Using Galvani potential difference in Biphasic Flow Battery

Vahid Abbasi[1,2*], Pekka Peljo[1,2], Ali Tuna[3], Eduardo Martinez Gonzalez[1,2]

[1]Materials Engineering Department, University of Turku, Turku, Finland

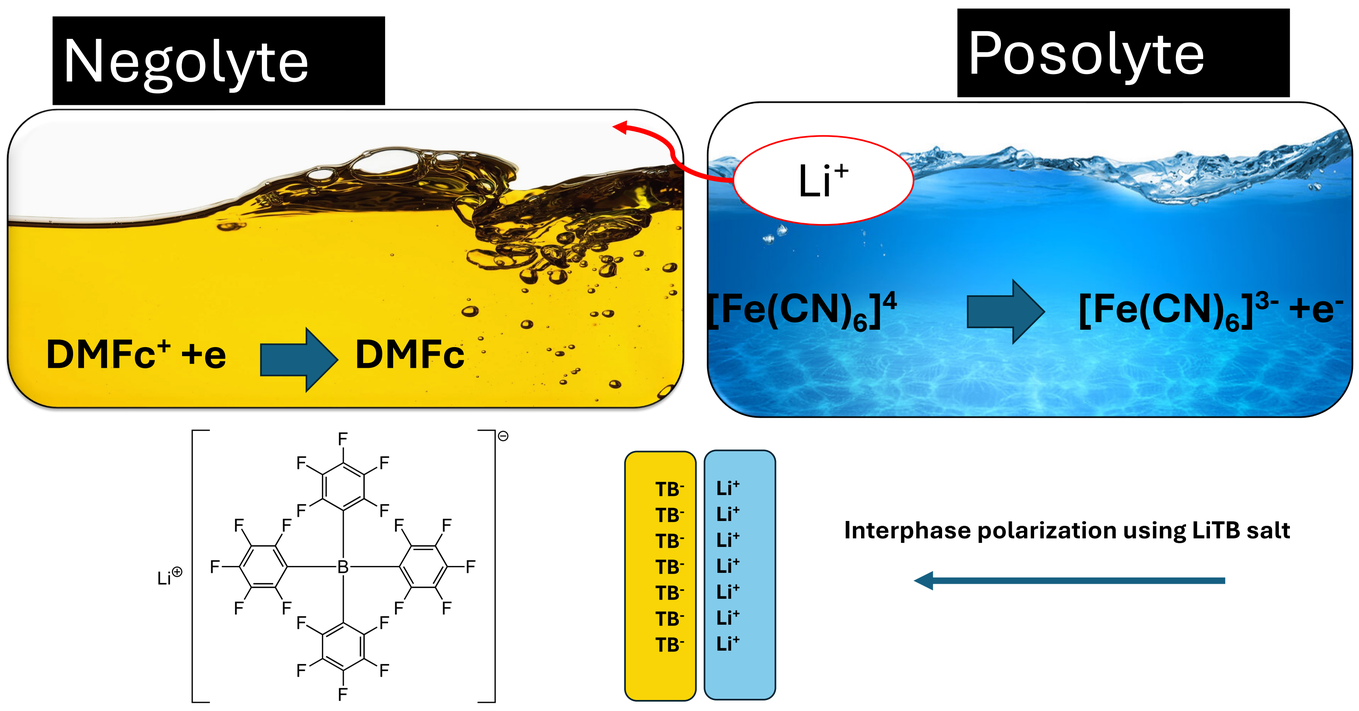
[2]Department of Chemistry, Aalto University, Espoo, Finland

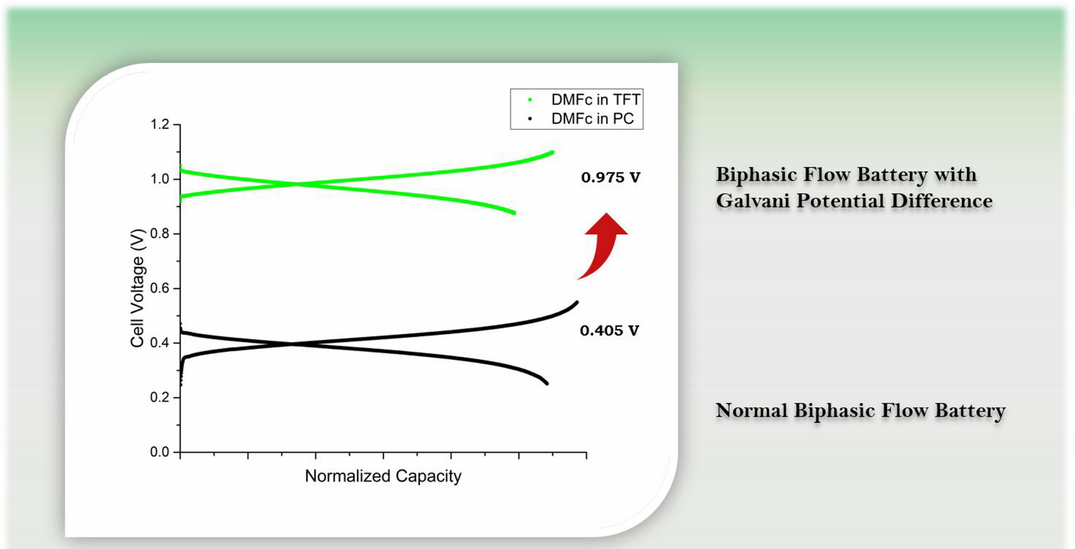
[3]Department of Chemistry, University of Turku, Turku, Finland

vahid.abbasi@aalto.fi

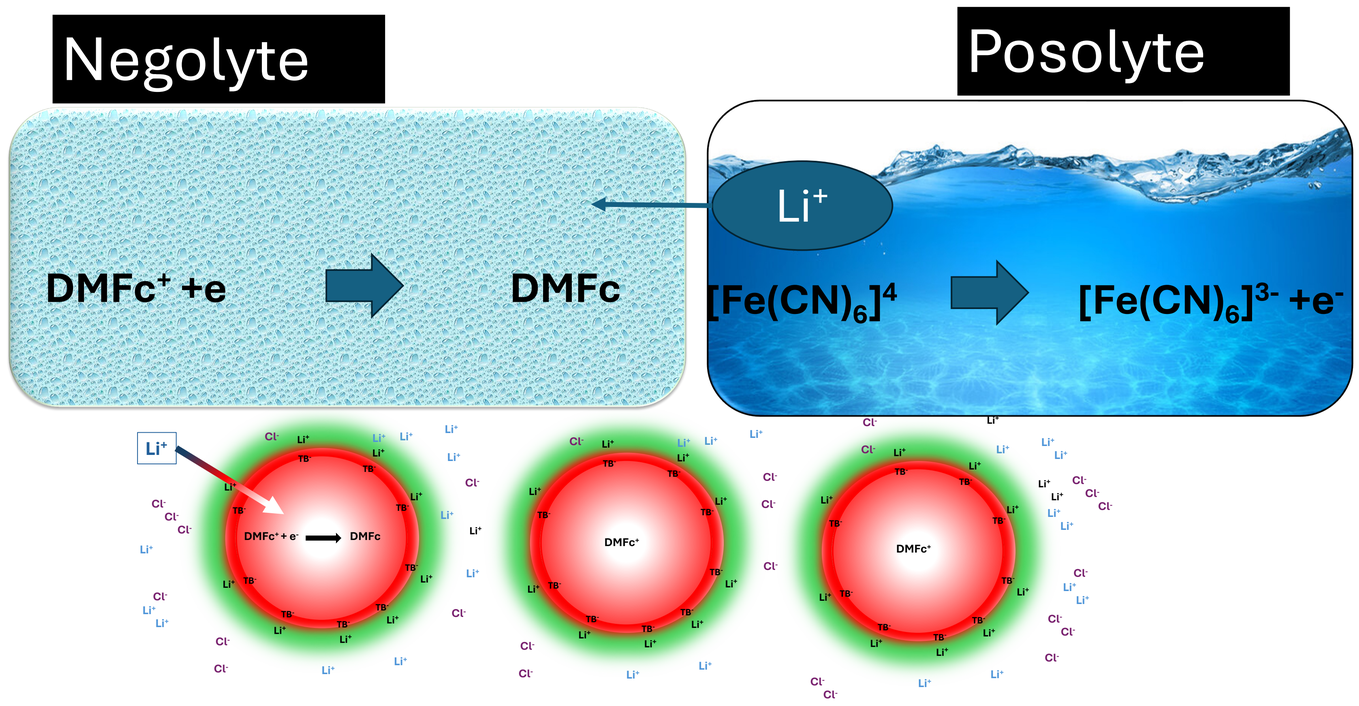
The **Galvani potential difference** is the voltage that arises at the interface between two immiscible liquids due to differences in ion solvation. In a flow battery, when ions move from **polar** (water) to a **non-polar** (organic) this interfacial potential can **boost the cell voltage** and improving energy output.

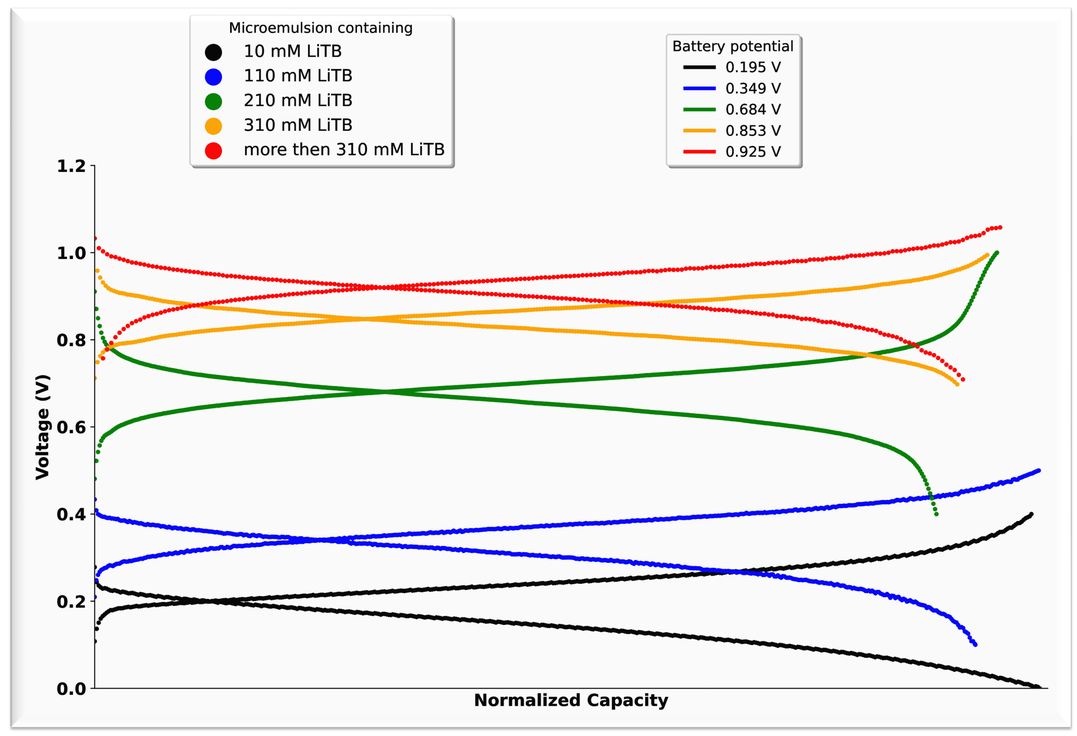
For example, trifluorotoluene and propylene carbonate is used as the organic solvent and water as the polar solvent. Decamethylferrocene (DMFc) as an electroactive species in negolyte was investigated.



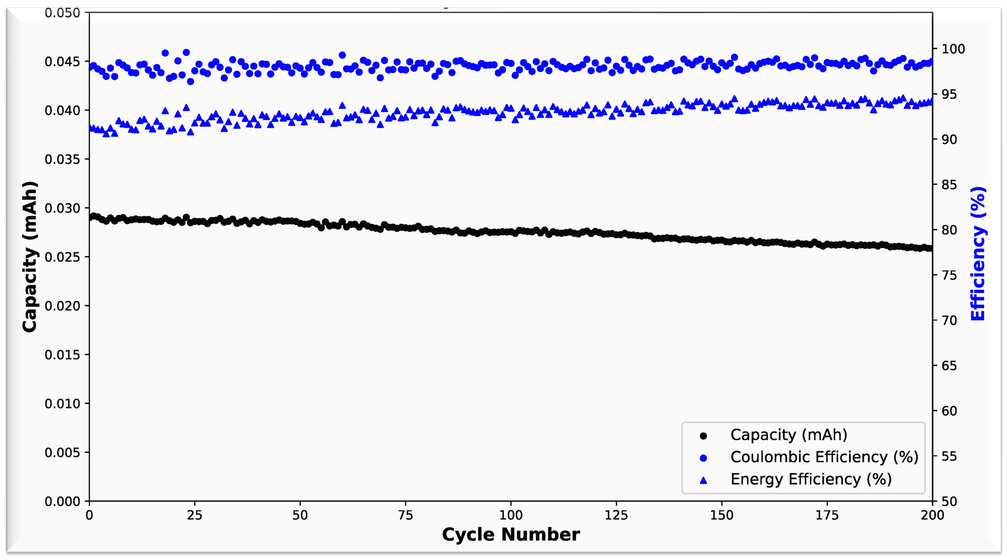


To address the drawbacks of the biphasic system—such as poor cyclability and low conductivity—a **microemulsion-based** system was introduced to replace the organic solvent. This led to improvements in both cyclability and conductivity.





At the final step, the battery potential reaches **0.925 V**, of which **0.730 V** arises from the **Galvani potential difference**. Additionally, the resistance from iR drop significantly decreases—from 100 mV in the biphasic flow battery to 33 mV in the microemulsion-based battery. This reduction indicates improved conductivity and reduced internal resistance in the microemulsion system as water is used.



References

1) V. Abbasi, P. Peljo, Boosting the cell voltage in biphasic flow batteries via Galvani potential difference, Phys. Chem. Chem. Phys., 26, 17476-17480, 2024.
2) P. Peljo, M. Bichon and H. H. Girault, Ion transfer battery: storing energy by transferring ions across liquid–liquid interfaces, Chem. Commun., 2016, 52, 9761–9764.