REDOX-MEDIATED FLOW BATTERIES: FIRST STEPS FROM FUNDAMENTS TO APPLICATION

Edgar Ventosa[1], Teresa Páez[2], Jesús Palma[2]

1– Department of Chemistry, University of Burgos, E-09001 Plaza Misael Banuelos s/n, Burgos, Spain

2- Electrochemical Processes Unit, IMDEA Energy Institute, E-28933, Móstoles (Madrid), Spain

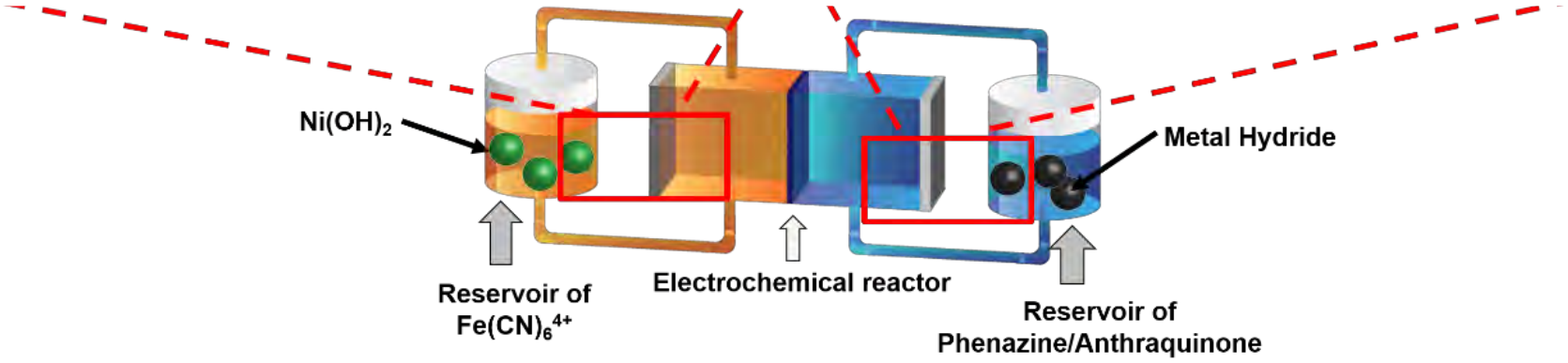
E-mail: eventosa@ubu.es

UNIVERSIDAD DE BURGOS

UNIVERSIDAD DE BURGOS

4. Ni – MH Mediated Redox Flow Battery

Fundaments of the Concept

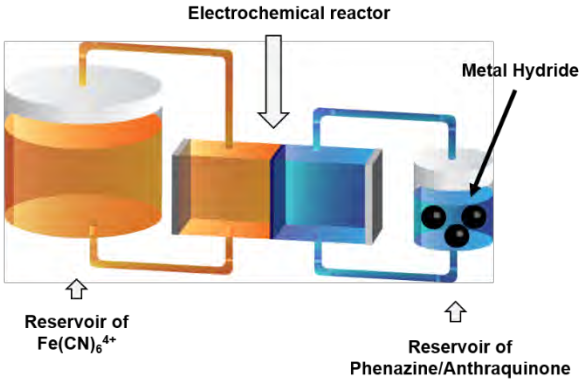


T. Paez,…..E Ventosa, *Advanced Energy Materials*. 12 (2022) 210286

4. Ni – MH Mediated Redox Flow Battery

Mediated MH anolyte

(a)

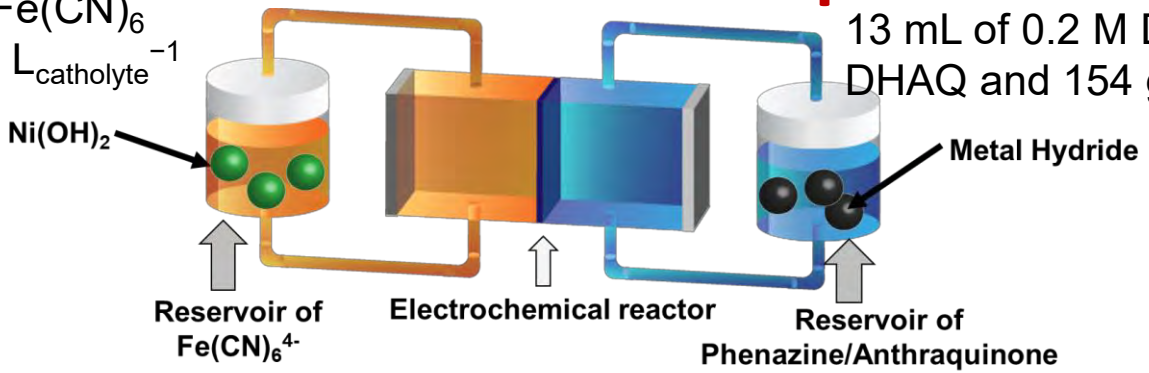


4. Ni – MH Mediated Redox Flow Battery

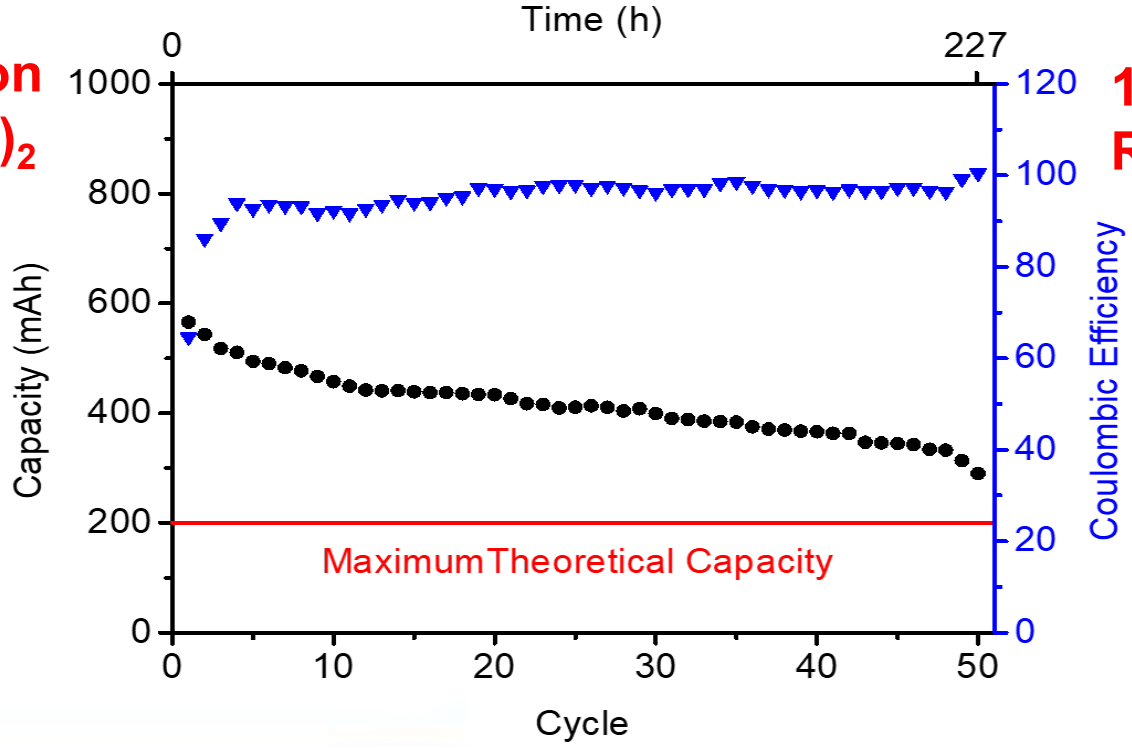
Proof of Concept

26 mL of 0.3 M $K_4Fe(CN)_6$ and 270 g $Ni(OH)_2$ $L_{catholyte}^{-1}$

13 mL of 0.2 M DHPS+0.2 M 2,6-DHAQ and 154 g MH $L_{anolyte}^{-1}$.



42 % Utilization Rate of $Ni(OH)_2$



100 % Utilization Rate of MH

Take-Home Messages

- Energy can be stored in solid materials confined in the external reservoirs
- The FC – $Ni(OH)_2$ couple is a versatile system for alkaline media
- Kinetics of spontaneous liquid – solid charge transfer need to be studied in detail
- Engineering efforts need to be devoted in the new type of reservoir

Acknowledgements

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

European Innovation Council
Funded by the European Union

MeBattery has received funding from the European Innovation Council (EIC) under grant agreement No 101046742. The EIC receives support from the European Union's Horizon Europe research and innovation programme.

Electrochemical Processes Group at University of Burgos

Financiado por la Unión Europea NextGenerationEU

MINISTERIO DE CIENCIA E INNOVACIÓN
Plan de Recuperación, Transformación y Resiliencia

NOS IMPULSA

Junta de Castilla y León

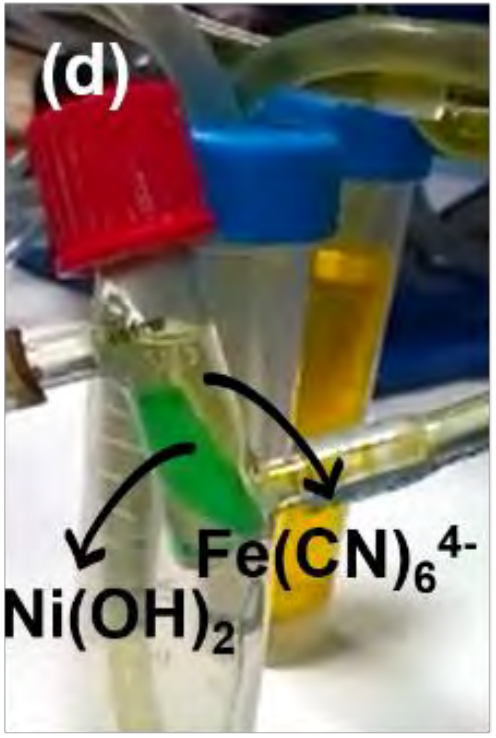
Thank you for your attention

3. Batteries based on $K_4Fe(CN)_6$ – $Ni(OH)_2$

Evidence of Spontaneous Charge Transfer

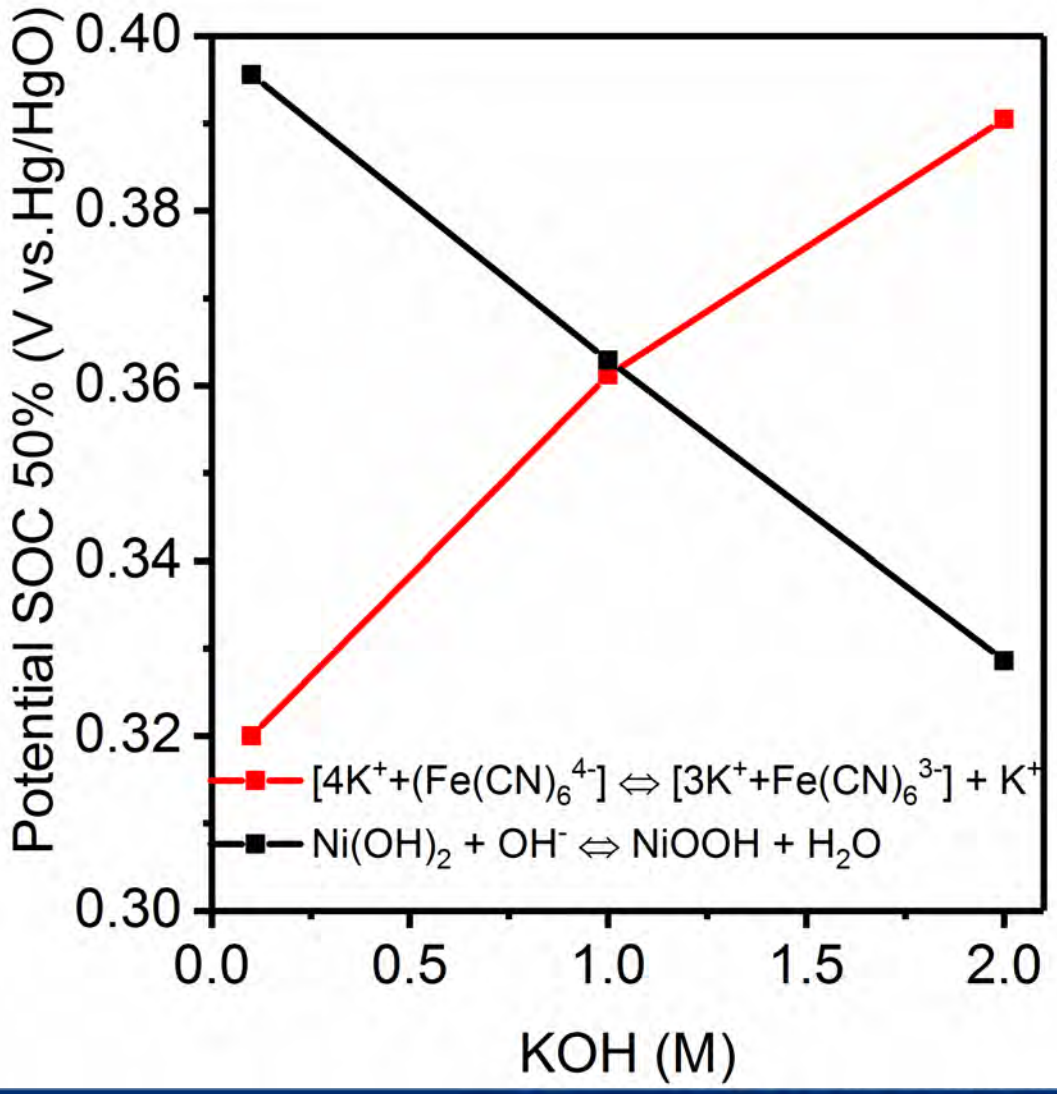
3. Batteries based on $K_4Fe(CN)_6$ – $Ni(OH)_2$

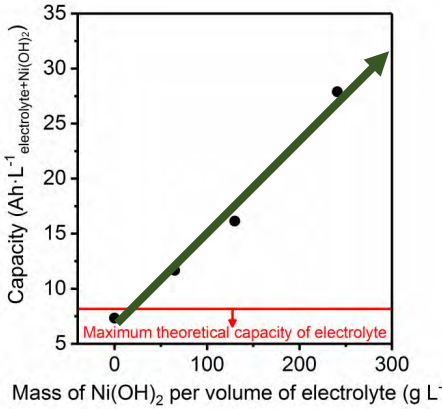
Evidence of Spontaneous Charge Transfer



3. Batteries based on $K_4Fe(CN)_6$ – $Ni(OH)_2$

Utilization Rate of Solid Material

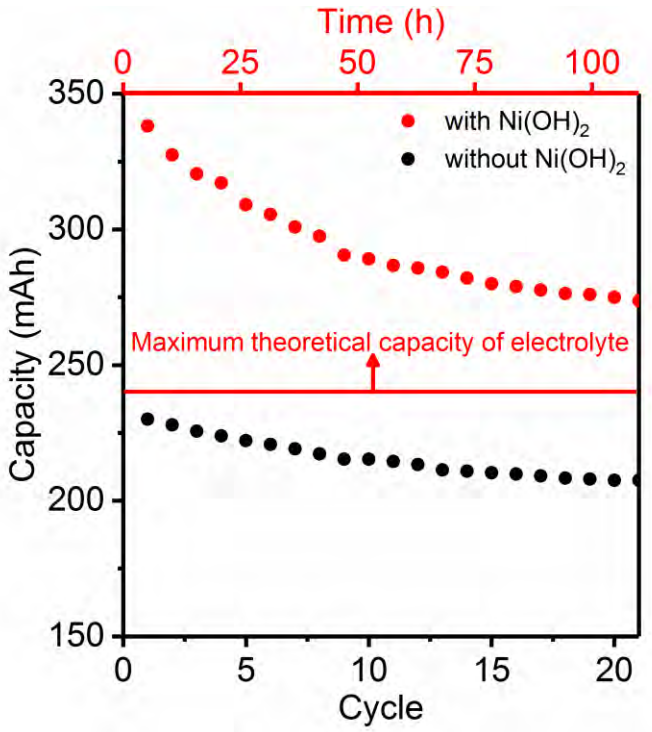




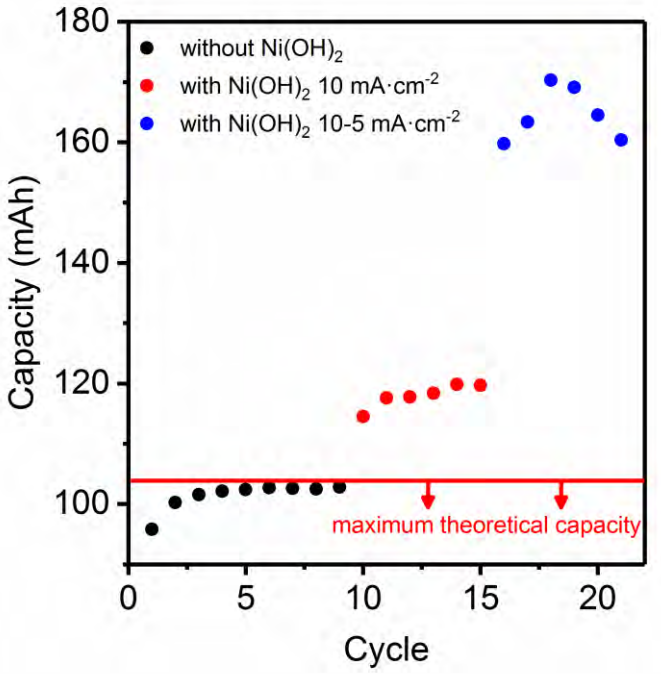
3. Batteries based on $K_4Fe(CN)_6$ – $Ni(OH)_2$

Versatility: other Battery Chemistries

Anthraquinone // $K_4Fe(CN)_6$



Zn // $K_4Fe(CN)_6$

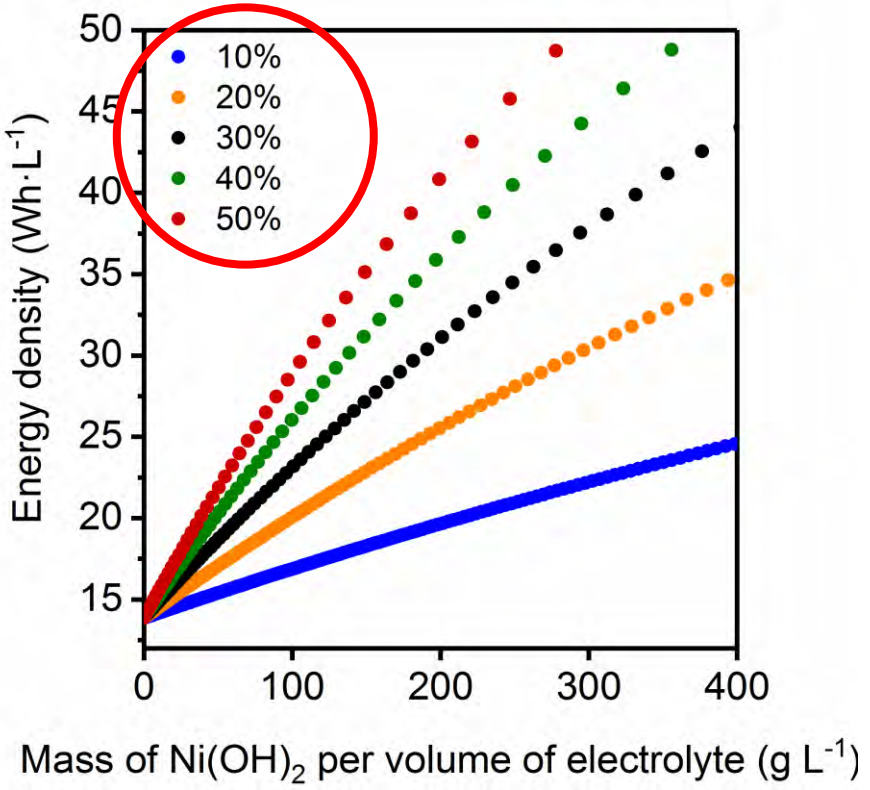


3. Batteries based on $K_4Fe(CN)_6$ – $Ni(OH)_2$

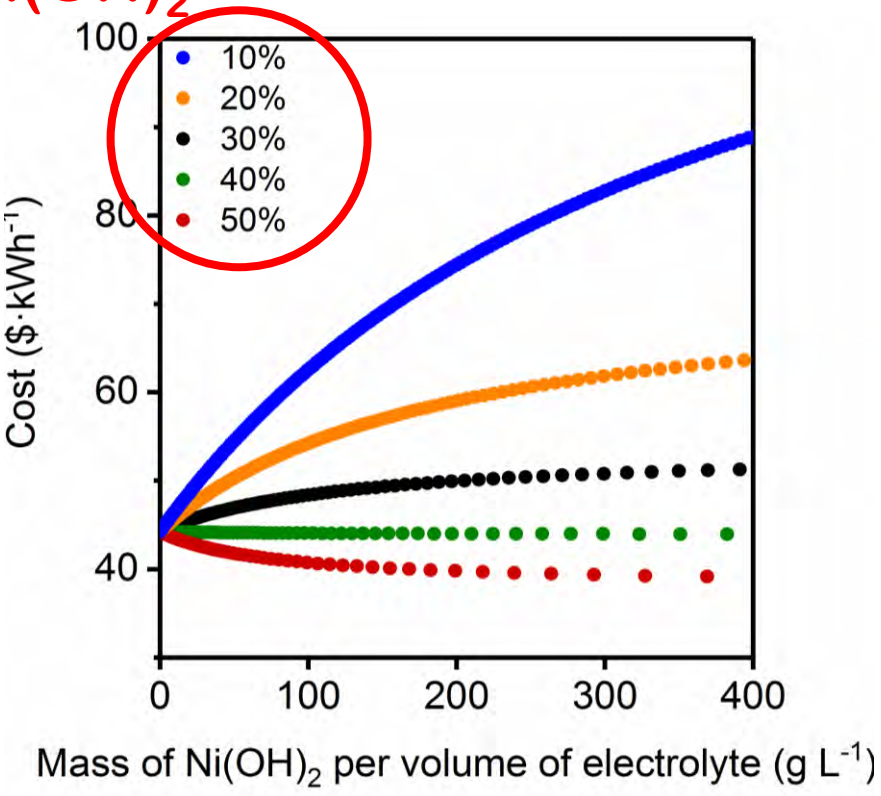
Trade-off for Utilization Rate

Ni-MH batteries have demonstrated
50.000 – 100.000 cycles for **40 – 20 % DoD**

Utilization rates of $Ni(OH)_2$



Ph -FC



AQ -FC

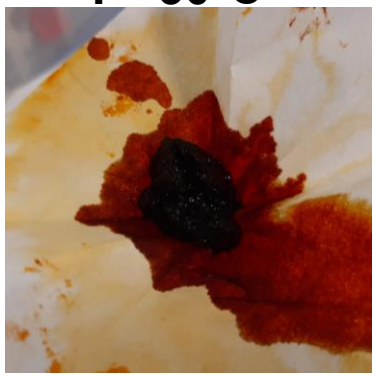
4. Ni – MH Mediated Redox Flow Battery

Widening the Operating Temperature

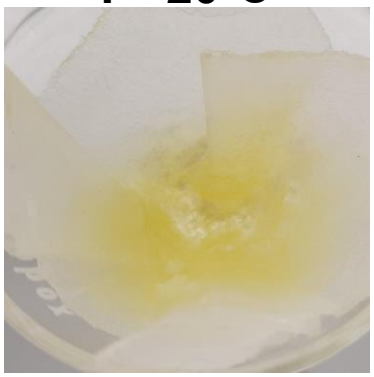
0.2 M DHPS +
0.2 M 2,6-DHAQ

0.3 M $K_4Fe(CN)_6$

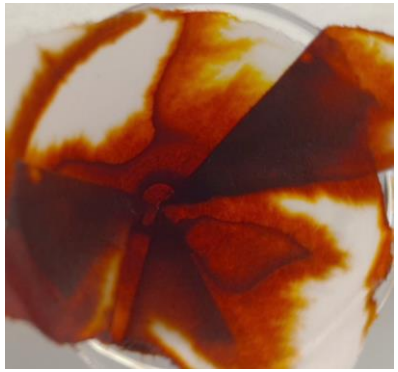
T=-30ºC

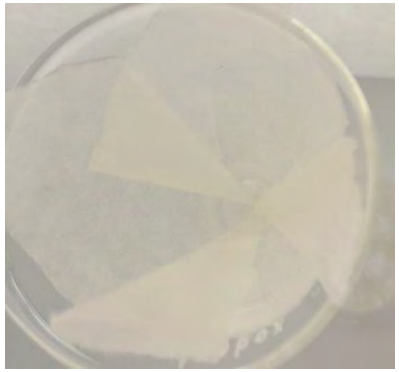


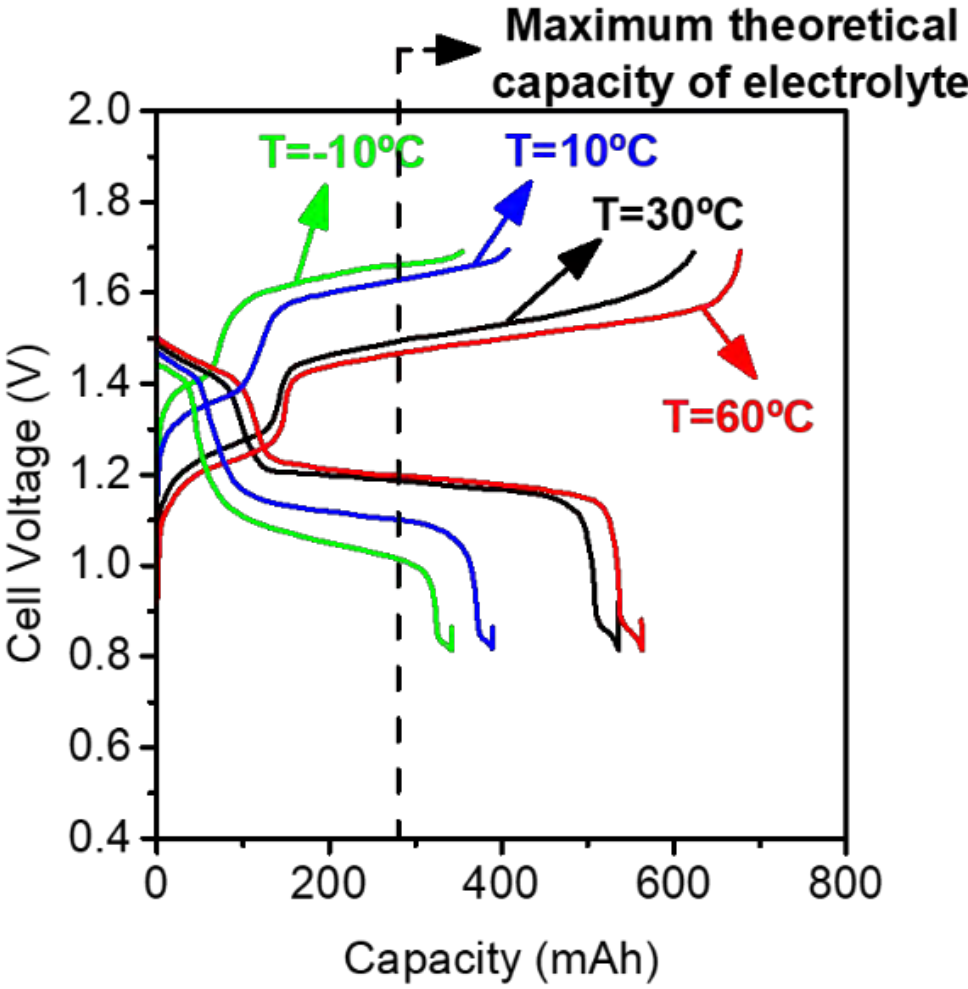
T=-20ºC



T=-10ºC







4. Ni – MH Mediated Redox Flow Battery

Compatibility Issue