# Ag nano fern Cu supported bimetallic electrocatalyst for ammonia electrogeneration from nitrate pollution

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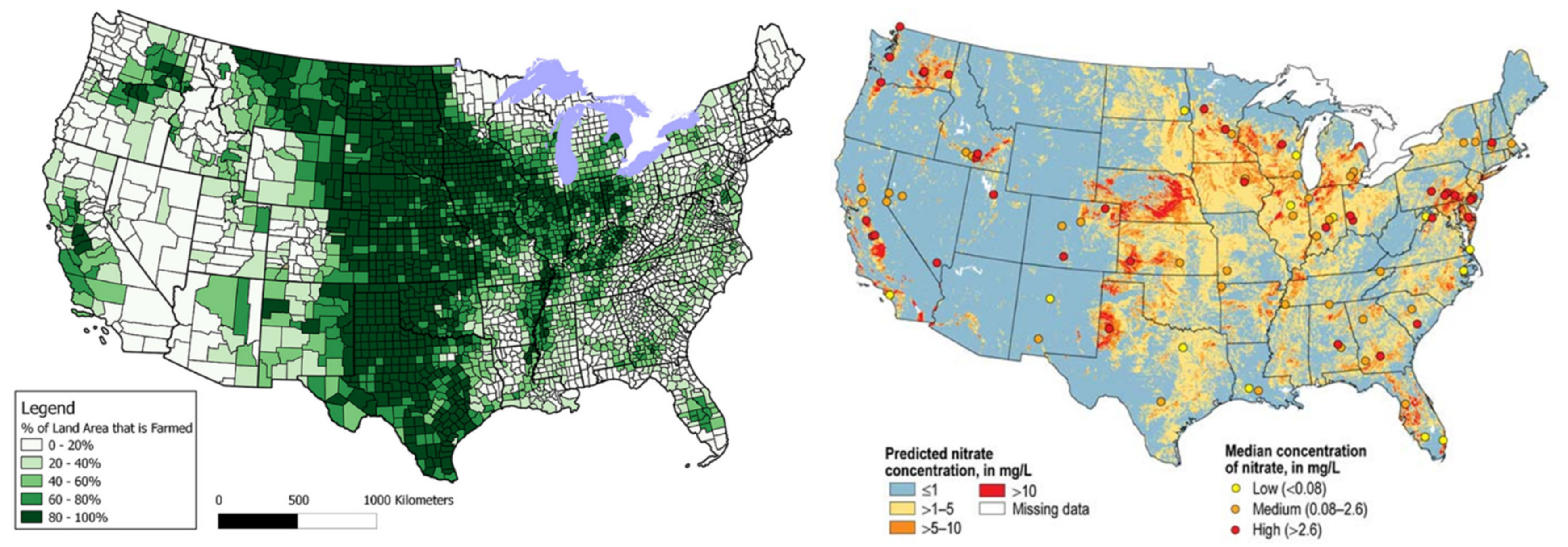
## Background




Land devoted to Farming by US county. UCAR center for science education. https://scied.ucar.edu/image/where-are-farms-united-states

Nitrates In Drinking Water. *Aquanui.* https://myaquanui.com/nitrates-in-drinking-wat

Figure 1: Land devoted to farming and agricultural practices (left) and nitrate pollution in groundwater (right)

- Agricultural runoff causes high levels of nitrate in ground and surface water.
- Additional nitrate pollution stems from industrial water discharge, and leaching from landfills
- Electrochemical reduction of nitrate (ERN) can remove nitrate while creating an added-value product ($NH_3$).

## Methods

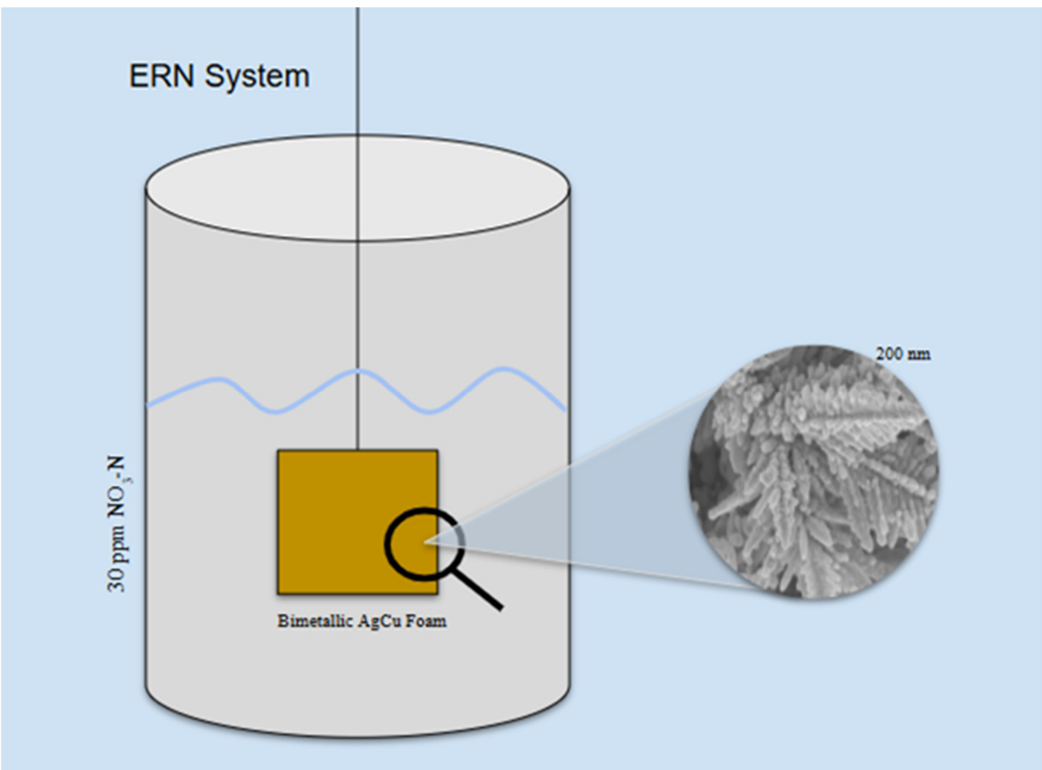



Figure 2: ERN system with AgCu Foam

- $AgNO_3$ used for silver precursor
- Complex nano Ag structures generated spontaneously

## Results:

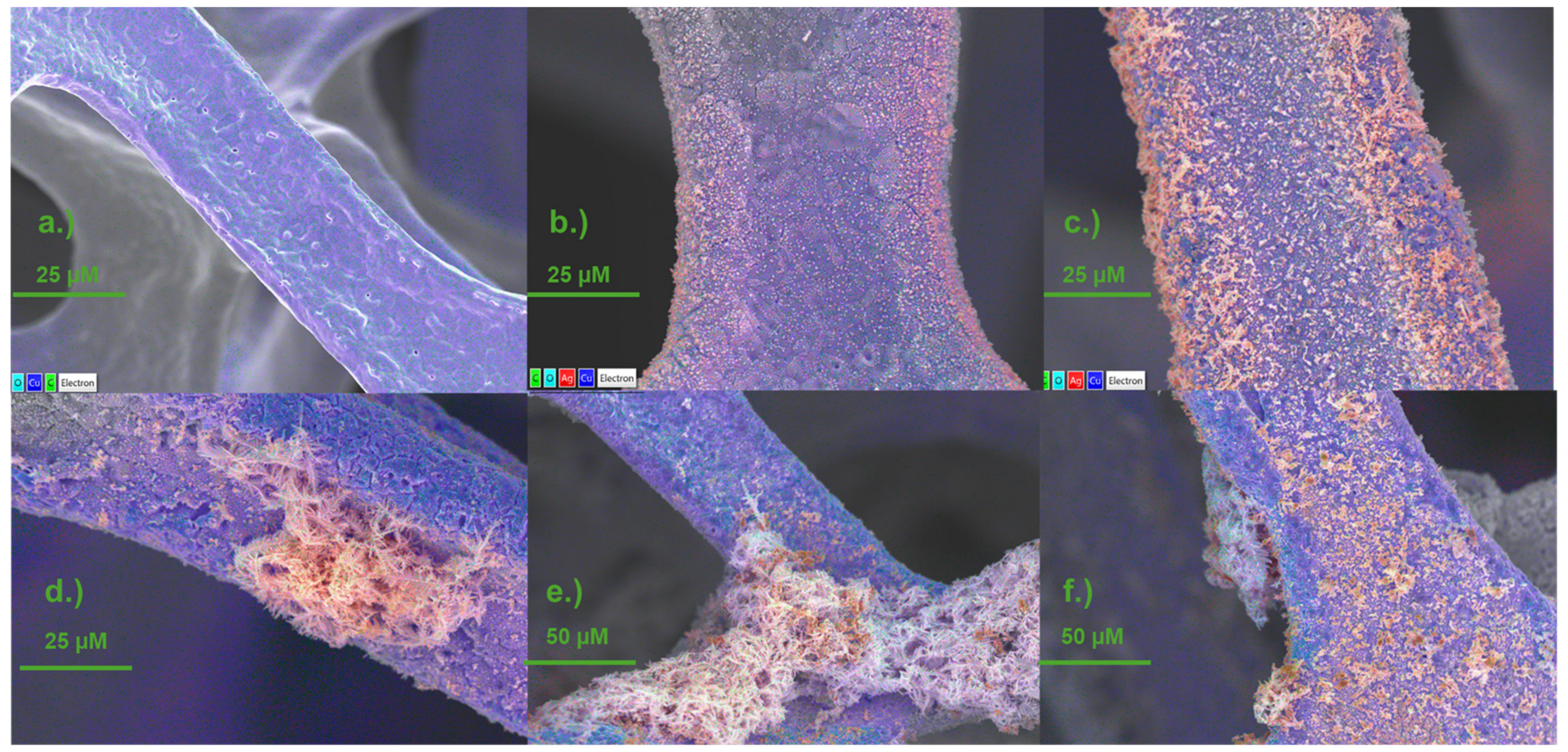



Figure 3: FE-SEM-EDS analysis of the pristine Cu foam (a), 8 mmol L[-1] Cu/Ag electrocatalyst (b), 16 mmol L[-1] Cu/Ag electrocatalyst (c), 32 mmol L[-1] Cu/Ag (d), 64 mmol L[-1] Cu/Ag (e), and 100 mmol L[-1] Cu/Ag (f)

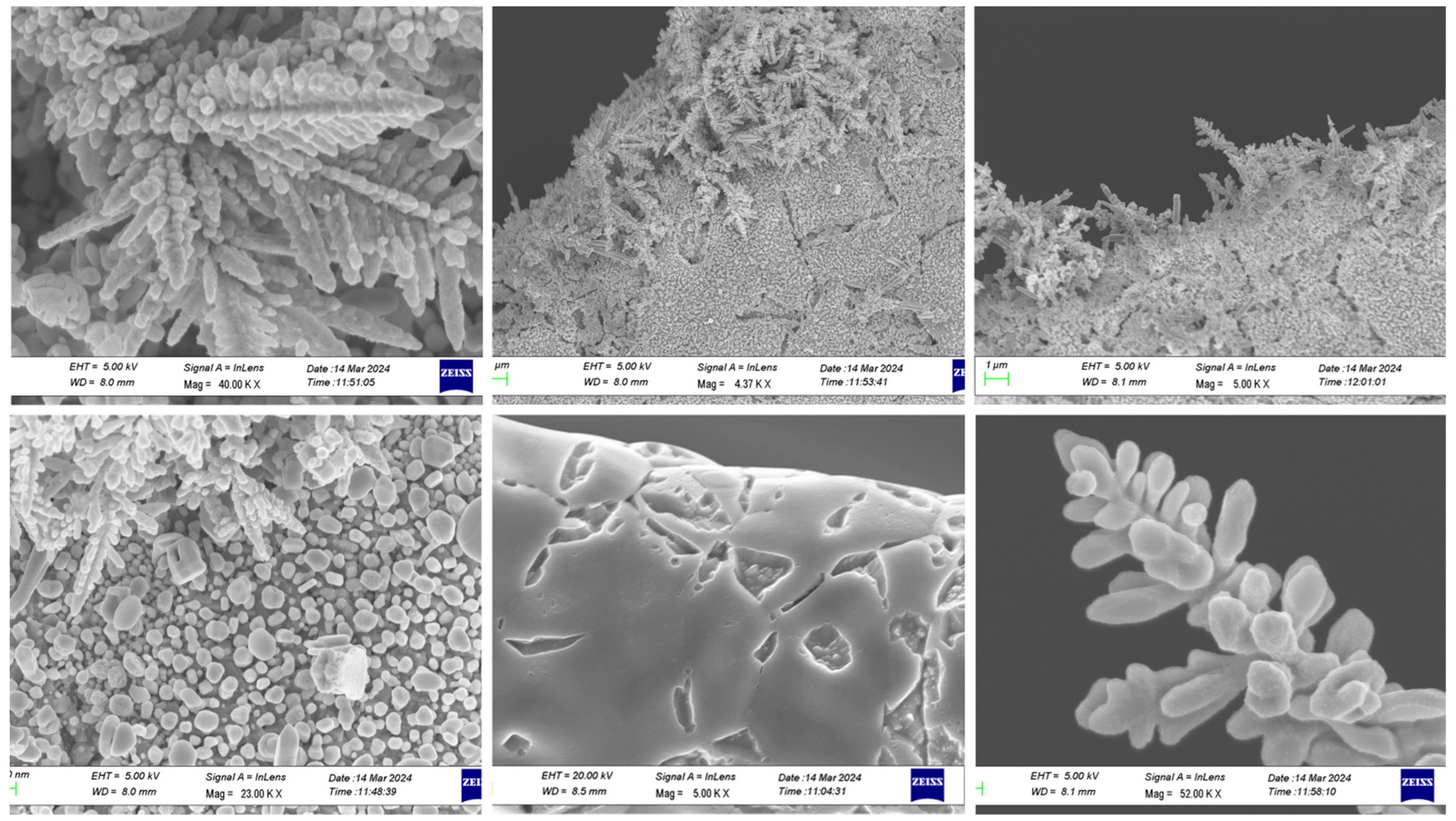


Figure 4: FE-SEM analysis of the Cu/Ag bimetallic electrocatalyst synthesized from 32 mmol L[-1] $AgNO_3$ synthesis with perspective of the Ag nano fern structure.

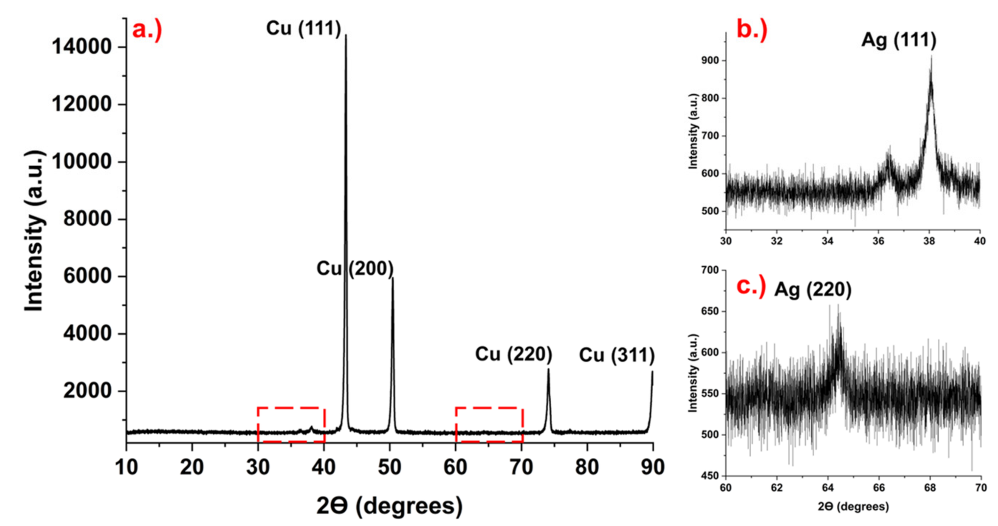



Figure 5: XRD diffractogram for the Cu/Ag bimetallic electrocatalyst with a full scan range from 10-90° vs 2θ in a.), zoomed in perspective for 30-40° vs 2θ b.), as well as zoomed in perspective for 60-70° vs 2θ c.)

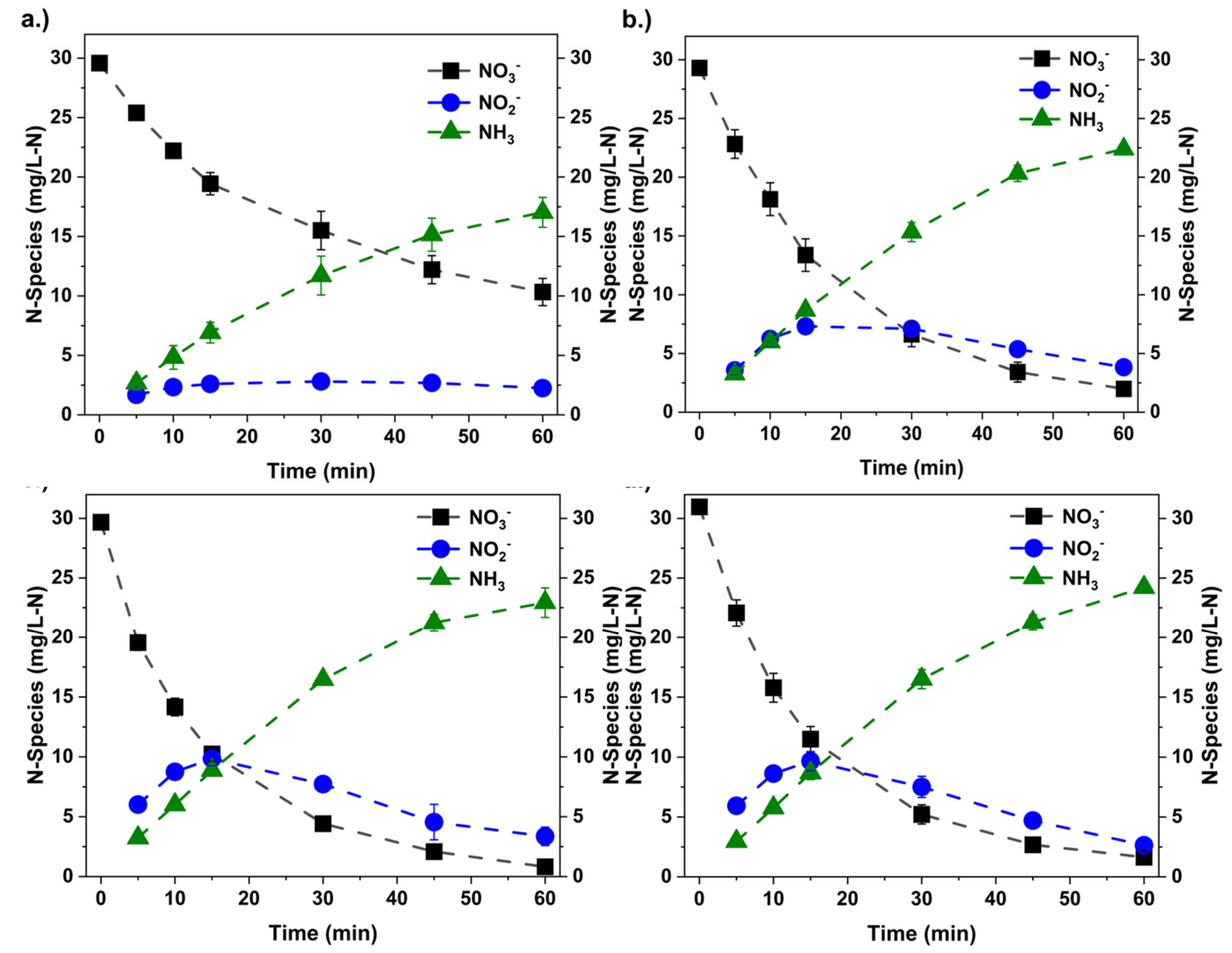



Figure 6: Reaction kinetics for ERN electrolysis for the Cu foam (a) 8 mmol L[-1] Cu/Ag (b) 16 mmol L[-1] (c) and 32 mmol L[-1] Cu/Ag electrocatalyst in term of N-species concentrations at 5,10,15,30,45, and 60 minutes of treatment.

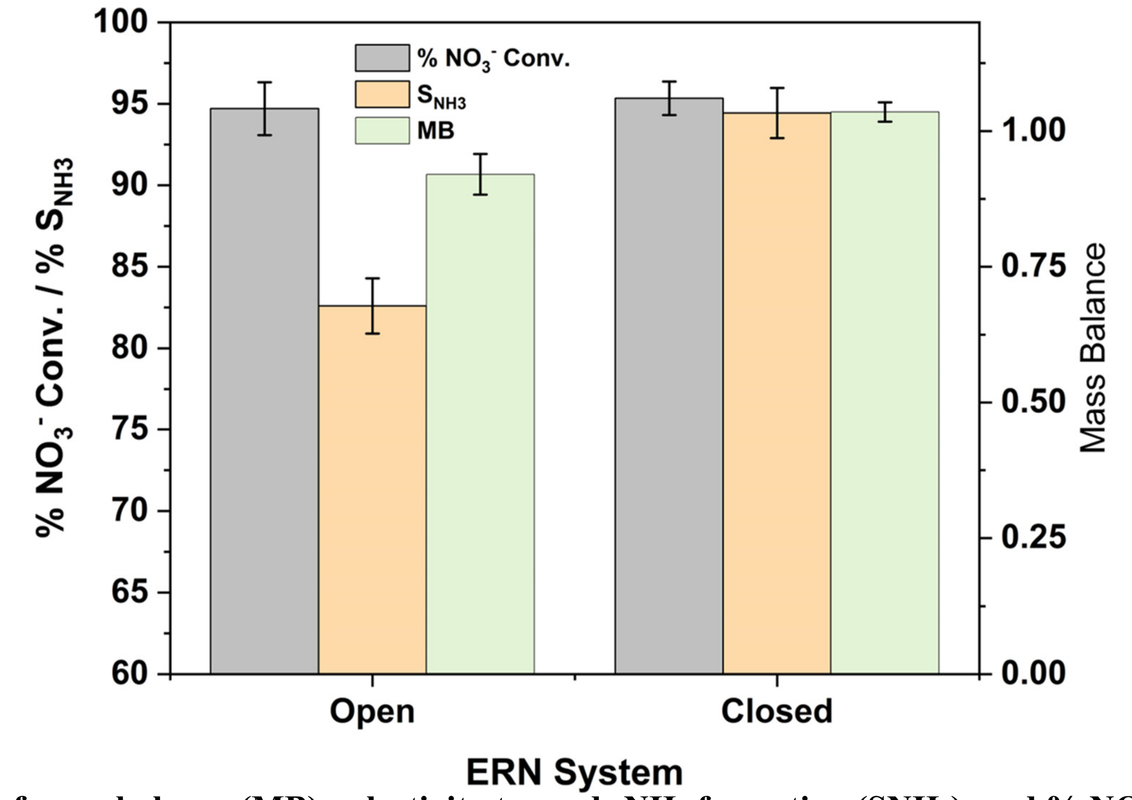



Figure 7: Comparison of mass balance (MB), selectivity towards $NH_3$ formation (SNH$_3$), and % $NO_3^-$ conversion for both the open and closed ERN systems, utilizing the 32 mmol Cu/Ag electrocatalyst, at a current density of 33.3 mA·cm[-2].

## Conclusion

- 95% conversion $NO_3 \rightarrow NH_3$, 95% selectivity towards $NH_3$
- Electrocatalyst generated through spontaneous galvanic reaction.
- ERN operation is modular, compatible with renewable energy, and easily deployed.

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