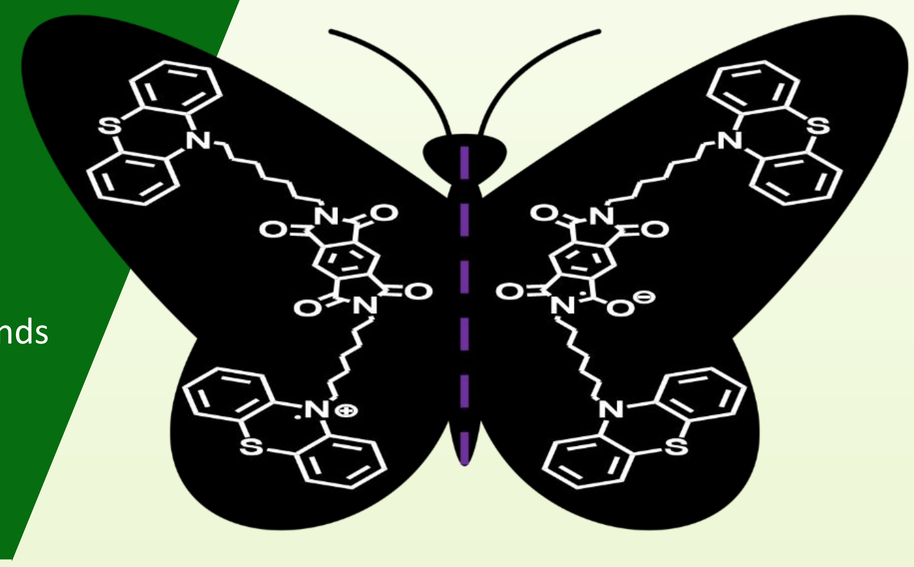
Phthalimide-based Bipolar Redox Active Molecules for Nonaqueous RFBs



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Background

Redox flow batteries (RFBs) are very promising storage systems in the transition towards renewable energy sources. They can be broadly classified in aqueous and non-aqueous systems. Combination of organic solvents with organic redox active materials could pave the way for all carbon-based RFBs with higher cell voltage compared to aqueous systems. However, these

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systems still suffer from heavy crossover due to immature membranes which results in a capacity loss and can also lead to degradation. Furthermore, ion-exchange membranes (IEM) are expensive and make almost 10% of the costs of vanadium RFB applications.[1] Another problem when using IEMs is rebalancing of the electrolytes to recover capacity.[2] Both drawbacks can be overcome by using bipolar redox active materials,

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which can be used as both, anolyte and catholyte. Rebalancing can be simply performed by switching the polarity of the battery, while cheap, porous separator are used, which also enables highly desired fast charging and discharging.

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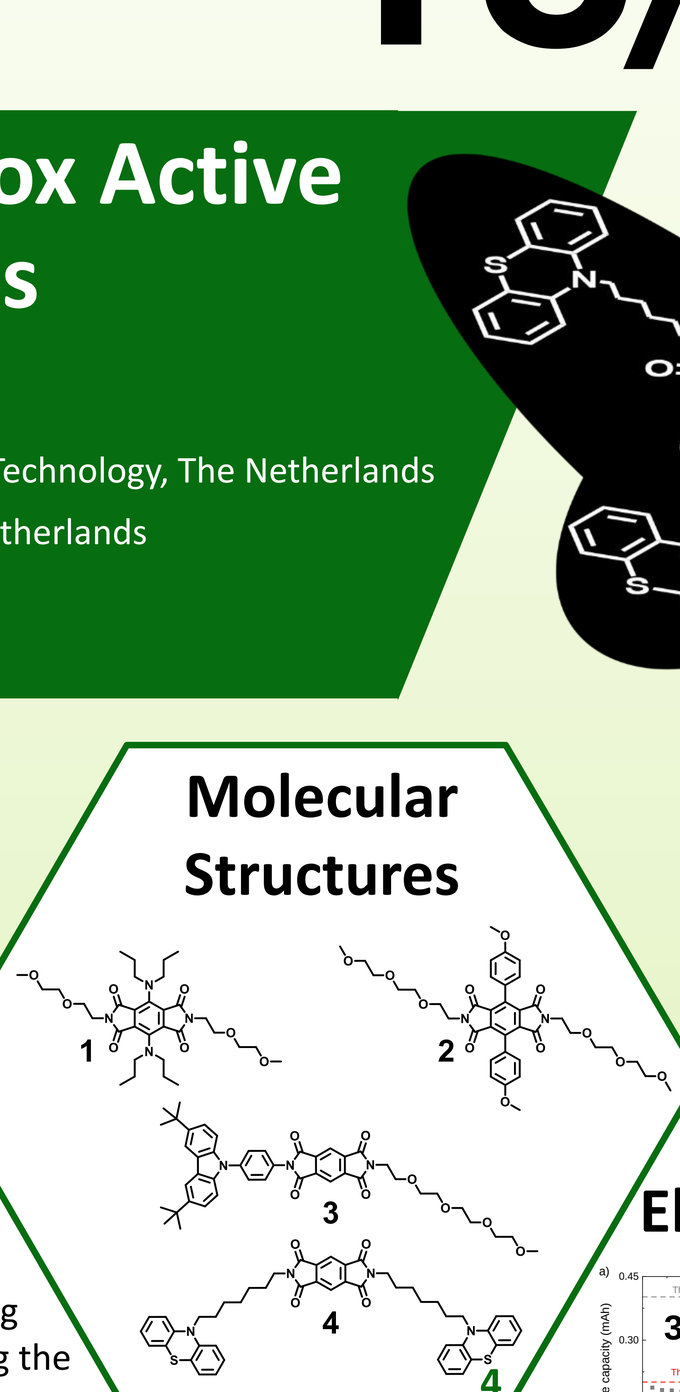
Molecular Structures



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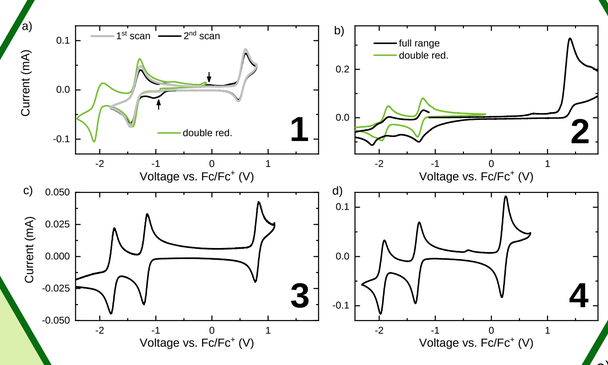
Cyclic Voltammetry



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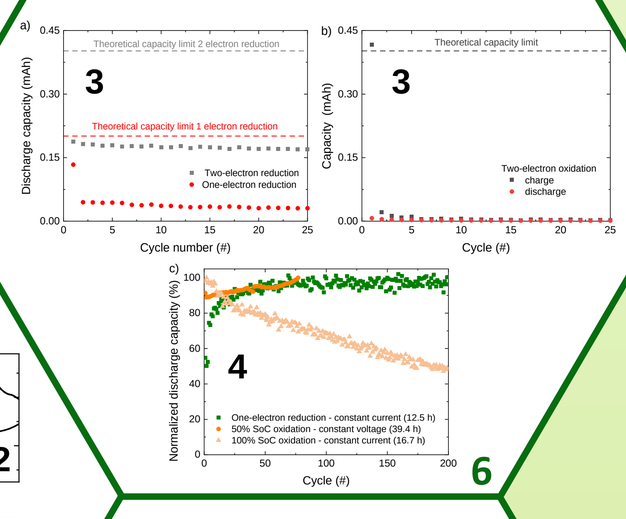
Bulk Electrolysis of 3&4



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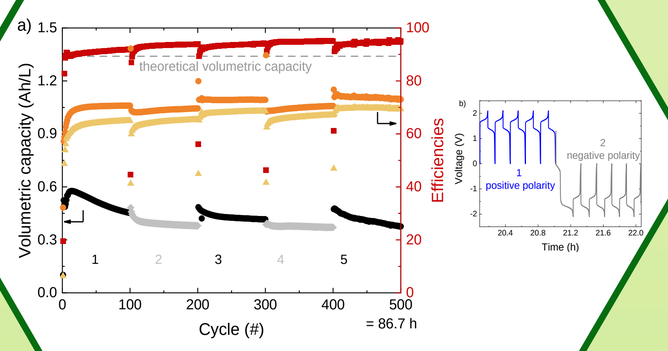
Flow Battery Cycling of 4



Capacity retention: 99.86%/#
Energy efficiency: 69%

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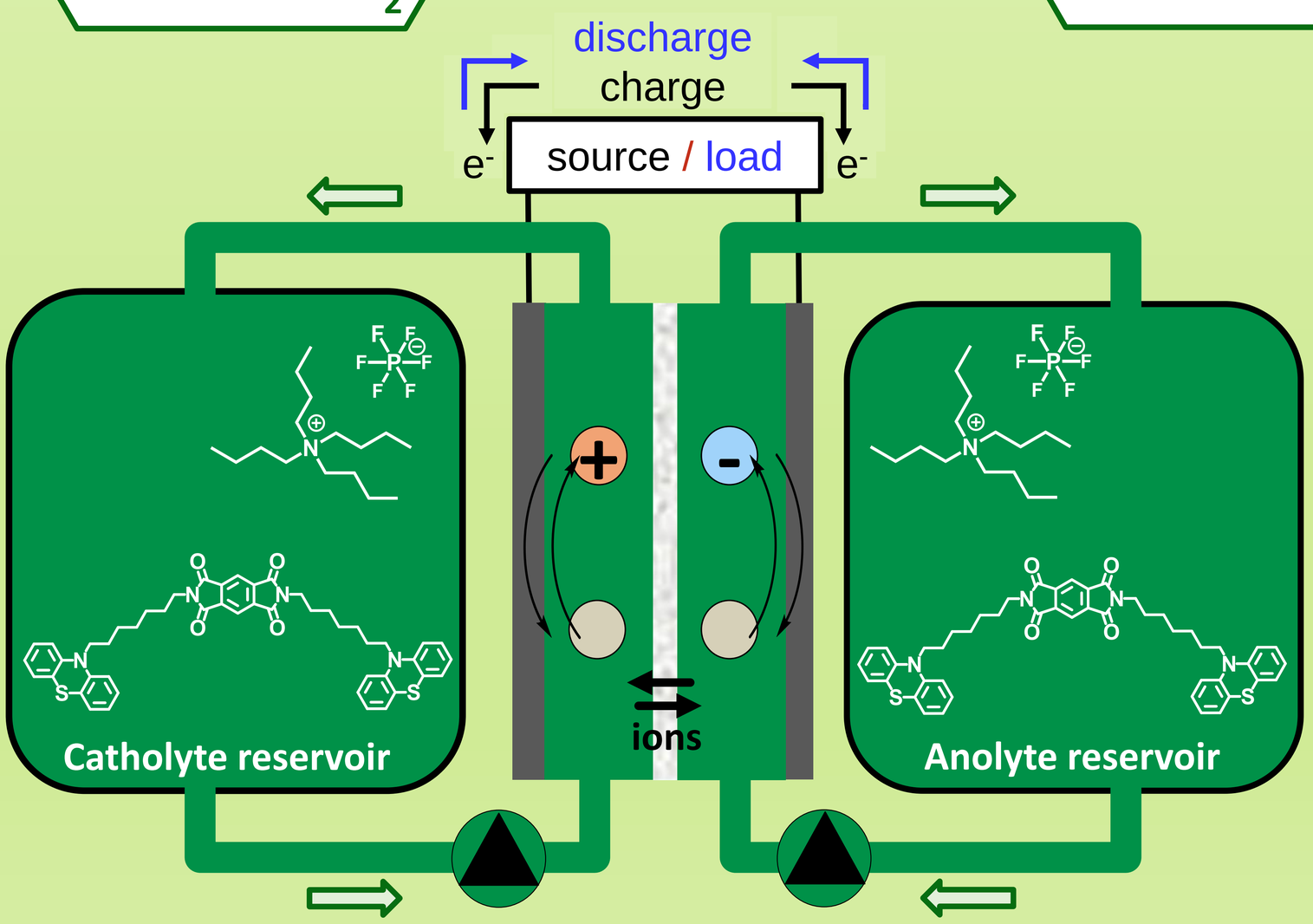

Conclusion

- ✓ 1.6 V symmetric RFB (2.2 V possible)
- ✓ Proof-of-principle: tested over 500 cycles (87 h), including polarity inversions
- ❑ Exploit double reduction & oxidation
- ❑ Performance measurements
- ❑ Solubility optimization

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References

[1] *J. Power Sources* **2015**, 296, 122.
[2] *Electrochim. Acta* **2013**, 98, 66.

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