A Proxyl-Based High Redox Potential Catholyte for Aqueous Organic Redox Flow Batteries

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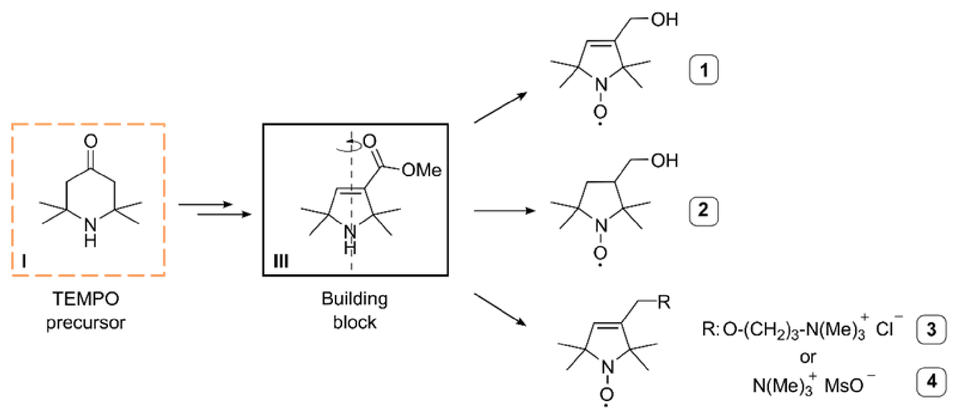
1. Introduction

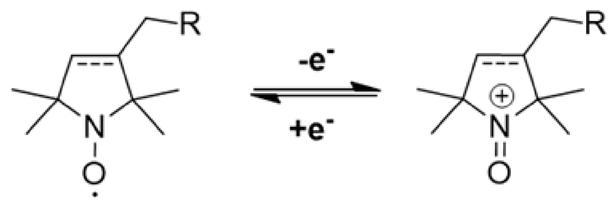
This study introduces a new family of PROXYL derivatives as potential catholyte materials for Aqueous Organic Redox Flow Batteries (AORFB). These derivatives are based on PROXYL nitroxyl radicals, featuring a 5-membered cyclic core. A non-symmetric pyrroline intermediate is used as a key building block to create highly soluble compounds with diverse structures.
Comprehensive characterization of solubility, redox potential, kinetics, and cycling stability reveals the impact of functionalization on catholyte performance.



2. Results

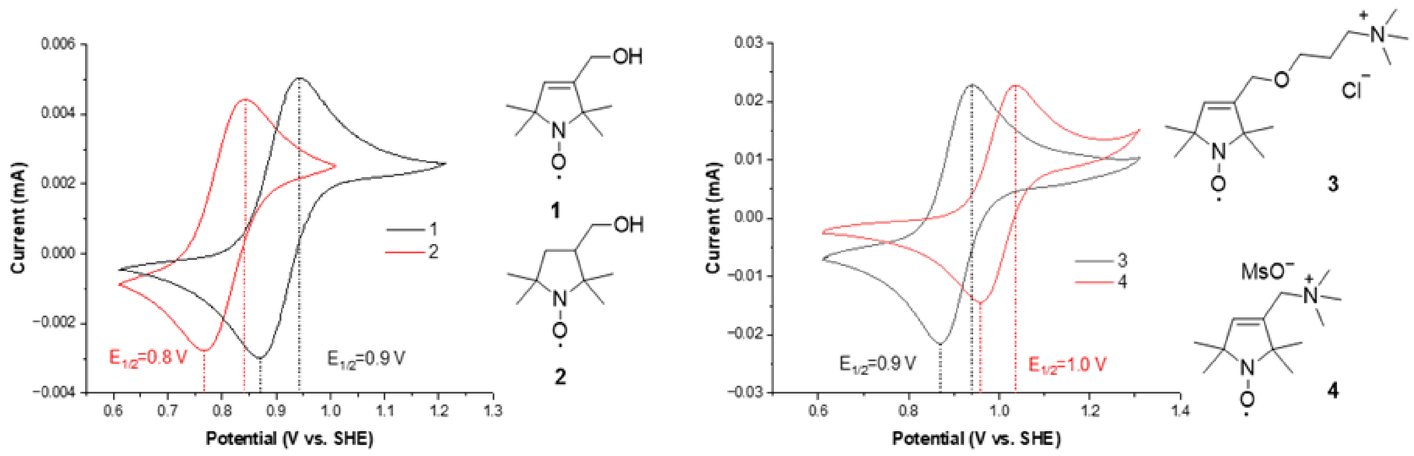
Electrochemical Characterization

› Redox process of PROXYL derivatives

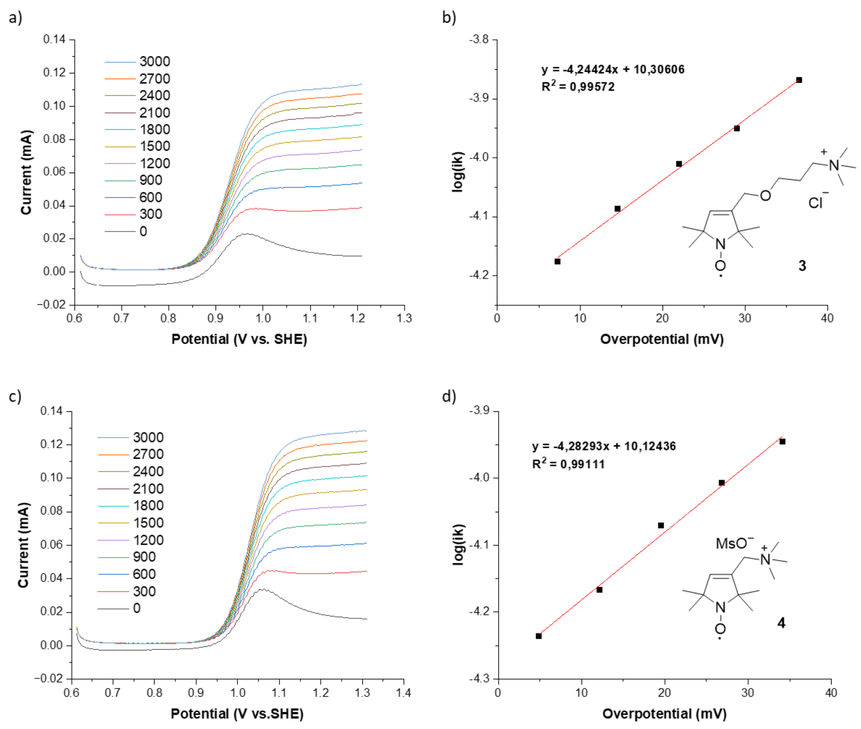


Compound	$E_{1/2}$ (V *vs.* SHE)	D ($cm^2\ s^{-1}$)	k_0 ($cm\ s^{-1}$)
1	0.9	5.3×10^{-6}	1.7×10^{-3}
2	0.8	5.3×10^{-6}	4.8×10^{-3}
3	0.9	3.6×10^{-6}	3.0×10^{-3}
4	1.0	4.2×10^{-6}	2.8×10^{-3}

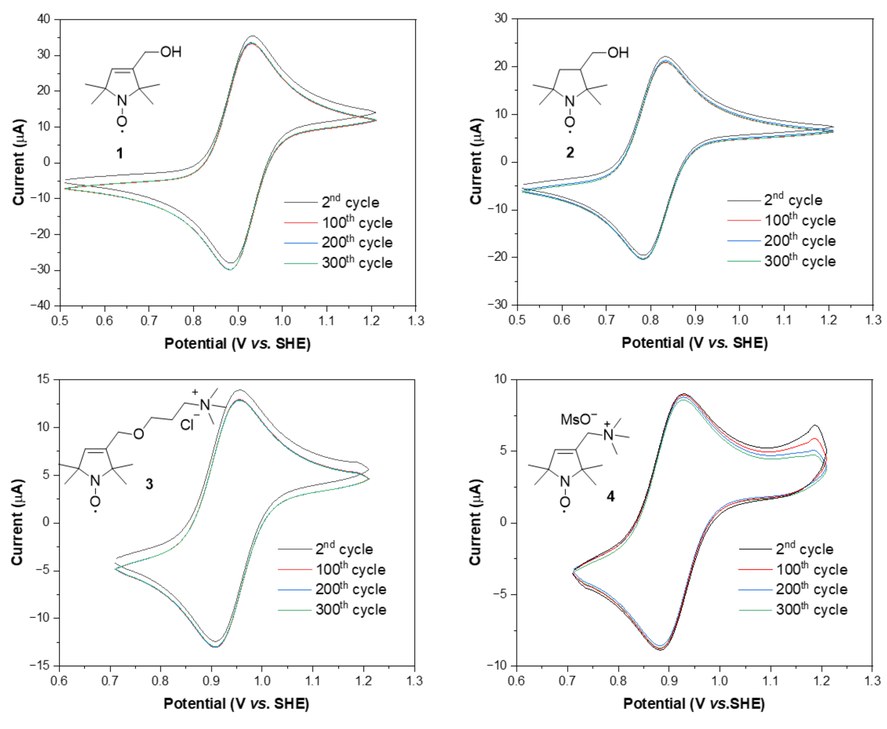
› Cyclic Voltammetry of alcohol intermediates **1-2** and final compounds **3-4**



› Rotating Disk Electrode of PROXYL derivatives



› Long term cyclic voltammetry to evaluate stability



3. Conclusions

Development of advanced PROXYL materials featuring fast kinetics and reversible redox processes. The impact of the internal double bond and the effect of substituents on redox properties has been assessed.
Remarkably, compounds **1**, **3** and **4** present high redox potentials (0.9-1.0 *vs*. SHE) leading to highly interesting catholyte electrolytes for high voltage redox flow batteries.

4. Next Steps

Future work will be focused on conducting further stability test of the different PROXYL derivatives in symmetric cells. prior to integration of the best candidate in a full cell with Viologen derivatives as anolytes

References

[1] O. Nolte, P. Rohland, N. Ueberschaar, M. D. Hager, U. S. Schubert, J. Power Sources 2022, 525, 230996.
[2] B. Hu, H. Fan, H. Li, M. Ravivarma, J. Song, Adv. Funct. Mater. 2021, 31, 2102734.

Acknowledgements

This work was financially supported by Basque Government (GV-ELKARTEK-2022 KK-2022/00043)