

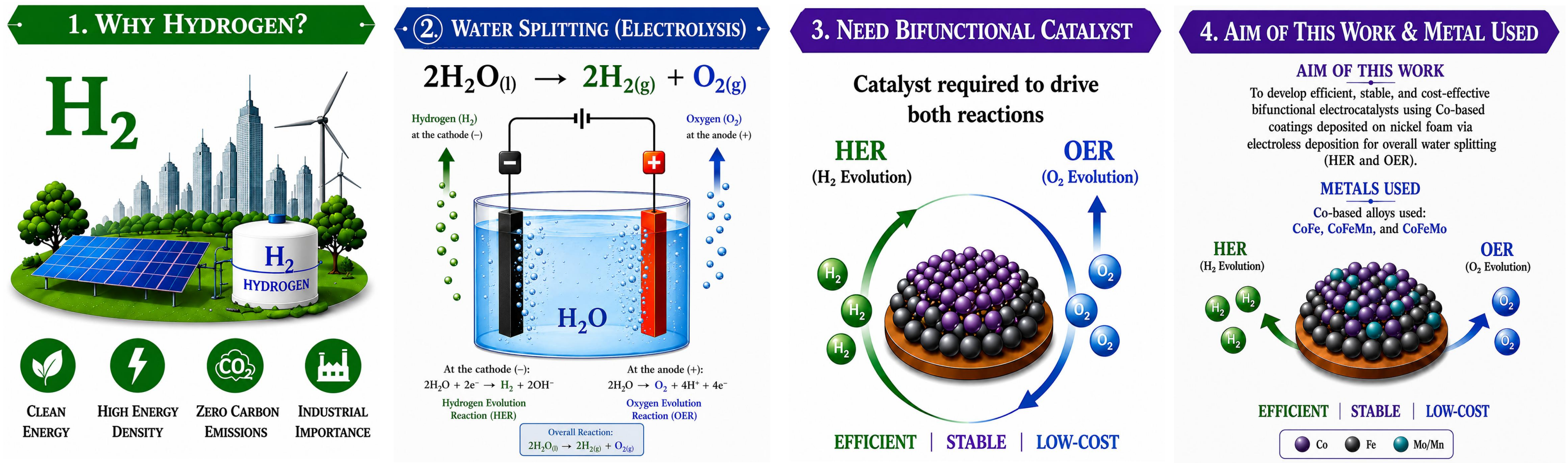
Bimetallic and Trimetallic Electrocatalysts for Efficient Hydrogen and Oxygen Evolution in Alkaline Media

Huma Amber*, Karina Vjunova, Jūratė Vaičiūnienė, Loreta Tamašauskaitė-Tamašiūnaitė, Eugenijus Norkus

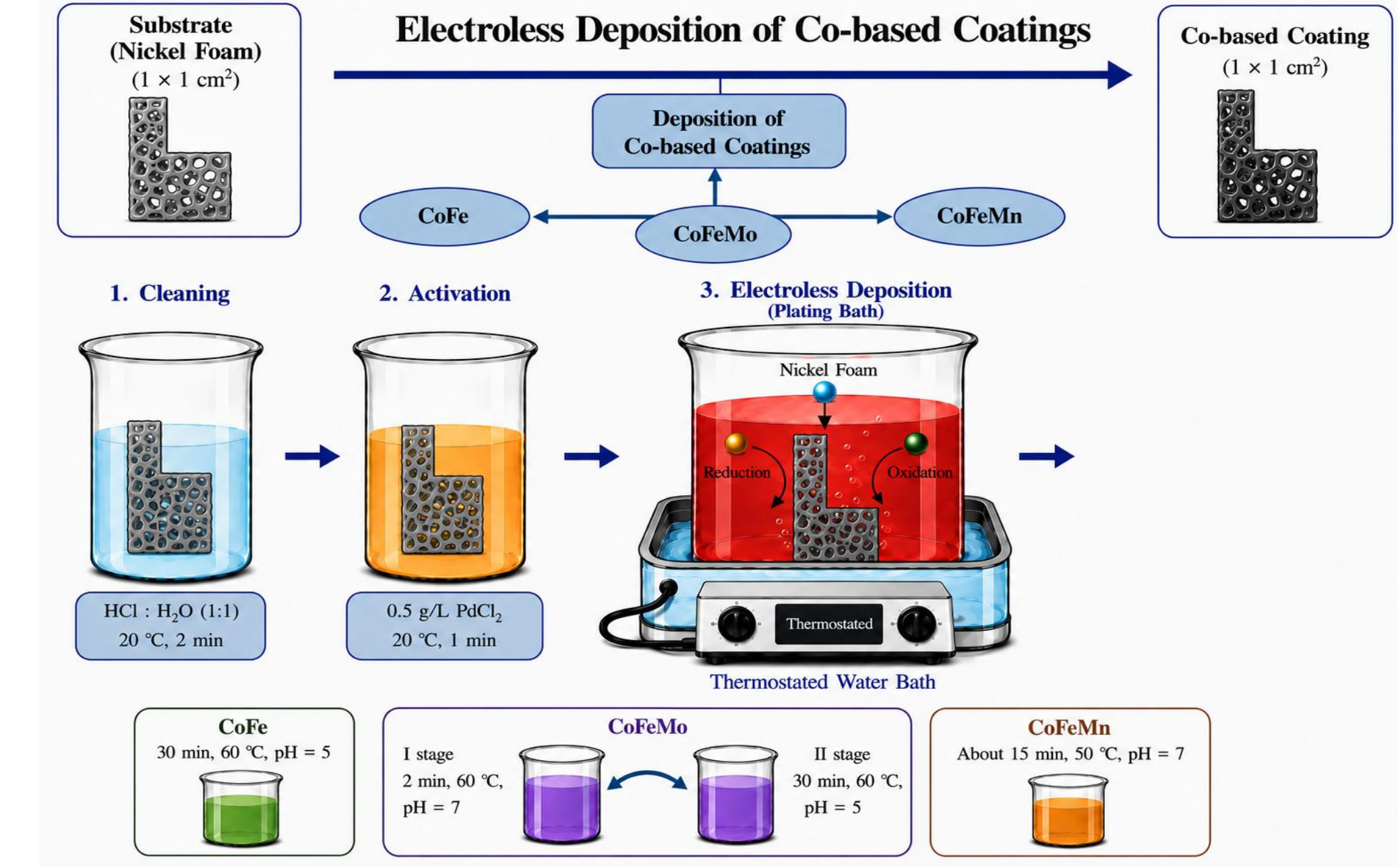
Department of Catalysis, Center for Physical Sciences and Technology (FTMC), Sauletekio Ave. 3, Vilnius, Lithuania

E-mail: huma.amber@ftmc.lt

INTRODUCTION & AIM



FABRICATION of CATALYSTS



RESULTS & DISCUSSION

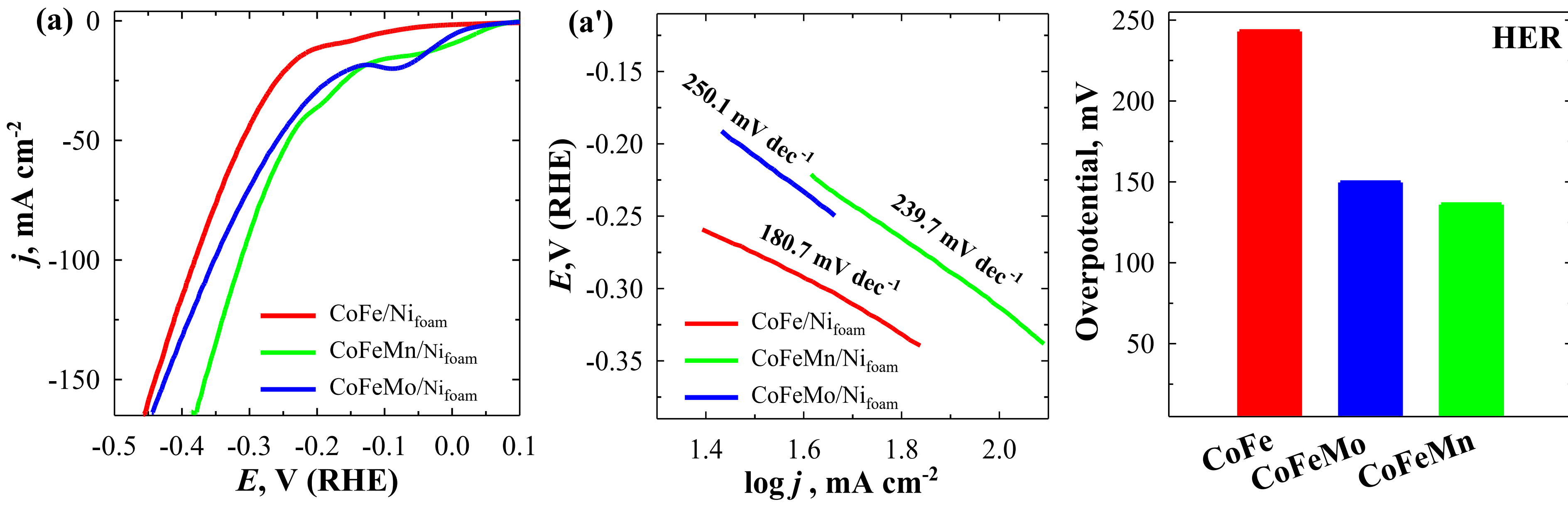


Fig. 2. HER LSVs (a) and Tafel Slopes (a') of the investigated catalysts recorded in a 1M KOH solution at 5mV/s.

Fig. 3. HER overpotential column bar to reach a current density of 20 mA cm⁻².

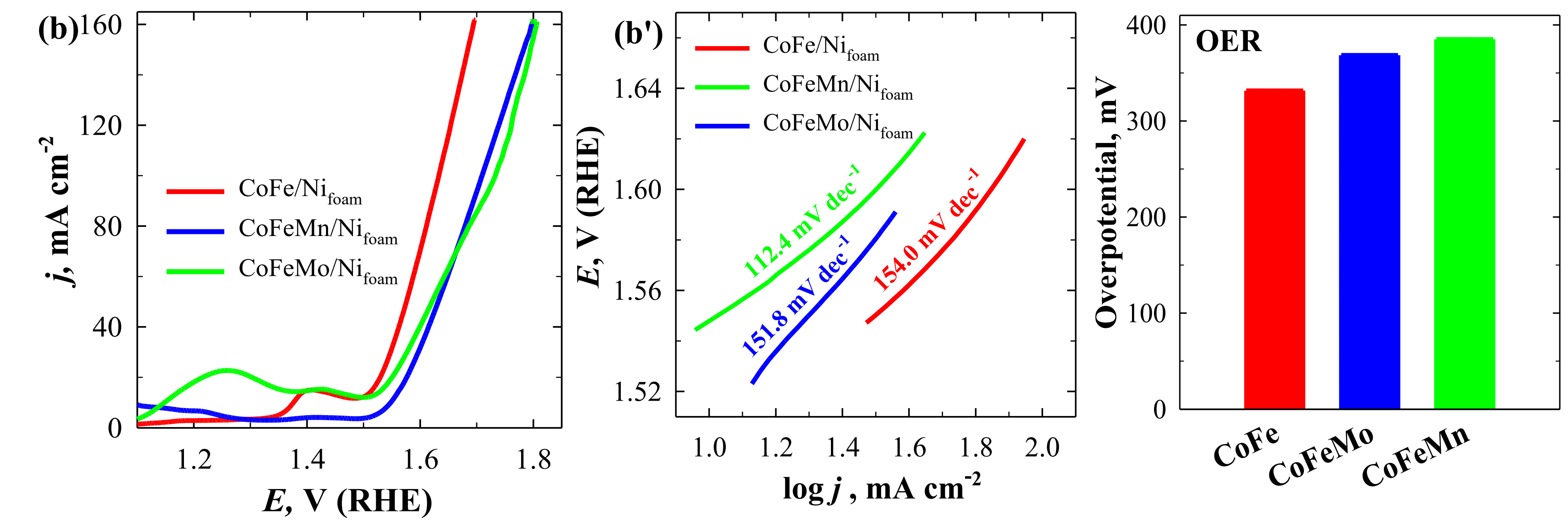


Fig. 4. OER LSVs (b) and Tafel Slopes (b') of the investigated catalysts recorded in a 1M KOH solution at 5mV/s.

Fig. 5. OER overpotential column bar to reach a current density of 40 mA cm⁻².

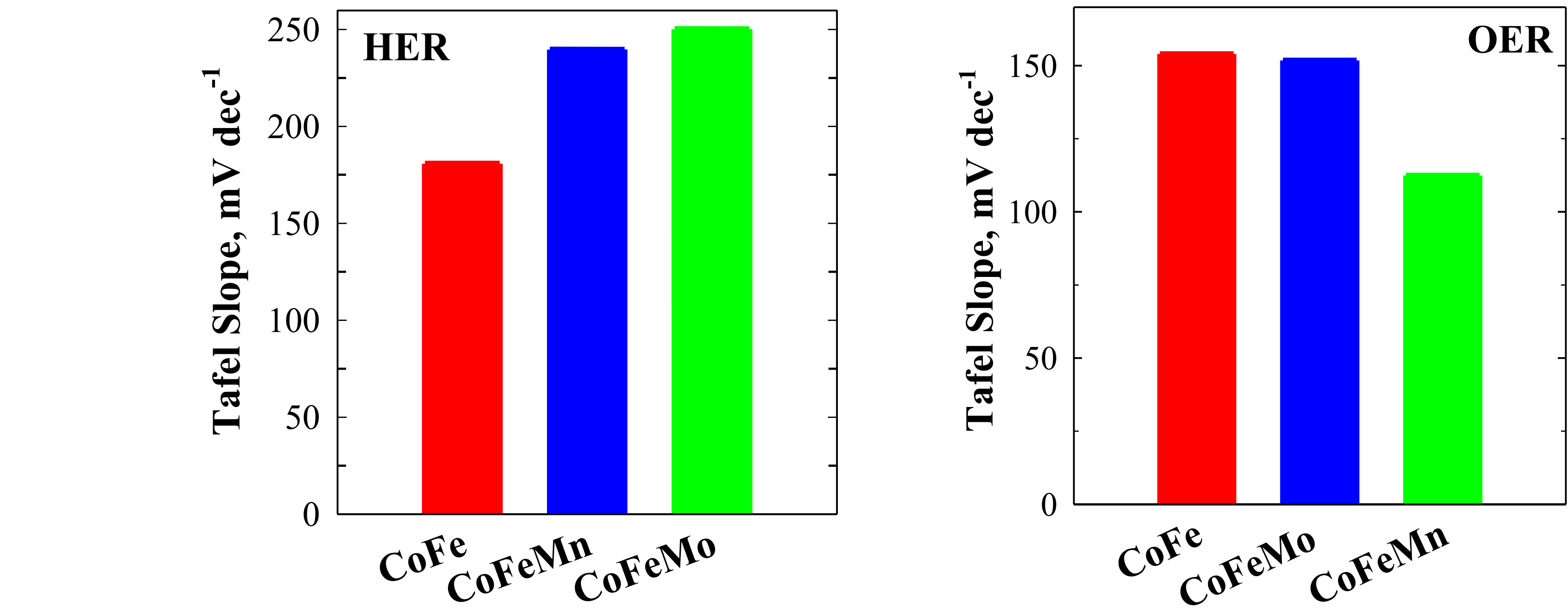


Fig. 6. Comparison of the Tafel slopes of the investigated catalysts for HER.

Fig. 7. Comparison of the Tafel slopes of the investigated catalysts for OER.

Table 2. Electrochemical parameters of investigated catalysts for HER.

Catalyst	Overpotential at j = 20 mA cm ⁻² , mV	Tafel Slope, mV dec ⁻¹
CoFe/Ni _{foam}	243.9	180.7
CoFeMn/Ni _{foam}	135.9	239.7
CoFeMo/Ni _{foam}	149.6	250.1

Table 3. Electrochemical parameters of investigated catalysts for OER.

Catalyst	Overpotential at j = 40 mA cm ⁻² , mV	Tafel Slope, mV dec ⁻¹
CoFe/Ni _{foam}	331.7	154.0
CoFeMn/Ni _{foam}	385.1	112.4
CoFeMo/Ni _{foam}	368.4	151.8

SEM & EDS ANALYSIS

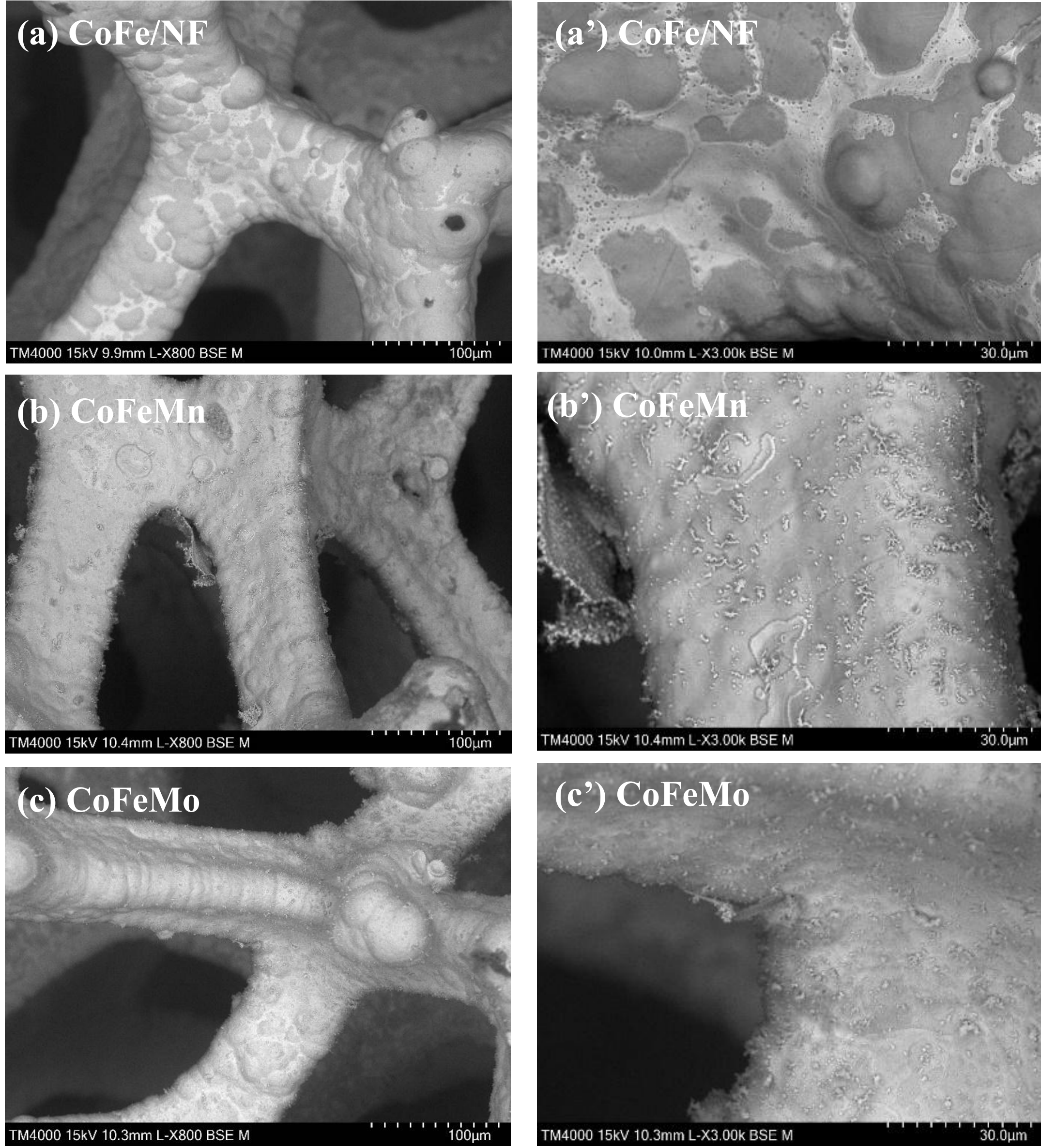


Fig. 1. SEM images of the CoFe (a, a'), CoFeMn (b, b') and CoFeMo (c, c') coatings on Ni foam.

Table 1. Composition of CoFe, CoFeMn and CoFeMo coatings.

Catalyst	Composition mass %				Loadings, mg cm ⁻²
	Co	Mn	Mo	Fe	
CoFe/Ni _{foam}	31.92	-	-	68.08	0.489
CoFeMn/Ni _{foam}	95.45	0.49	-	4.06	1.134
CoFeMo/Ni _{foam}	82.04	-	6.21	11.74	2.003

CONCLUSIONS

- Successfully synthesized CoFe, CoFeMn, and CoFeMo electrocatalysts using a simple and cost-effective fabrication method.
- CoFeMn and CoFeMo exhibited superior HER activity, requiring overpotentials of 135.8 mV and 149.6 mV at 20 mA cm⁻², respectively, compared to 243.9 mV for CoFe. The improved HER performance is attributed to the higher surface area and greater exposure of active catalytic sites.
- CoFe showed the best OER performance, achieving 40 mA cm⁻² at an overpotential of 331.7 mV, outperforming CoFeMo and CoFeMn. The superior OER activity of CoFe is associated with its favorable surface morphology and optimized composition.
- The results demonstrate that composition engineering effectively tailors catalytic activity for HER and OER. This work provides a promising, low-cost, and scalable strategy for developing efficient bifunctional electrocatalysts for sustainable hydrogen production through water splitting.