Single-Crystal Nitrogen-Rich 2D Mo_5N_6 Nanosheets for Efficient and Stable Seawater Splitting

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Huanyu Jin, Yao Zheng*, Shizhang Qiao*
School of Chemical Engineering and Advanced Materials
The University of Adelaide, SA 5005, Australia
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Abstract

- Seawater is the most abundant water source and electrolyte for low-cost hydrogen production.[1, 2]
- However, the stability of most electrocatalysts for hydrogen evolution reaction (HER) in seawater is poor due to the highly corrosive environment.[3, 4]
- Nitrogen–rich metal nitrides (N/metal > 1) such as Mo_5N_6 are preferable for seawater splitting because of their good corrosion resistance and high activity.[4]

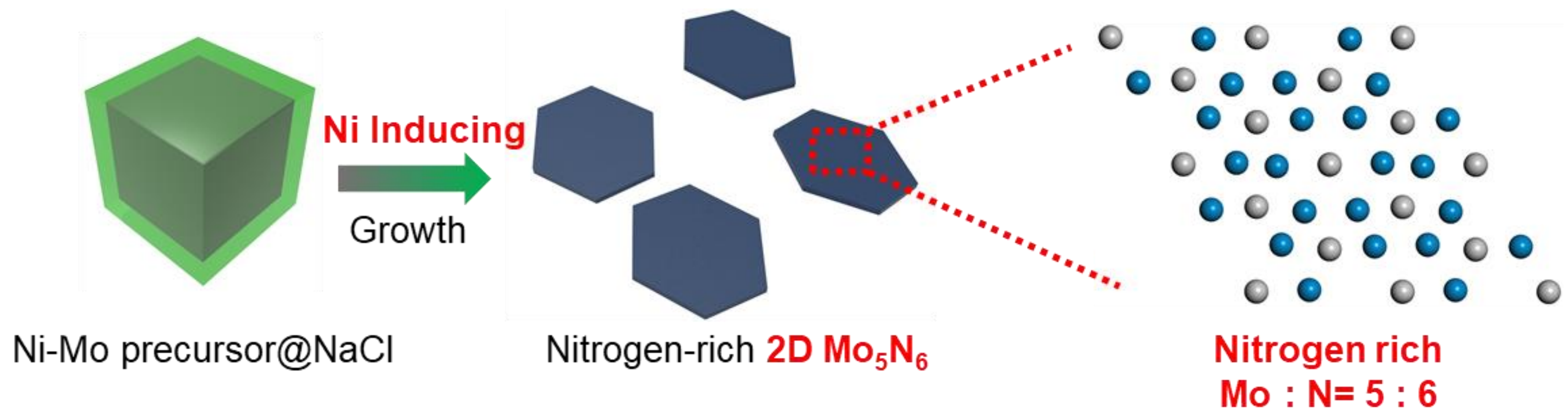

Figure 1. Schematic of the synthesis of Mo_5N_6 nanosheets.

Highlights

- Nitrogen-rich 2D Mo_5N_6 single-crystal nanosheets are synthesized for the first time.[5]
- Excellent HER performance in pH universal electrolytes including natural seawater.
- The performance of 2D Mo_5N_6 for seawater splitting is better than the commercial Pt/C benchmark.

Materials Characterization

- Morphology of 2D Mo_5N_6.
- Electronic structure of 2D Mo_5N_6.

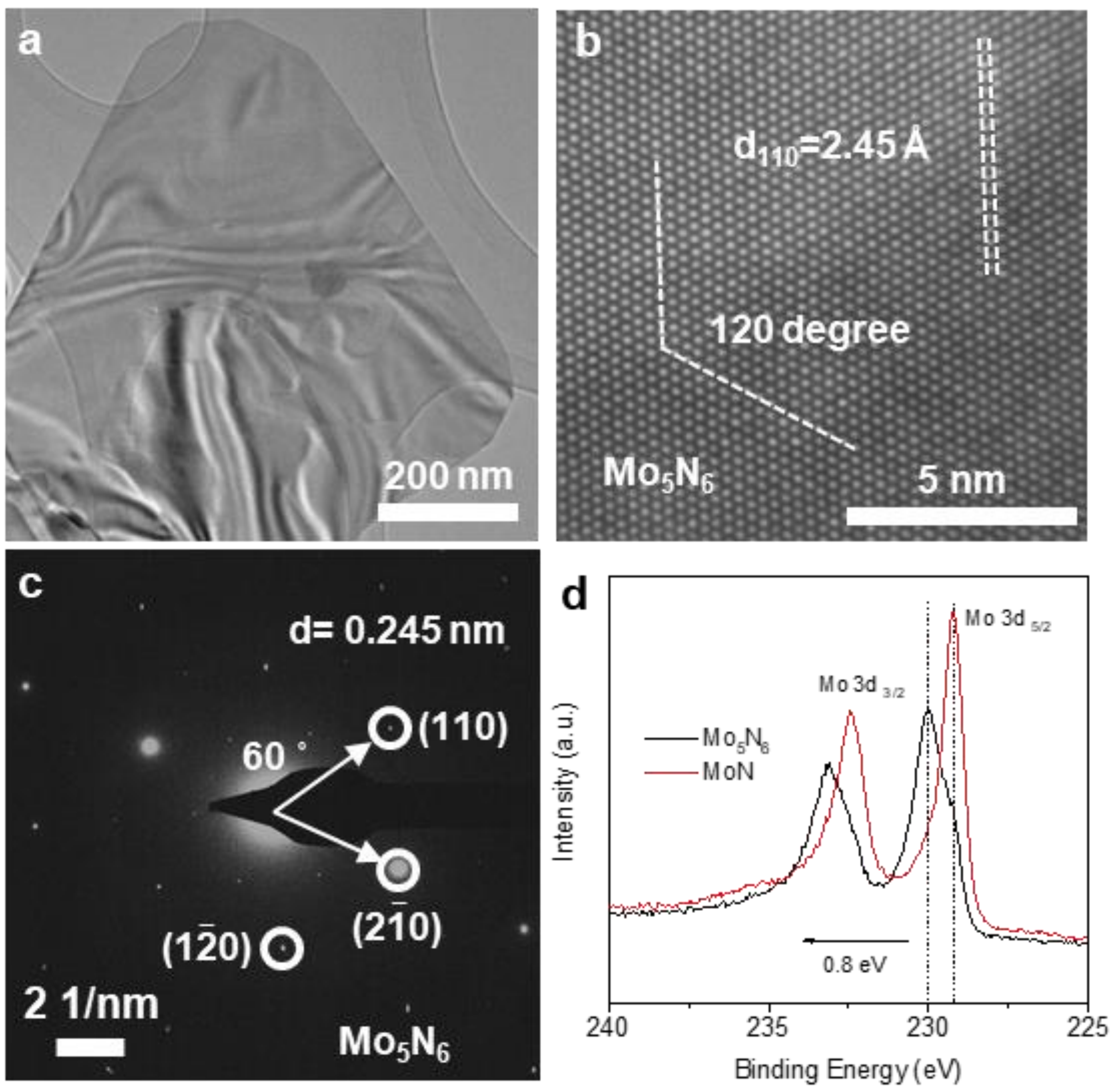

Figure 2. (a-c) Transmission electron microscopy analysis of Mo_5N_6. (c) Mo 3d XPS spectra of MoN and Mo_5N_6.

HER Performance and Activity Origin

- Excellent HER activity and stability in seawater.
- The *d* band center position of Mo_5N_6 is close to Pt.

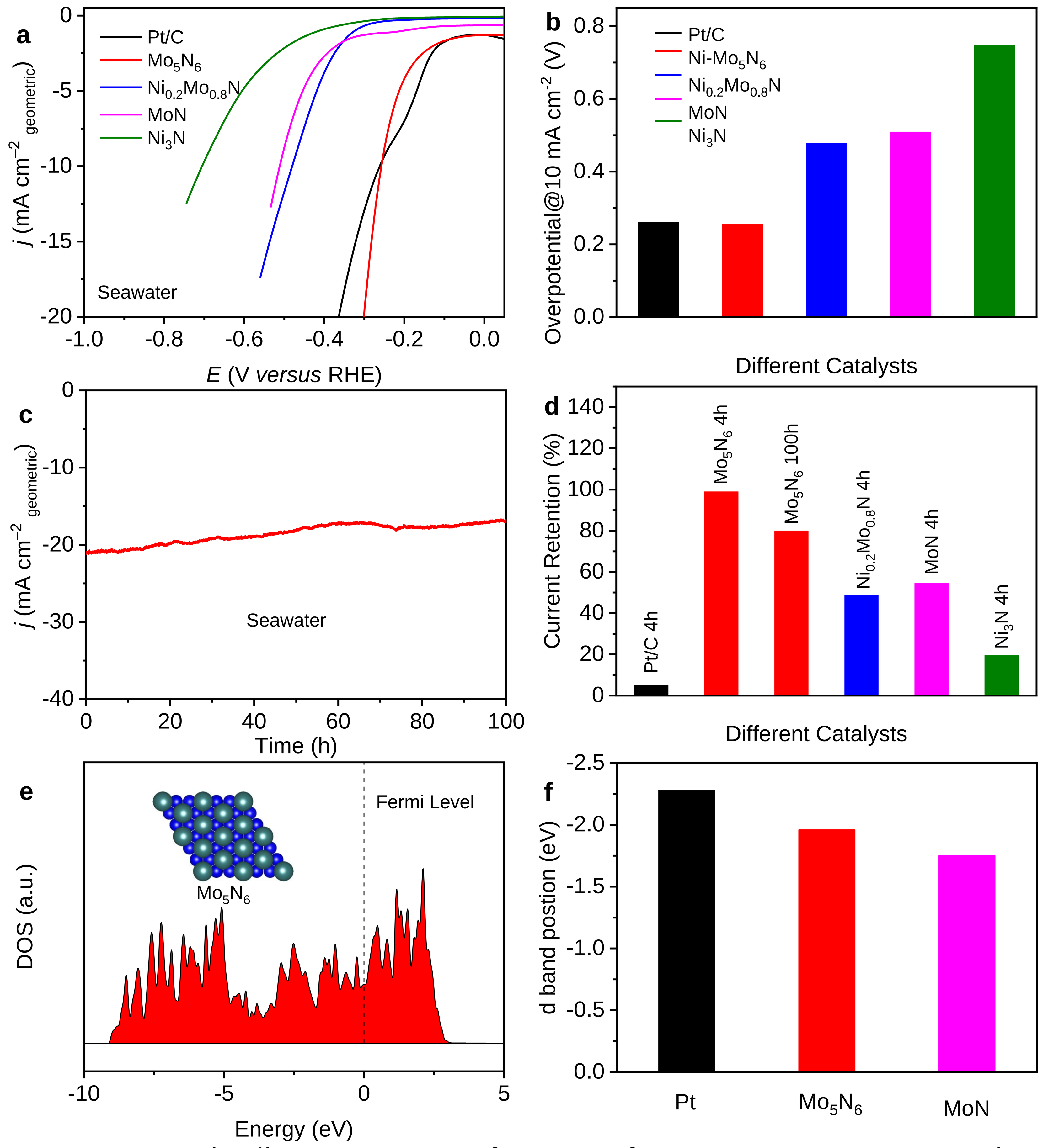

Figure 3. (a-d) Comparison of HER performance in seawater with other TMNs and Pt/C in seawater conditions. (e) DOS of Mo_5N_6. (f) d band centre position of Pt (111), Mo_5N_6 and MoN.

Conclusion

- The HER performance of 2D Mo_5N_6 in natural seawater is better than Pt/C benchmark.
- Excellent stability in seawater splitting with over 80% of its initial current retention for 100 h test.
- The high Mo valence state in Mo_5N_6 enhanced its corrosive-resistance.

References

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