

NiMo based bifunctional catalysts for water electrolysis

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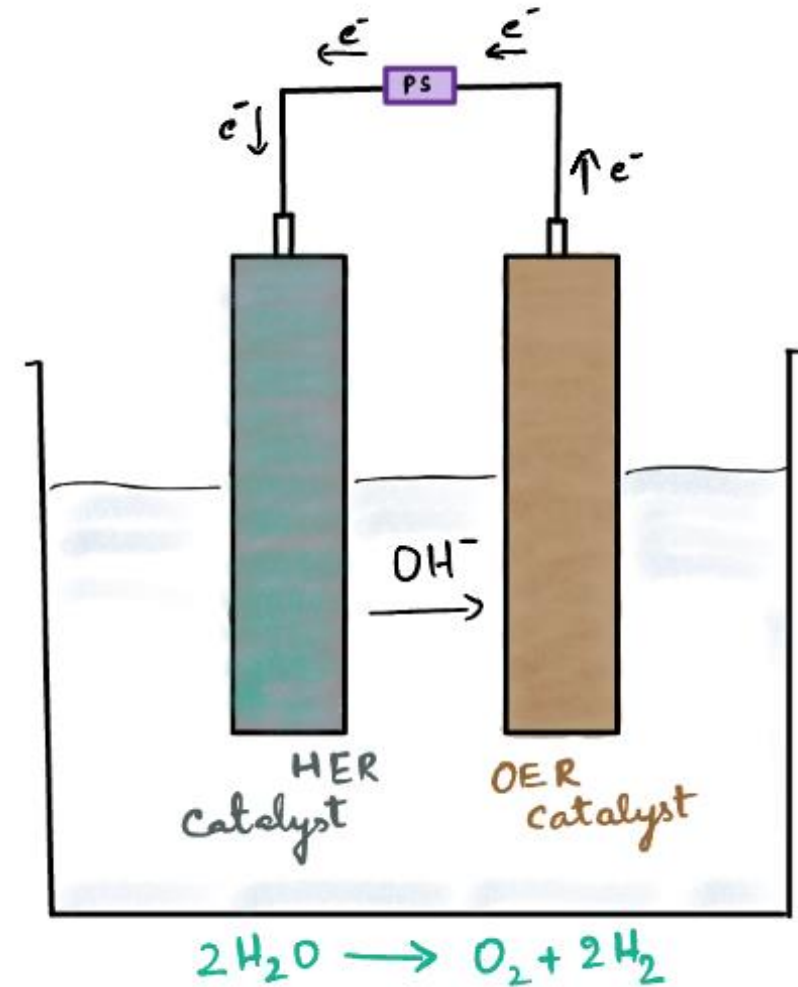
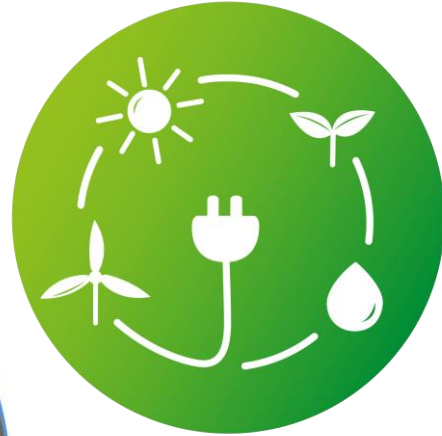
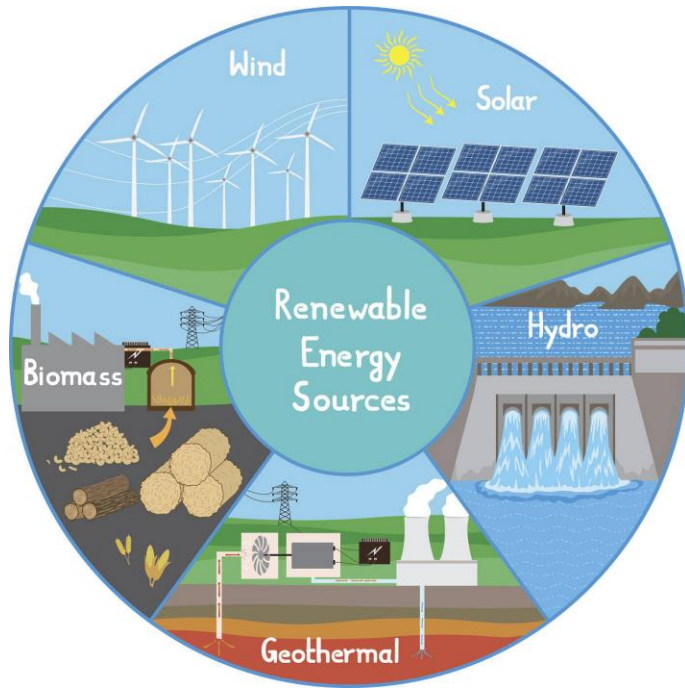
Research Day
February 24, 2024



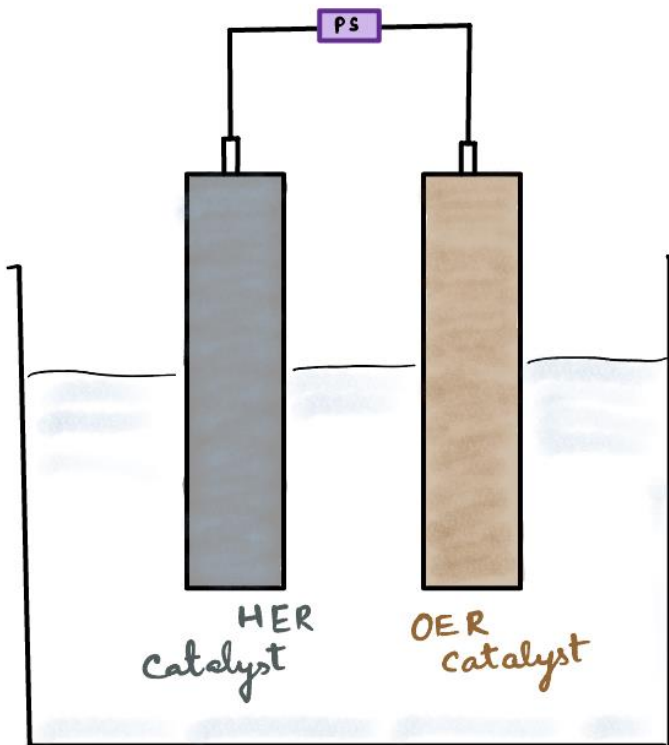
Outline

- Water electrolysis
- Bifunctional catalyst
- Performance
- Morphology study
- Conclusion

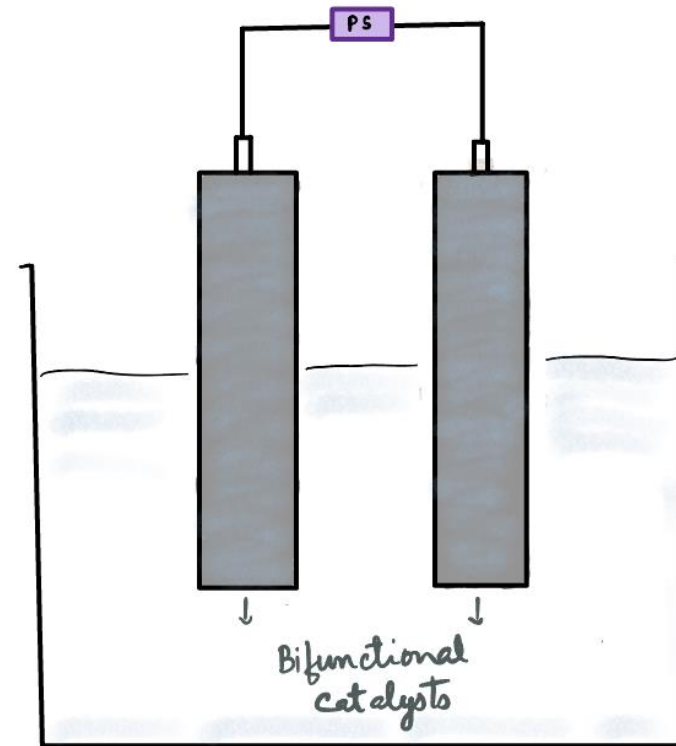
Water electrolysis



Bifunctional catalyst



HER – Hydrogen evolution reaction
OER – Oxygen evolution reaction



Bifunctional – Performs HER and OER simultaneously
Reduces cost of the technology
Simplifies the setup

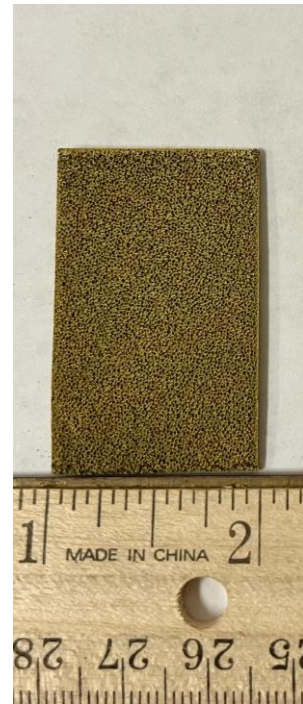
Substrate



Nickel Foam (NF)

Hydrothermal
→
NiMo

Step 1



NiMoO_4/NF
precursor

Deposition
→

NiFe LDH

Immersed in a solution of
 $\text{Ni}(\text{NO}_3)_2$ and FeSO_4
for 1-5h.

Step 2

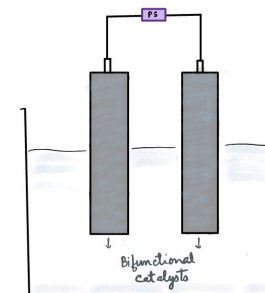
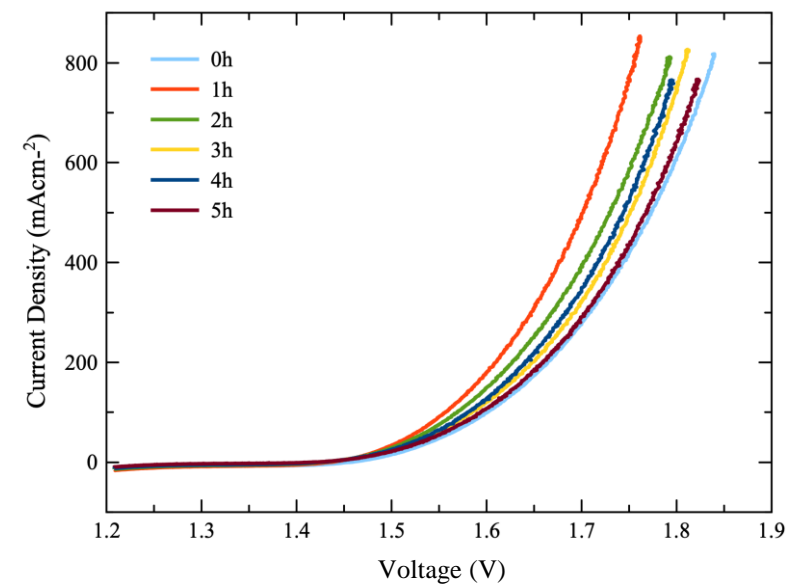
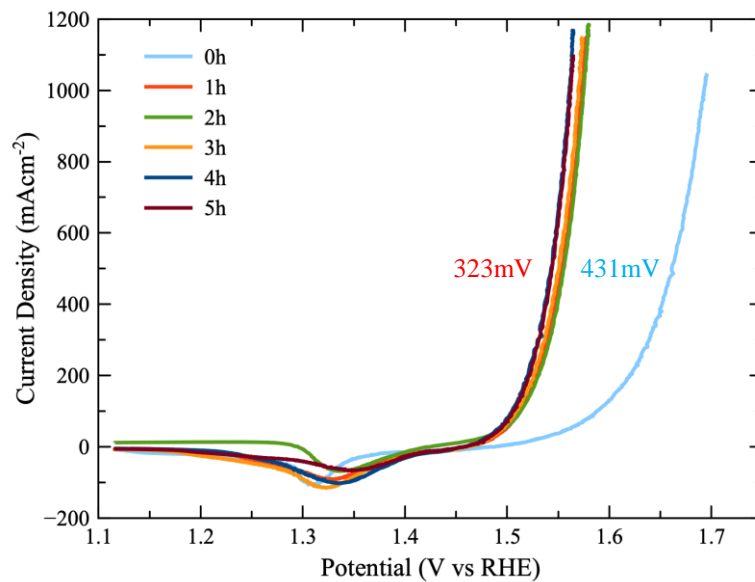
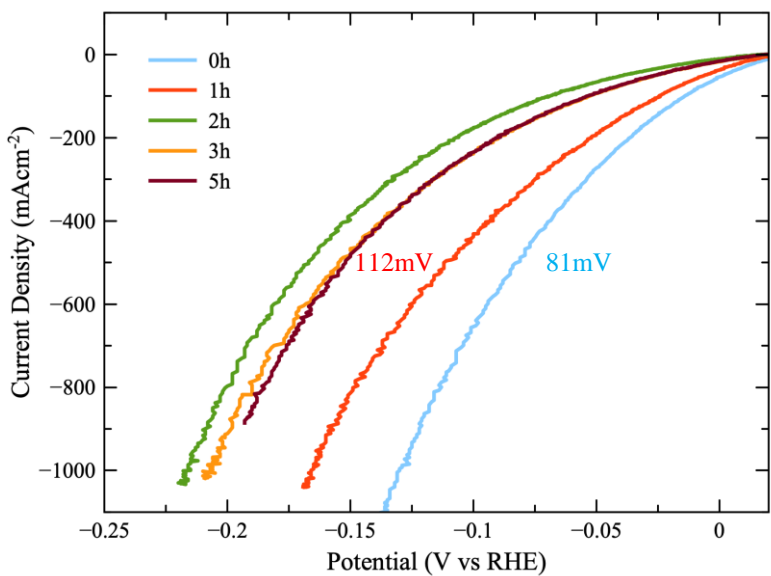


$\text{NiFe LDH}/\text{NiMoO}_4/\text{NF}$
OER

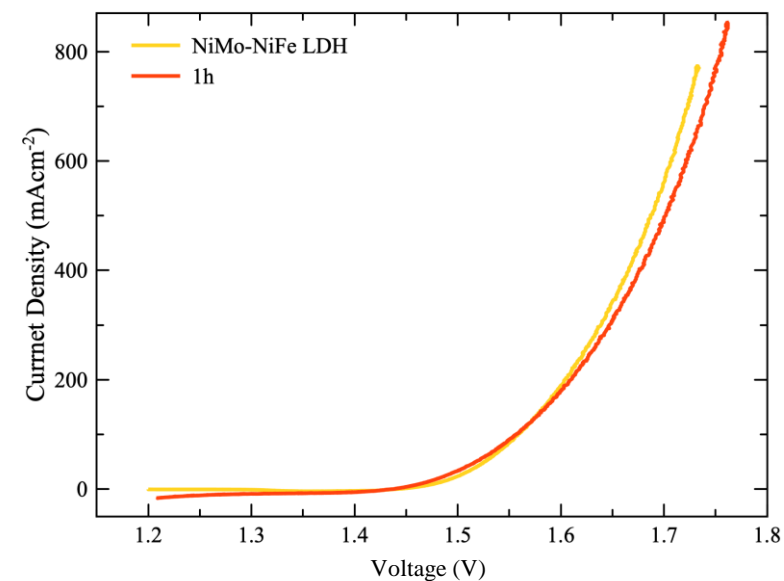
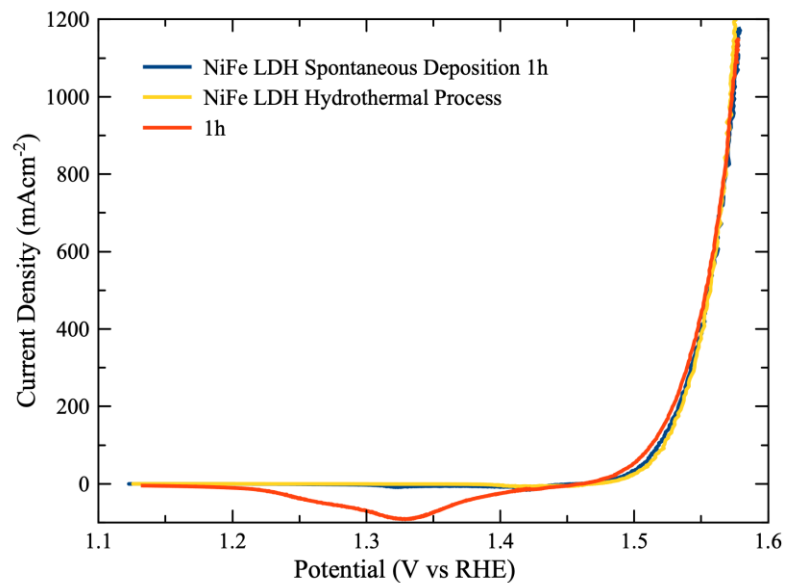
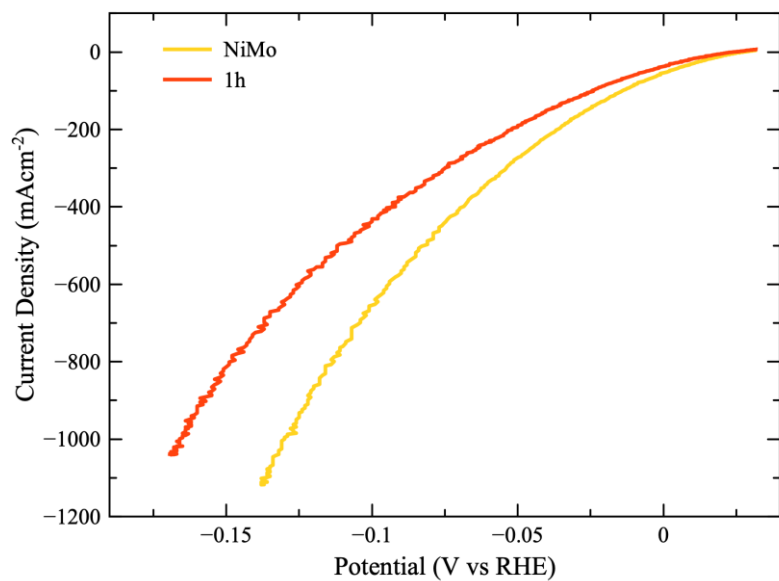
Annealed
→
In H_2/Ar

$\text{NiFe}/\text{MoNi}_4/\text{MoO}_2/\text{NF}$

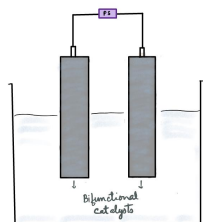
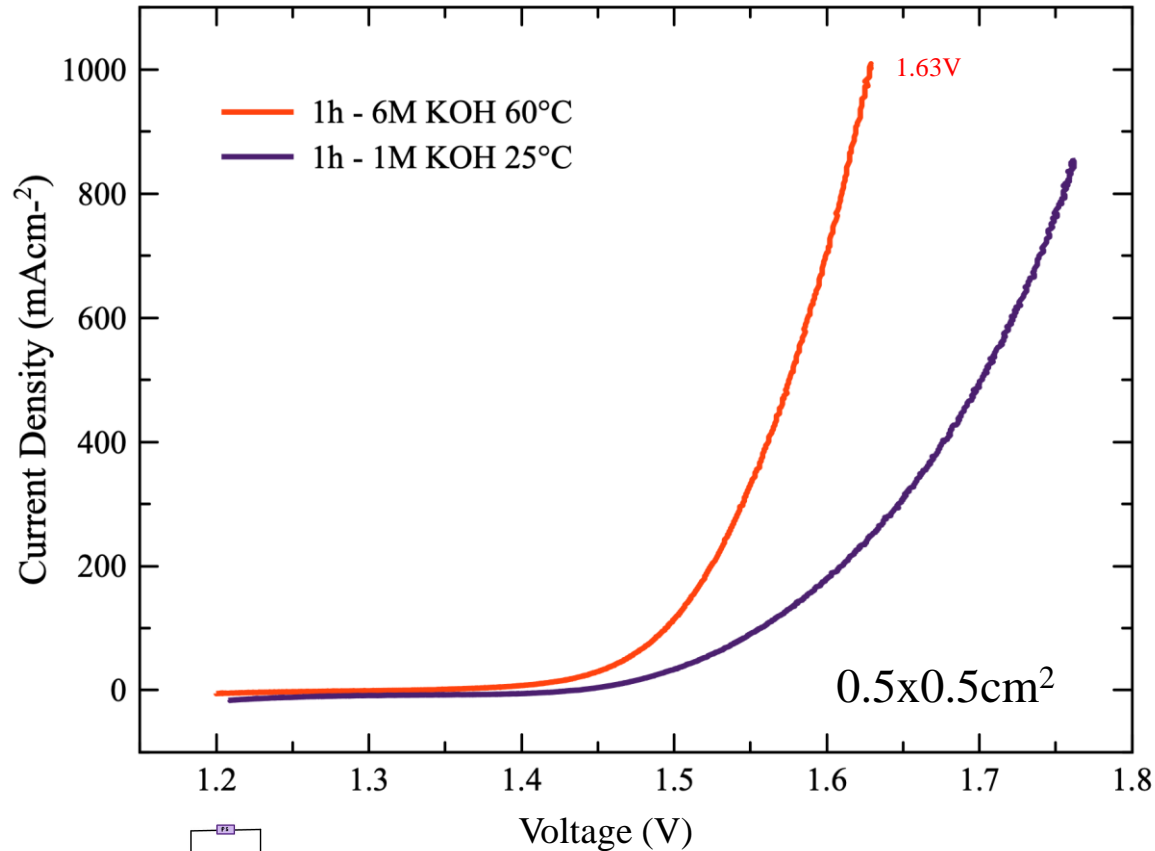
Optimizing Step 2 – OER layer



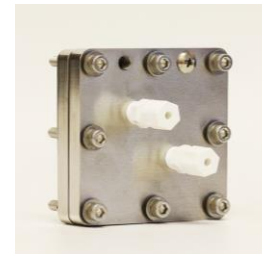
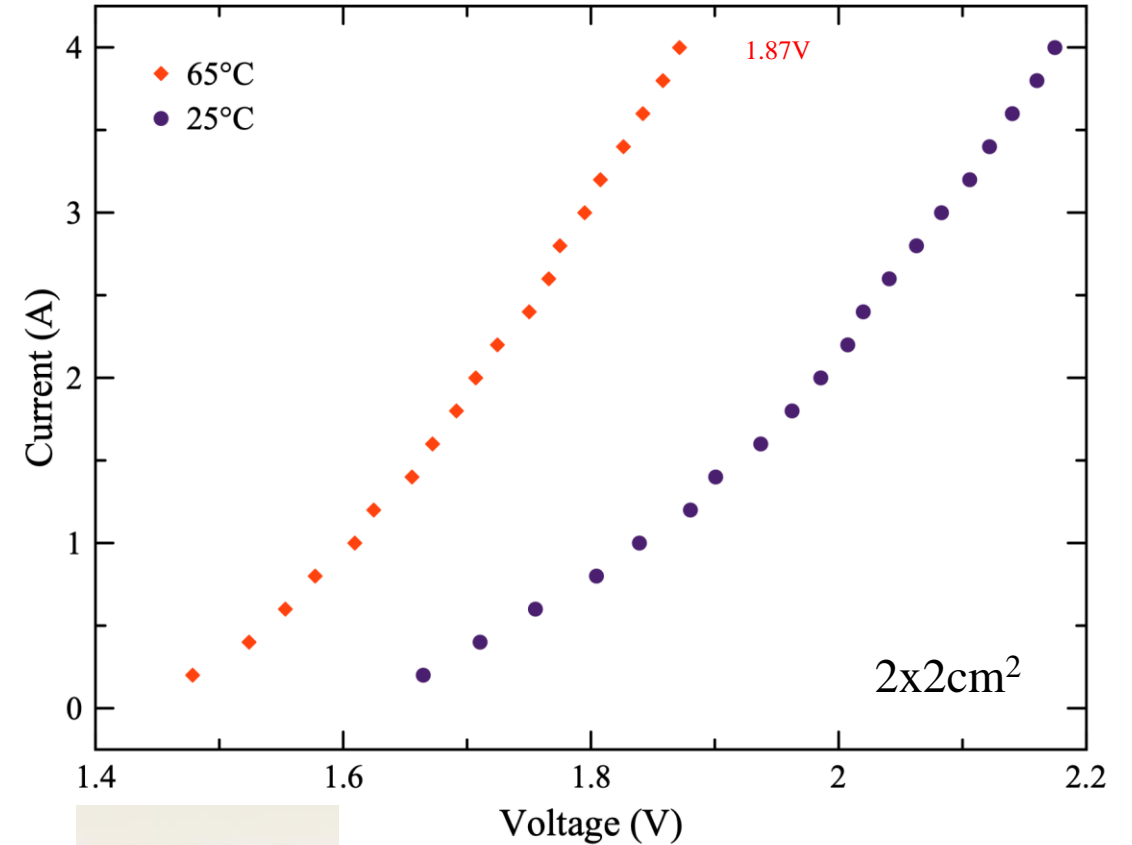
Comparison with benchmarks



Tests under industrial conditions

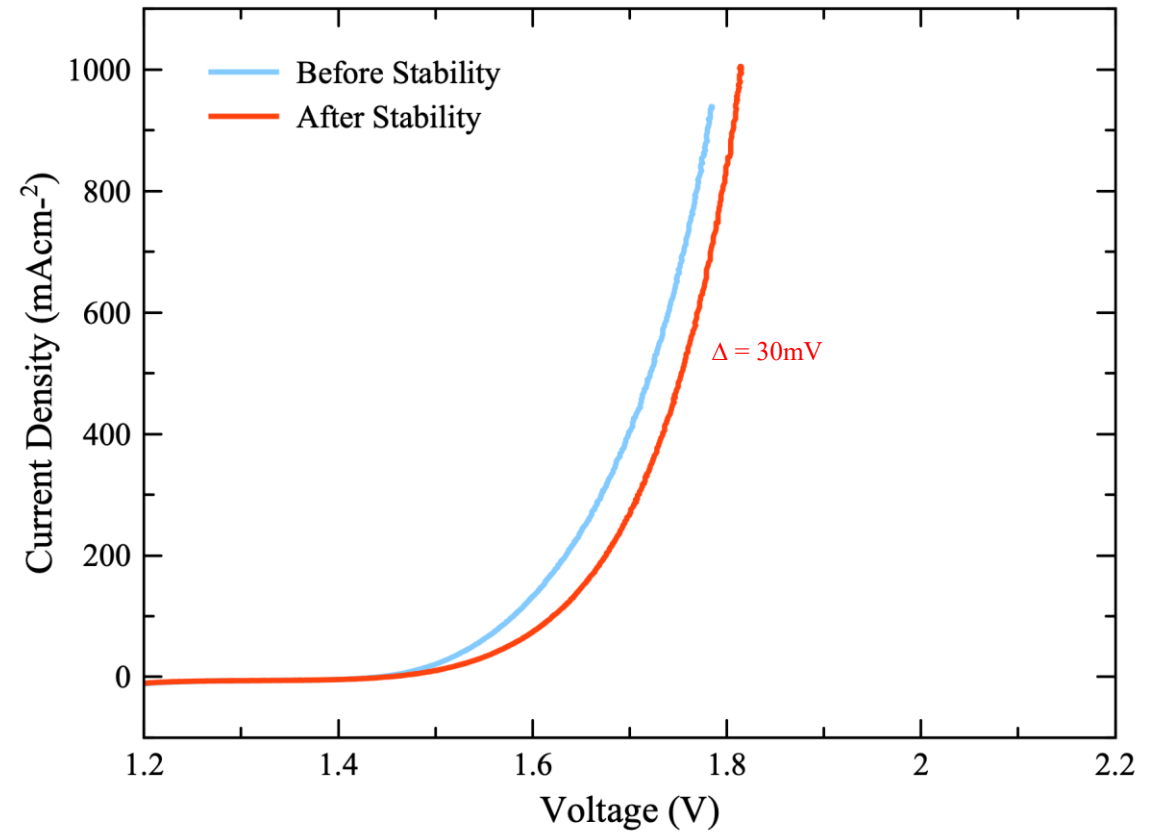
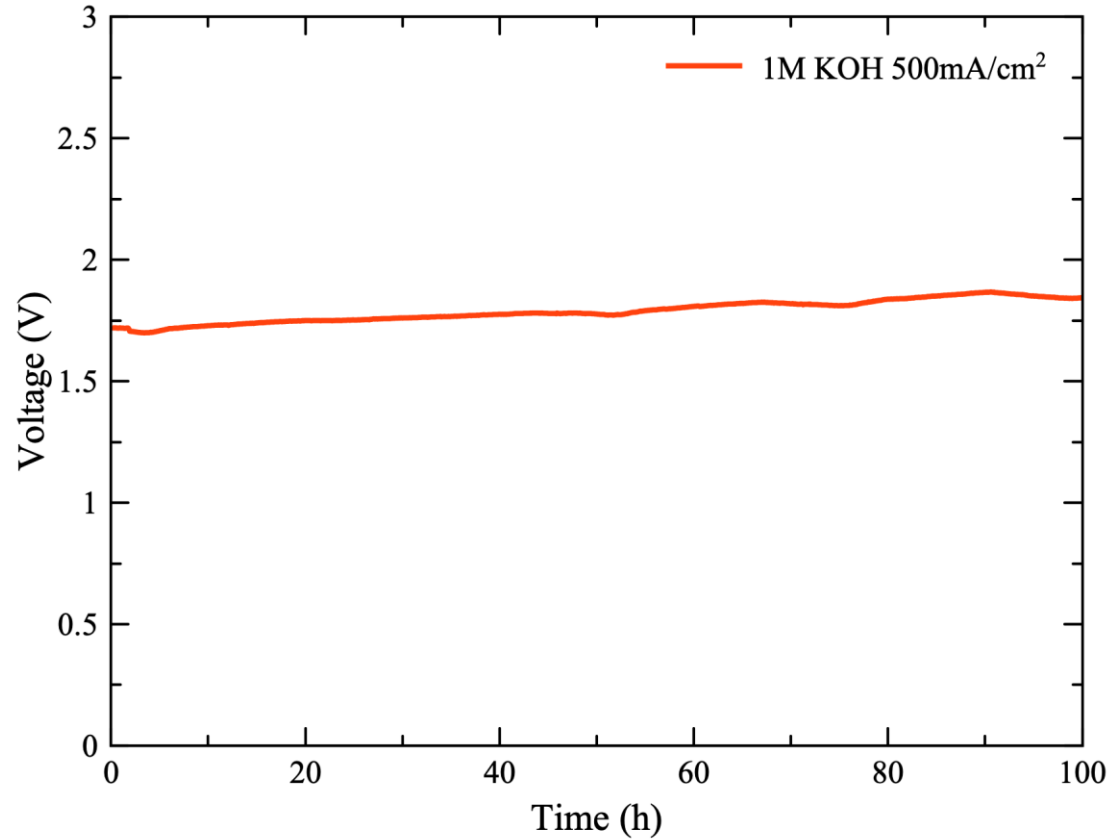


Beaker electrolyzer
With IR compensation



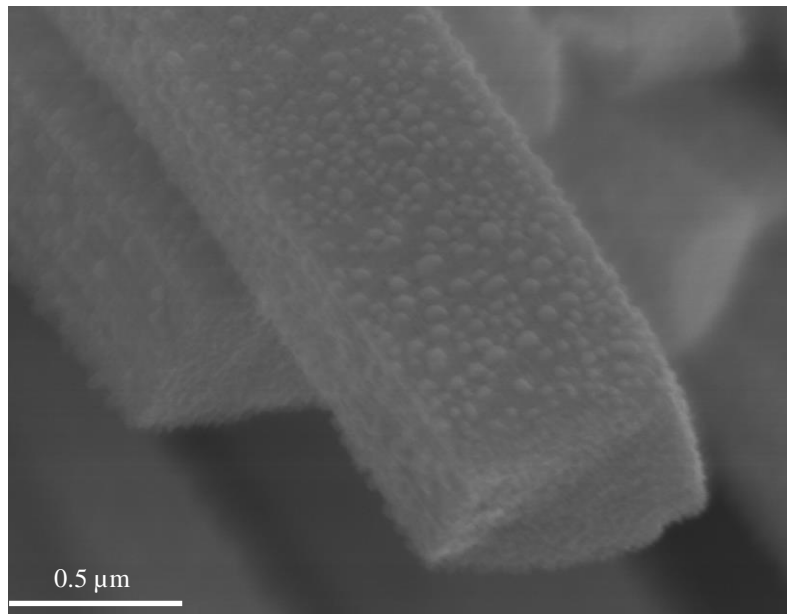
AEM electrolyzer
Without IR compensation

Stability

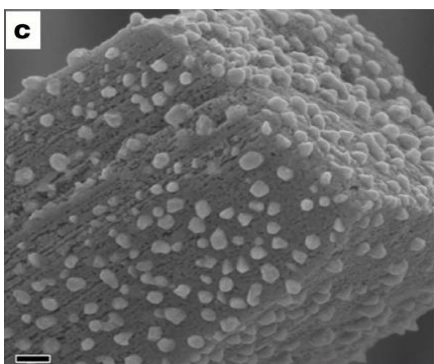
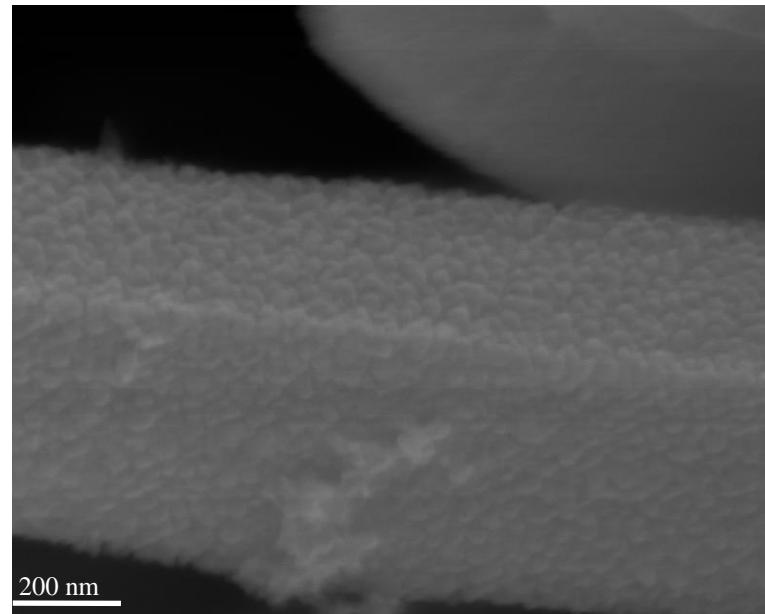


Morphology

0h



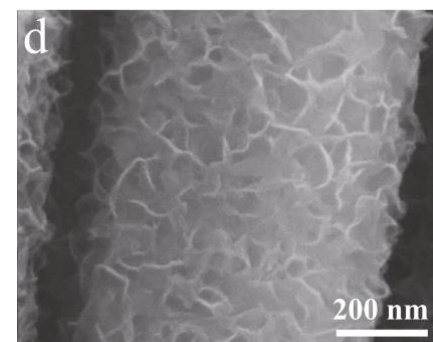
1h



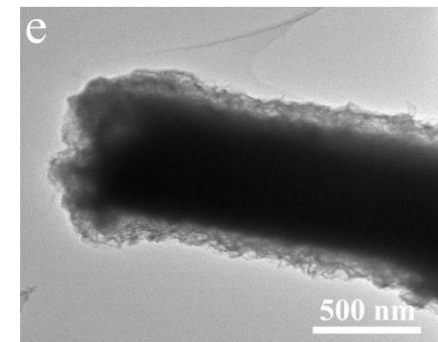
10.1038/ncomms15437 Jian Zhang, 2017



<https://doi.org/10.1016/j.mtphys.2022.100841>
Fanghao Zhang, 2022



<https://doi.org/10.1038/s41467-023-37091-x> Panlong Zhai, 2023



Conclusions and further research

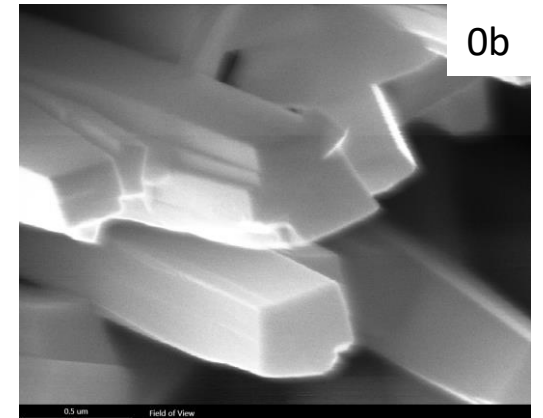
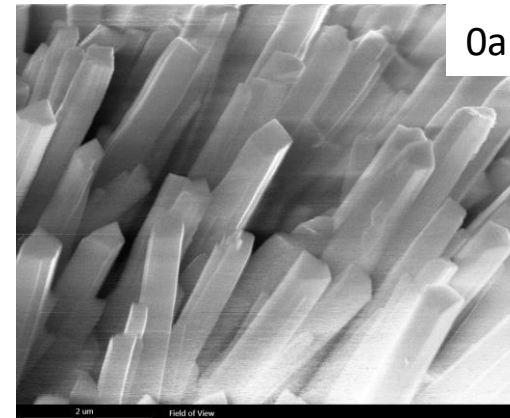
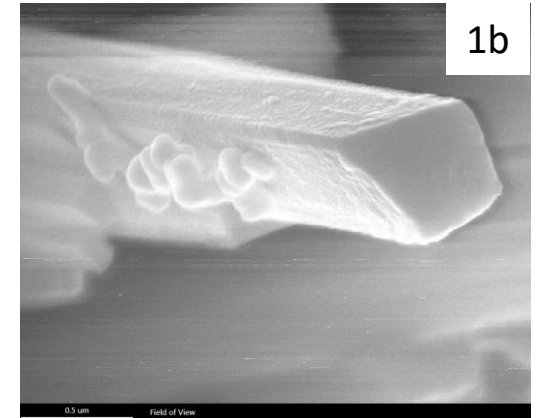
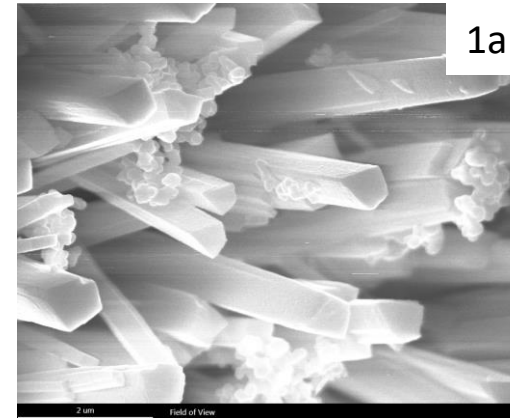
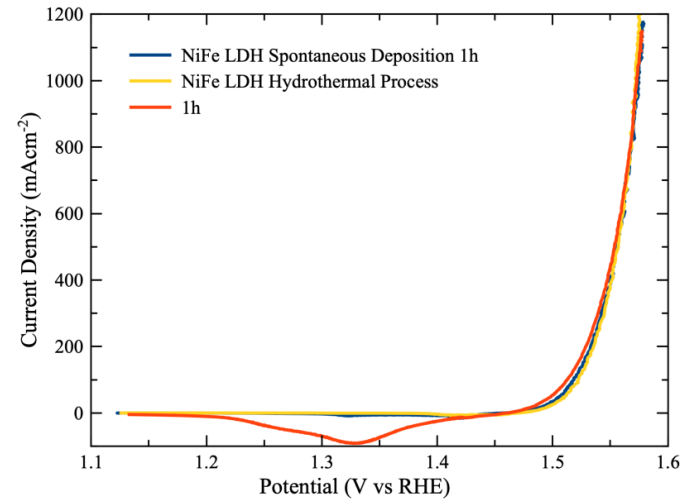
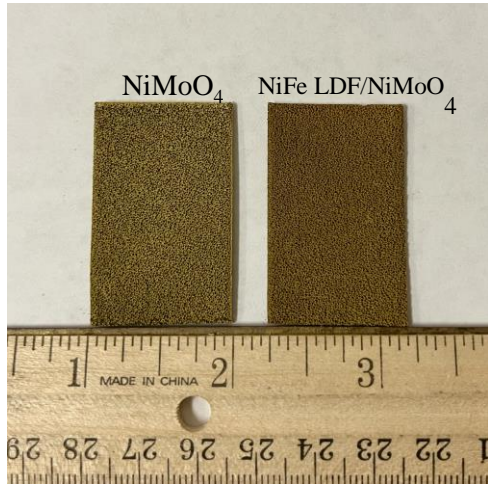
- A bifunctional catalyst with performance comparable to benchmarks was synthesized.
- An industrial AEM electrolyzer was built.
- The catalyst was found to be stable for over 100h.
- Future work will focus on improving the performance further using different methods, especially with electrodeposition to build a core shell structure.

Acknowledgements

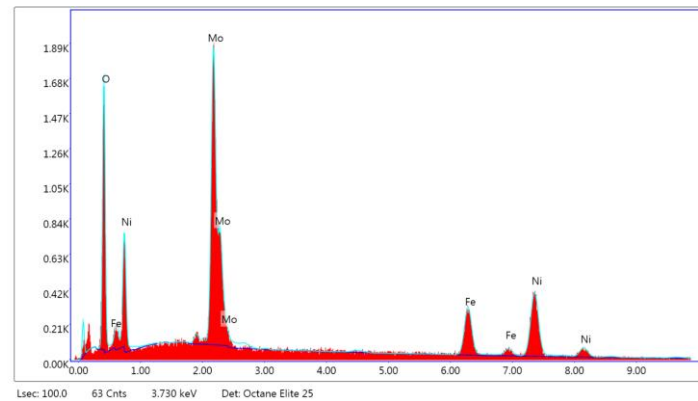
- Dr. Zhifeng Ren
- Dr. Dezhi Wang
- Minghui Ning
- Yu Wang
- Dr. Luo Yu

Thank you!

Supplementary information



	O	Mo	Fe	Ni
At. %	19.2	33.1	14.9	32.9
Wt. %	50.5	14.5	11.2	23.6



Electrodeposition?