Redox-active Covalent Organic Frameworks as promising organic electrodes for metal-ion batteries

Manuel Souto,[a,b]

[a] *CIQUS, Centro Singular de Investigación Química Bioloxica e Materiais Moleculares, Departamento de Química Física, Universidade de Santiago de Compostela, 15782, Santiago de Compostela, Spain*

[b] *Department of Chemistry, CICECO-Aveiro Institute of Materials, University of Aveiro, Aveiro, 3810-393, Portugal*

Keywords: *electroactive porous frameworks, redox-active COFs, organic batteries.*

A breakthrough in chemistry and materials science has been the development of Lithium-Ion Batteries (LIBs), which show great potential for storing energy from renewable sources and as the power source for electric cars.[1] However, commercially available LIBs are based on transition metal oxide cathodes, presenting significant development bottlenecks in terms of efficiency and raw materials availability. Organic materials have received much attention as alternative electrodes because of their high theoretical capacity, resources availability, and sustainability.[2,3] In particular, Covalent Organic Frameworks (COFs), crystalline porous polymers based on organic building blocks linked by strong covalent bonds, have emerged in the past few years as promising organic electrode materials due to their insolubility in electrolyte, porosity, and outstanding chemical and structural versatility.[4-5] However, there are still some challenges that need to be addressed, such as the processing of these materials as well as their relatively low electrical conductivity.[6] In the talk, I will present an approach to improve the electrochemical performance of an anthraquinone-based COF (**DAAQ-TFP-COF**) cathode material in metal anode (Li, Mg) based batteries through proper selection of the electrolyte and binder.[7] Our findings demonstrate that the appropriate choice of electrolyte and binder is crucial to maximize the performance of COF-based materials in different post-lithium-ion metal anode batteries. Finally, the synthesis and electrical properties of a series of redox-active tetrathiafulvalene (TTF)-based COFs that were explored as organic p-type cathode materials for lithium batteries will be presented.[8]

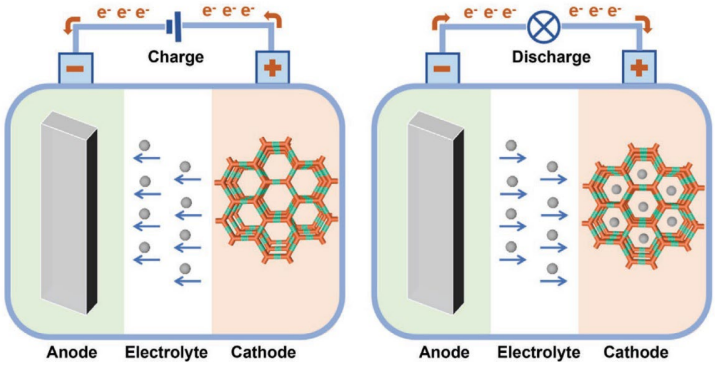

Figure 1. Schematic representation of the electrochemical working process in COF-metal batteries.

Acknowledgements

This work has received funding from the European Research Council (ERC) under the European Union's Horizon Europe Framework Programme (ERC-2021-Starting Grant, grant agreement no. 101039748-ELECTROCOFS). This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, Grants UIDB/50011/2020 and UIDP/50011/2020, financed by national funds through the FCT/MEC and when appropriate co-financed by FEDER under the PT2020 Partnership Agreement. We thank FCT for funding the project PTDC/QUI-ELT/2593/2021.

References

[1] J. B. Goodenough, *Nat. Electron.* **2018**, *1*, 204.
[2] M. Armand, J.-M. Tarascon, *Nature* **2008**, *451*, 652–657
[3] Z. Song, H. Zhou, *Energy Environ. Sci.* **2013**, *6*, 2280–2301.
[4] R. Dantas, C. Ribeiro, M. Souto. *Chem. Commun.* **2024**, *60,* 138-149.
[5] M. Souto, K. Strutyński, M. Melle-Franco and J. Rocha, *Chem. Eur. J.*, **2020**, 26, 10912.
[6] M. Souto, D. F. Perepichka. *J. Mater. Chem. C* **2021**, *9*, 10668–10676.
[7] O. Luzanin, R. Dantas, R. Dominko, J. Bitenc, M. Souto. *J. Mater. Chem. A* **2023**, *11,* 21553.
[8] G. Valente *et al.*, **2024**, *submitted*.