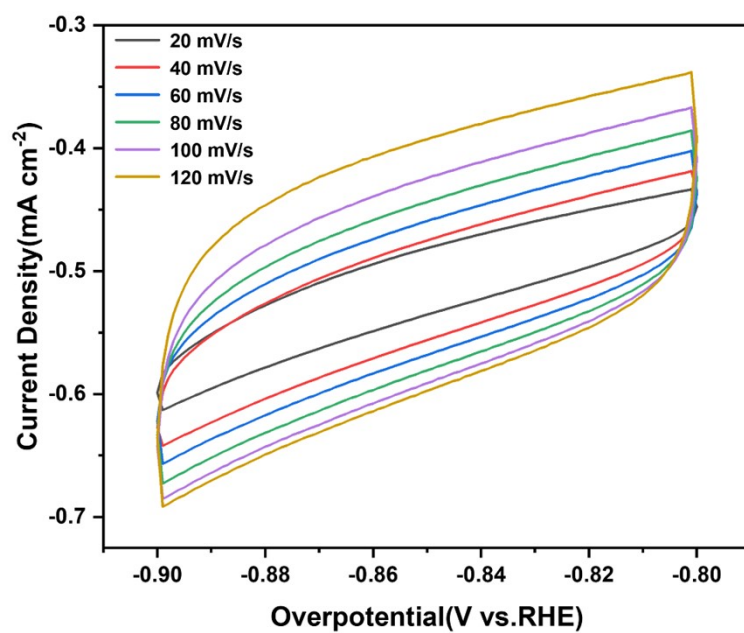


Fig. S4 CV curve of La-Co(OH)₂/NF in the range of -0.8 V to -0.9 V under alkaline conditions.

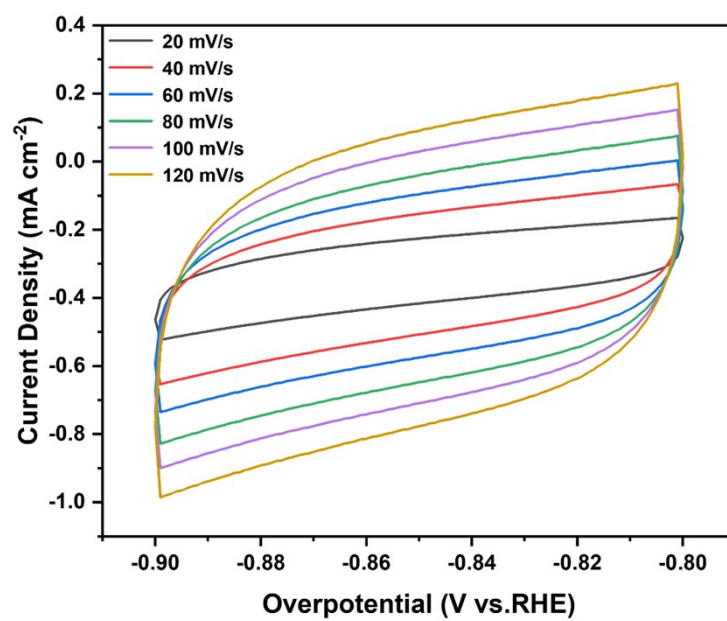


Fig. S5 CV curve of La-CoP /NF in the range of -0.8 V to -0.9 V under alkaline conditions.

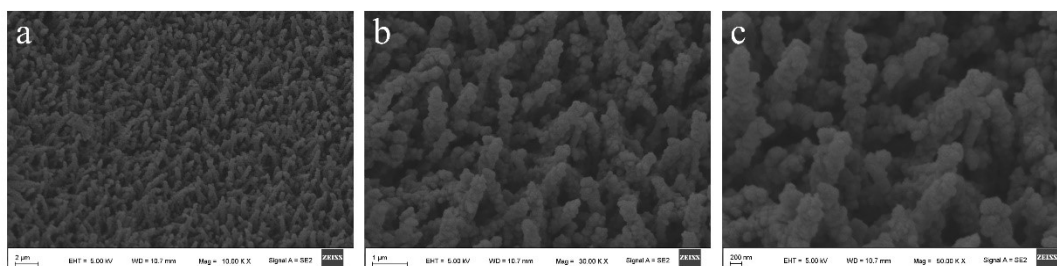


Fig. S6 SEM images La-CoP/Co(OH)₂/NF after HER in 1 M KOH.

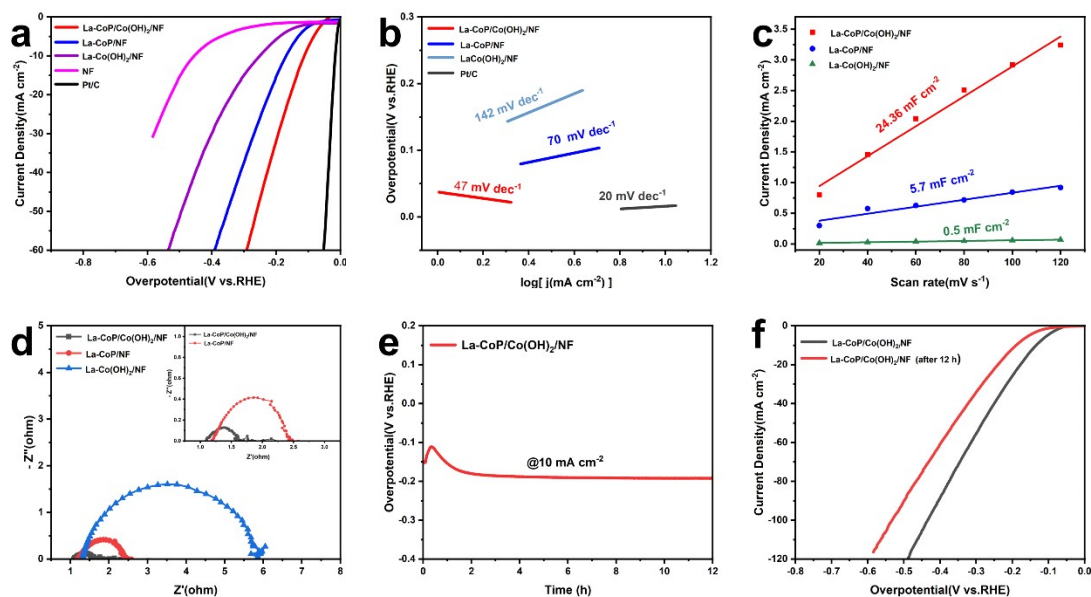


Fig. S7 (a) Polarization curves of La-CoP/Co(OH)₂/NF, La-CoP/NF, La-Co(OH)₂/NF, NF and Pt in 0.5 M H₂SO₄; (b) Tafel slope plots of La-CoP/Co(OH)₂/NF, La-CoP/NF, La-Co(OH)₂/NF and Pt, (c) C_{dl} values of La-CoP/Co(OH)₂/NF; (d) Nyquist plot of La-CoP/Co(OH)₂/NF, La-CoP/NF, La-Co(OH)₂/NF in 0.5 M H₂SO₄ (Inset: Nyquist plot of La-CoP/Co(OH)₂/NF and La-CoP/NF); (e) Chronopotentiometry (CP) long-time stability test at current density of 10 mA cm⁻² for 12 h; (f) LSV curves of La-CoP/Co(OH)₂/NF before and after 12 h.

Table S1 HER parameters of various as-prepared catalysts in 1 M KOH.

Catalyst	η_{10} (mV)	Tafel slope (mV dec ⁻¹)	C_{dl} (mFcm ⁻²)	R_{ct} (Ω)
La-CoP/Co(OH) ₂ /NF	114	99	12.75	1.84
La-CoP/NF	127	126	10.29	3.0
La-Co(OH) ₂ /NF	247	172	7.94	3.47
NF	284	/	/	/

Table S2 Comparison of HER activity of La-CoP/Co(OH)₂/NF (red words) and recently reported other electrocatalysts for HER.

HER catalysts	η_{10} (mV)	Tafel slope (mV dec ⁻¹)	Reference
La-CoP/Co(OH) ₂ /NF	114	99	This work
NiFe LDH@NiCoP/NF	120	88.2	[S1]
Ti/TNTs/CoOP	130	72.5	[S2]
Co ₂ P/CoP@Co@NCNT	118	46	[S3]
CoP-NCN	120	66	[S4]
CoP/Co ₂ P	133	60	[S5]
CoFeP@C/NF-2	119	69	[S6]
HNDCM-Co/CoP	135	66	[S7]
CoP@FeCoP/NC YSMP	141	56.34	[S8]
CoP-NC@NFP	162	84	[S9]
2D-MoS ₂ /Co(OH) ₂	128	76	[S10]
Ni(OH) ₂ /MoS ₂ NFs	155	62.1	[S11]
Ni/Ni(OH) ₂	168	95.7	[S12]

Reference

- [S1] H. Zhang, X. Li, A. Hähnel, V. Naumann, C. Lin, S. Azimi, S.L. Schweizer, A.W. Maijenburg, and R.B. Wehrspohn, *Adv. Funct. Mater.* 2018, 28, 1706847.
- [S2] M. A. Khaled, A. K. Tarek, J. Tahir Naveed, Q. Mohammad and B. Chanbasha, *Electrochim. Acta*, 2023, 456, 142436.
- [S3] L. Zhenjiang, C. Yali, X. Jing, H. Jindou, W. Kun and J. Dianzeng, *Chem. Eng. J.*, 2021, 430, 132877.
- [S4] H. Jia, N. Shang, J. Chen, Q. Yang, M. Su, M. Li and Y. Zhang, *J. Colloid Interface Sci.*, 2021, 601, 338-345.
- [S5] G. Liu, M. Wang, Y. Xu, X. Wang, X. Li, J. Liu, X. Cui and L. Jiang, *J. Power Sources*, 2020, 486, 229351.
- [S6] G. Mengyuan, Q. Fangfang, L. Na, Z. Pingping and S. Wenzhong, *Colloids Surf. A Physicochem. Eng. Asp.*, 2023, DOI: 10.1016/j.colsurfa.2023.131688.
- [S7] H. Wang, S. Min, Q. Wang, D. Li, G. Casillas, C. Ma, Y. Li, Z. Liu, L.-J. Li, J. Yuan, M. Antonietti and T. Wu, *ACS Nano*, 2017, 11, 4358-4364.
- [S8] J. Shi, F. Qiu, W. Yuan, M. Guo and Z.-H. Lu, *Chem. Eng. J.*, 2020, 403, 126312.
- [S9] E. Vijayakumar, S. Ramakrishnan, C. Sathiskumar, Y. Dong Jin, J. Balamurugan, N. Hyun Sung, K. Dawool, K. Young Hoon and L. Haigun, *Chem. Eng. J.*, 2021, 428, 131115.
- [S10] Z.J. Zhu, H.J. Yin, C.T. He, M. Al-Mamun, P.R. Liu, L.X. Jiang, Y. Zhao, Y. Wang, H.G. Yang, Z.Y. Tang, D. Wang, X.M. Chen, H.J. Zhao, *Adv. Mater.*, 2018, 30, 1801171.

- [S11] K.T. Le, N.N.T. Pham, Y.S. Liao, A. Ranjan, H.Y. Lin, P.H. Chen, H. Nguyen, M.Y. Lu, S.G. Lee, J.M. Wu, *J. Mater. Chem. A*, 2023, 11, 3481-3492.
- [S12] D. Lim, S. Kim, N. Kim, E. Oh, S.E. Shim and S.H. Baeck, *ACS Sustainable Chem. Eng.*, 2020, 8, 4431-4439.