

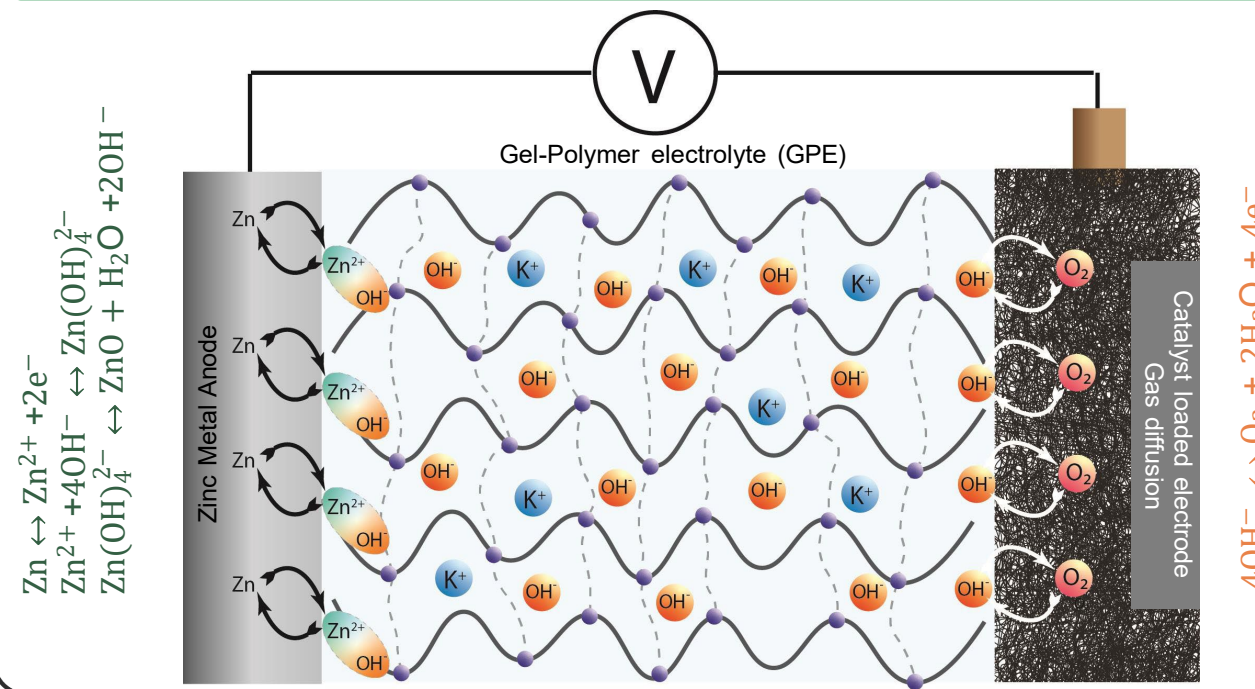
Development of Gel Polymer Electrolytes and Electrocatalysts for Long-Duration Zn-Air Batteries

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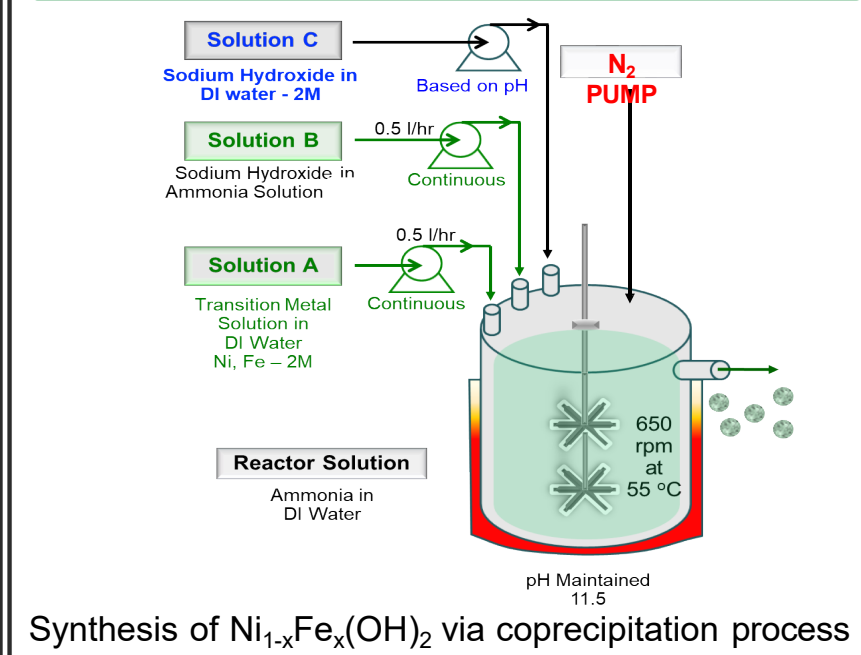
MOTIVATION AND OBJECTIVES

- Zn-air battery (ZAB):**
- Strong market demand and streamlined supply chain
- Low-cost (\$10/KWh) and high specific energy = 1086 Wh/Kg
- Key challenges:**
- Material development and processing
- Electrode, electrolyte and catalyst design, and cell engineering for long duration cycling
- Current work:**
- Fabrication and optimization of polymer electrolyte ($\sigma_{\text{ionic}} = 6.6 \text{ mS/cm}$) and electrocatalyst
- Understanding Catalyst activity, cell efficiency and Zinc dendrite growth and suppression strategies.

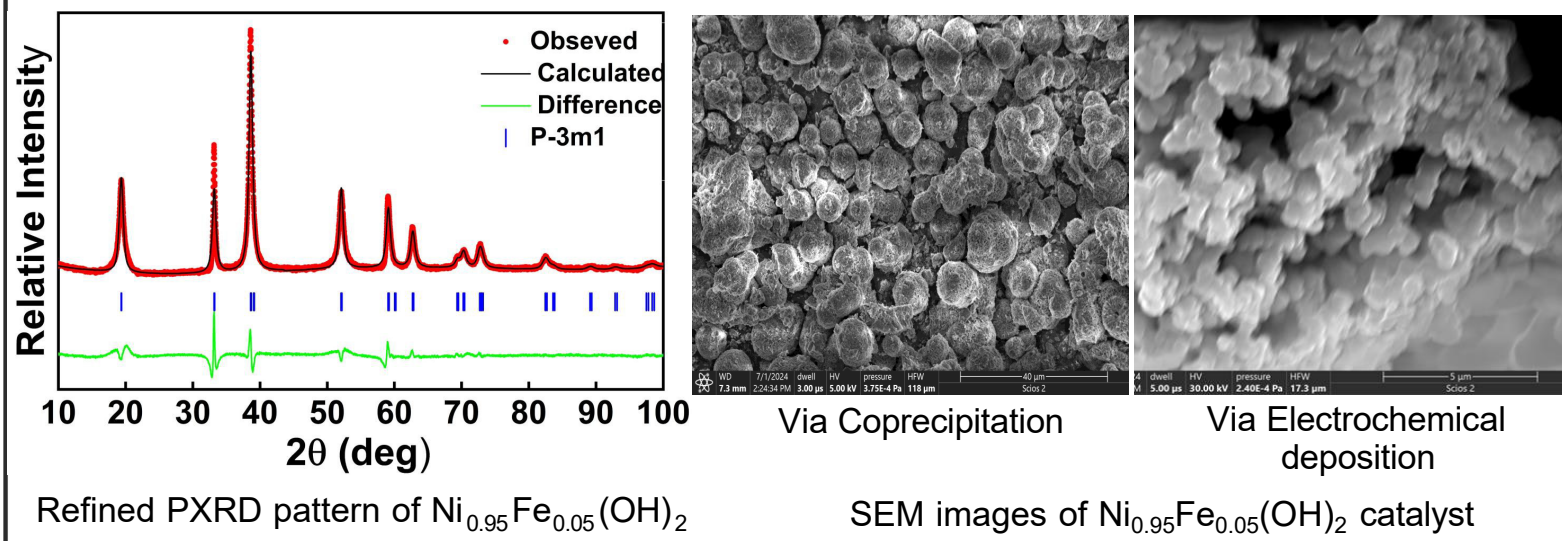
ZINC-AIR CELL



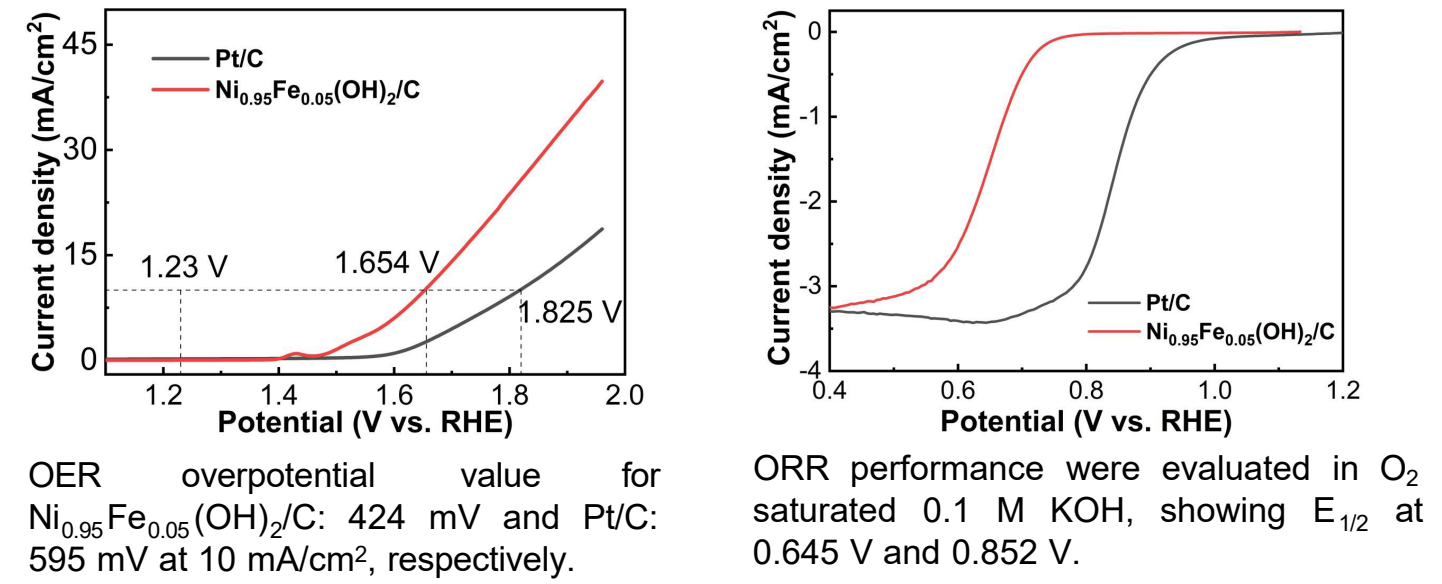
CATALYST SYNTHESIS



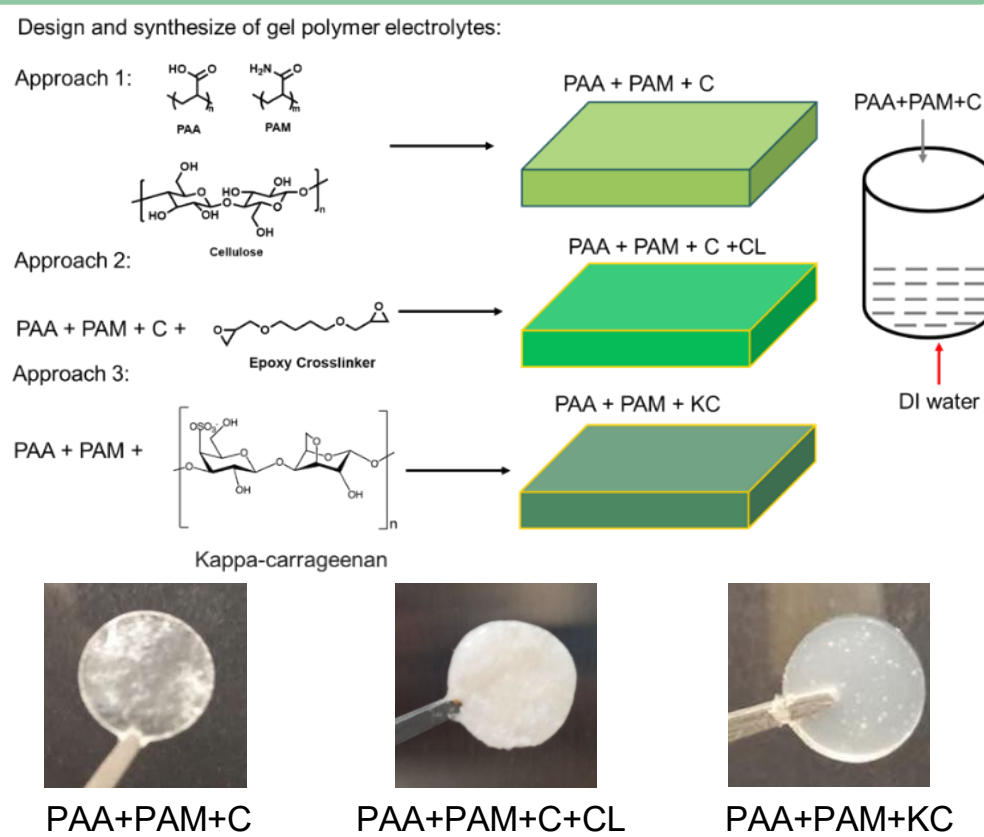
PHYSICAL ANALYSIS OF CATALYST



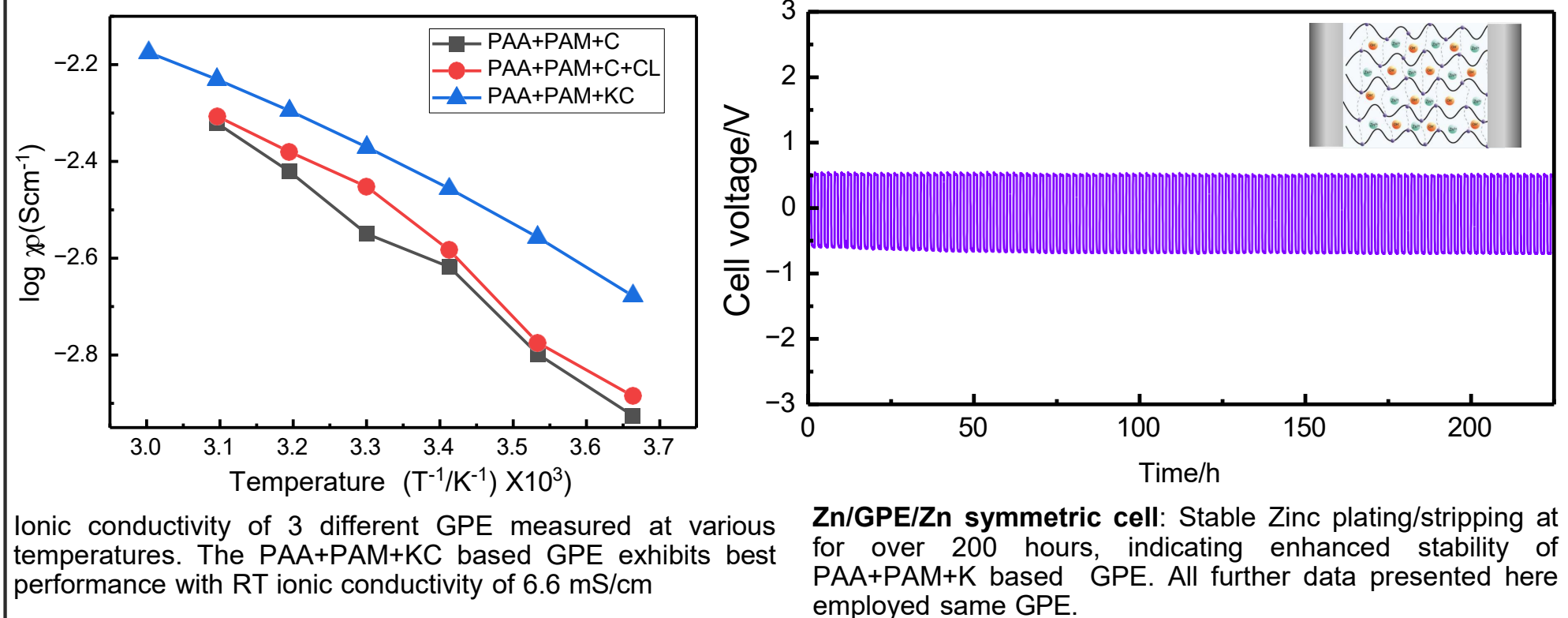
ELECTROCHEMICAL ANALYSIS OF CATALYST



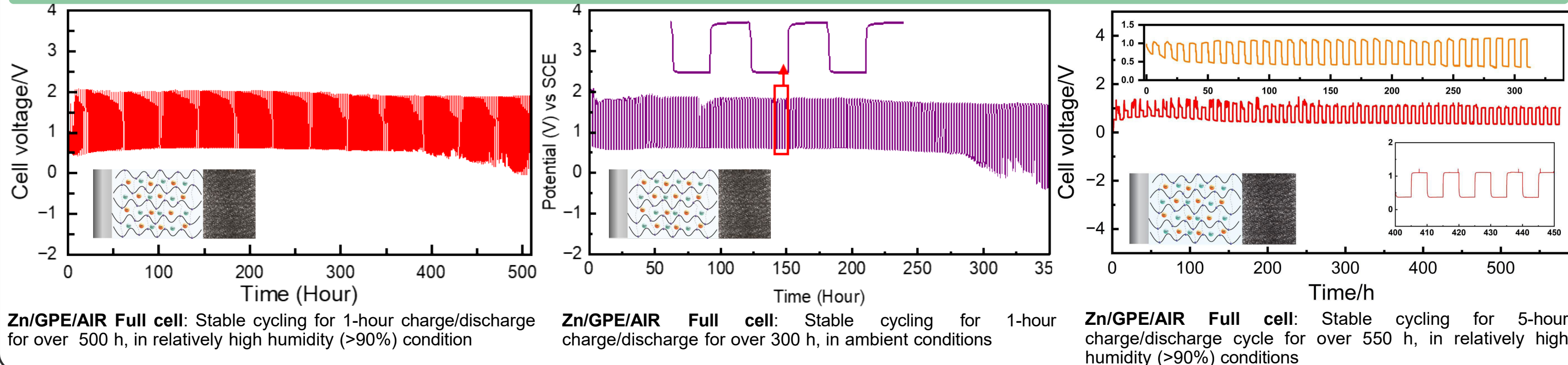
SYNTHESIS OF GEL POLYMER ELECTROLYTE



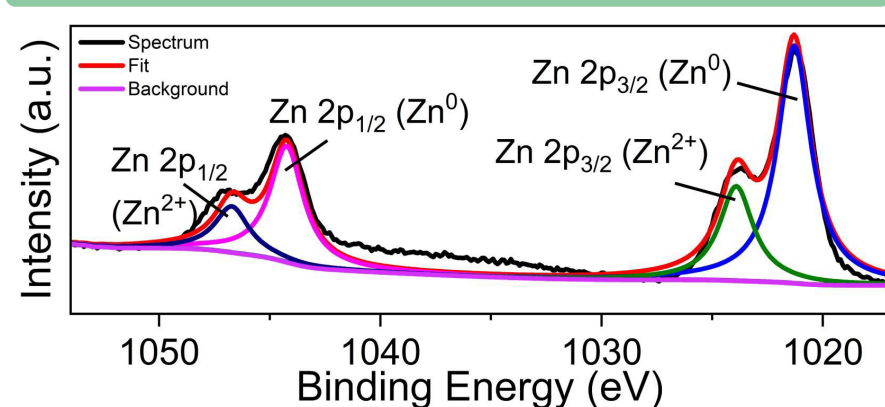
ELECTROCHEMICAL ANALYSIS OF GEL POLYMER ELECTROLYTE



ELECTROCHEMICAL PERFORMANCES OF ZINC-AIR BATTERY CELLS

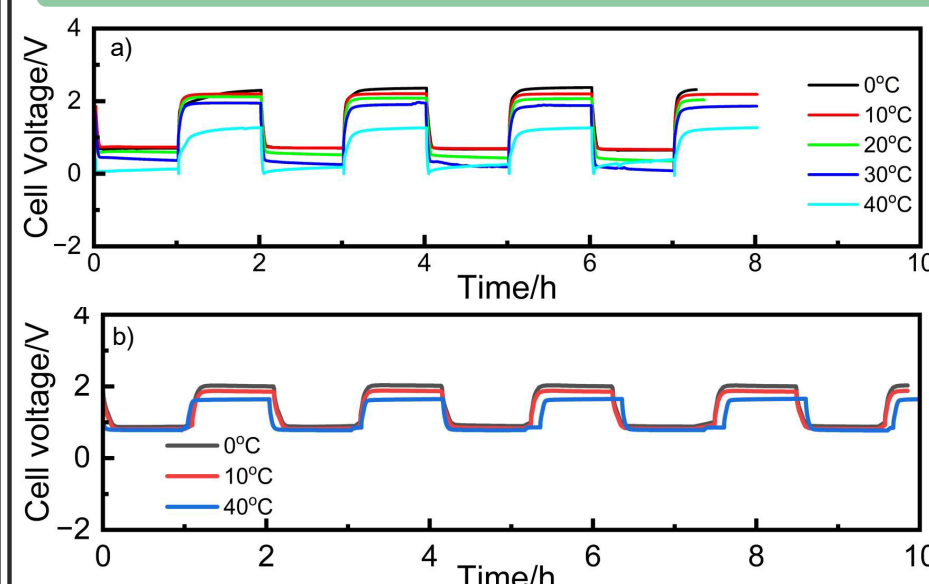


XPS



XPS on Carbon felt surface after cycling reveals the presence of metallic zinc, indicating zinc plating

TEMP BASED CYCLING



SCIENTIFIC ARTIFACTS AND OUTLOOKS

- Articles published, under review or in preparation:
- R. Amin et al., J. Mater. Chem. A, DOI: 10.1039/d4ta01061b. Selected as a Hot Article, 2024.
- M. Rahman---R. Amin et al., Electrochem. Energy Review, DOI: 10.1007/s41918-025-00249-w, 2025.
- R. Amin et al., "Composite Biopolymer Electrolytes for High-Performance Reversible Zinc-Air Batteries" (under review)
- 2 articles under final stages of preparation
- Oral presentations at MRS fall 2024, ECS Prime 2024, ECS Chicago 2025 and others.
- More work is needed on optimizing the bifunctional catalyst to reduce cell overpotential.
- Need to further optimize the mechanical properties and water retention capacity of KC based GPE.
- Investigate various types and microstructure of zinc anode for eliminating zinc plating issues at longer cycling durations.