
SBPMat
B-MRS
SOCIEDADE BRASILEIRA
DE PESQUISA EM MATERIAIS
SALVADOR
XXIII B-MRS Meeting 2025
September 28th to October 2nd
BRICS
Brasil 2025

Biopolymer-modified Ti_3C_2Tx MXene/ alginate composite electrodes for application in symmetric supercapacitors

Jorge Alexandre Alencar Fotius[1,2], Murilo H. M. Facure[3], Daniel Souza Correa[4], Emanuel Carrilho[5], Hernane da Silva Barud[6], Helinando Pequeno de Oliveira[1]

[1]Fundação Universidade Federal do Vale do São Francisco (*Instituto de Pesquisa em Ciência dos Materiais*) , [2]Instituto Federal de Educação, Ciência e Tecnologia do Sertão Pernambucano (*Campus Petrolina*) , [3]Instituto de Química de São Carlos - Universidade de São Paulo, [4]Embrapa Instrumentação (*Laboratório Nacional de Nanotecnologia Aplicada ao Agronegócio (LNNA)*) , [5]Instituto de Química de São Carlos - Universidade de São Paulo (*BioMicS Group*) , [6]Universidade de Araraquara (*Laboratório de Biopolímeros e Biomateriais (BioPolMat)*)

e-mail: jorge.fotius@ifsertao-pe.edu.br

MXenes, such as Ti_3C_2Tx, are promising materials for supercapacitors due to their high conductivity and outstanding EDLC and pseudocapacitive charge storage mechanisms. However, their natural tendency to restack reduces the number of ion-accessible sites, thereby limiting their electrochemical performance. In this study, we propose a strategy to mitigate restacking by incorporating Ti_3C_2Tx into a sodium alginate matrix, forming a flexible composite electrode. SEM and XRD results confirmed the increase in interlayer spacing resulting from the intercalation of alginate, while FTIR indicated a chemical interaction between the components. Electrochemical characterization revealed improved ion transport and charge storage. The symmetric supercapacitor assembled with Ti_3C_2Tx-Alg electrodes delivered a specific capacitance of 129.1 F g^{-1}, energy density of 10.2 Wh kg^{-1}, and power density of 1724.1 W kg^{-1} in 1 M H_2SO_4. Compared to pristine Ti_3C_2Tx, the composite showed higher Coulombic efficiency (~100%) and improved charge/discharge stability at high scan rates. These results underscore the significance of MXene/biopolymer hybrid systems in the development of cost-effective and high-performance supercapacitor electrodes.

Acknowledgements
FAPESP, CNPq, CAPES, FINEP, and FACEPE supported this work.

References

Y. Gogotsi et al., Science 341, 1502 (2013).

Dong, Y. et al., RSC Adv. 2019, 9, 29015–29022.

M.H.M. Facure et al., Energy Storage Mater. 61, 102919 (2023).