

Organometallic fibers used as potential separators for supercapacitors devices

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Since the last decade, interest of organic framework for electrochemical application have been more studied.¹ In general, very few works have been found in the literature. We can mainly mention the use of these derivatives in the presence of inorganic materials both to form solid electrolytes or to protect electrodes. For example, 1,4,7,10-tetraazacyclododecane-1,4,7,10-tetraacetic acid (H₄DOTA) was employed to functionalize PVA to coat the negative electrode surface in order to suppress its degradation.² This resulted in the improvement of the electrochemical properties of the LMNO/graphite cell. Recently, Kim *et al.* reported the addition of 1,4,8,11-tetramethyl-1,4,8,11-tetraazacyclotetradecane to a carbonate-based electrolyte intended to stabilize the Li metal-electrolyte interface by improving the solid electrolyte interphase.³ Very few examples relate to full organic frameworks used as separators are reported.

Therefore, our investigation to develop new supramolecular metal-based objects via a self-assembly process of molecular bricks will be presented. Working on cyclen derivatives permits to obtain metal complexes very stable able to pack in a well-oriented dimension. Cyclen derivatives, in the presence of metal salts such as copper or zinc chlorides and polar solvents such as aliphatic alcohols, has a strong affinity for metals and assembles spontaneously in some conditions.⁴

In terms of applications, these “metallo-organic” fibers (Figure 1), obtained by self-assembly, constitute an original substrate relatively easy to access for the preparation of 1D organic objects. Moreover, taking advantage of the proprieties and potentialities of those materials, we format an adequate shape to handle it as a potential separator for application for energy storage systems (ESS).

After presenting their synthesis and their formatting as potential separator for supercapacitors, preliminary electrochemical studies will be discussed.

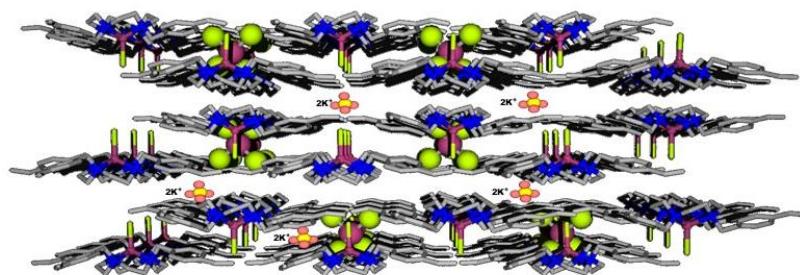


Figure 1: Presentation of the molecular packing to form fibers.

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References

- ¹S. Bai, K. Zhu, S. Wu, Y. Wang, J. Yi, M. Ishidab and H. Zhou, *J. Mater. Chem. A* **2016**, *4*, 16812-16817; Y. Yang, S. Yao, Z. Liang, Y. Wen, Z. Liu, Y. Wu, J. Liu and M. Zhu, *ACS Energy Lett.*, **2022**, *7*, 885-896.
- ²H-S. Kim, J. B. Lee, S. Hwang, S. Chae, J. H. Ryu, and S. M. Oh, *ACS Appl. Energy Mater.*, **2021**, *4*, 128-133.
- ³M. A Lee, H. J. Leem, J. Yu, and H-S. Kim, *ACS Appl. Matter. Interface*, **2022**, *14*, 35645-35653.
- ⁴L. Moreau, A. Balland-Longeau, P. Mazabraud, A. Duchêne and J. Thibonnet, *Chem. Commun.* **2010**, *46*, 1464-1466.