FOR A CIRCULAR ECONOMY

22nd ICCDU

2025 JUNE 23-27

LISBON, PORTUGAL

22nd International Conference on Carbon Dioxide Utilization

Book of Abstracts

TÉCNICO LISBOA

NOVA FACULDADE DE CIÊNCIAS E TECNOLOGIA

Sociedade Portuguesa de Química

P17. Functional alginate aerogels as green catalytic platform for CO_2-to-syngas conversion

Messias, S.[1,2], Paninho, A.B.[1,2*], Vieira, G. [1,2], Souza A[2], Rangel, C.M.[3], Nunes, A.V.M.[2], Nunes, D.[1], Martins, R.[1], Mendes, M.J.[1], Reis- Machado, A.S.[1,2]

[1] *i3N/CENIMAT, Department of Materials Science, Nova School of Science and Technology, CEMOP/UNINOVA, Campus de Caparica, Caparica, 2829-516, Portugal*
[2] *LAQV, REQUIMTE, Chemistry Department, Nova School of Science and Technology, Campus de Caparica, Caparica, 2829-516, Portugal*
[3] *Laboratório Nacional de Energia e Geologia Estrada do Paço do Lumiar 22, Lisboa 1649-038, Portugal,*

E-mail: inespaninho@fct.unl.pt

Bio-based aerogels offer key advantages such as high porosity, tunable structures, and environmental compatibility. These properties promote effective dispersion of the active phase and enhance mass transport by allowing the porous architecture to be tailored. Using renewable materials as support is especially appealing for sustainability, as biopolymers are abundant, low-cost, and scalable. Among these, alginate—a natural polysaccharide biopolymer extracted from brown algae—stands out due to its biodegradability, low toxicity, chemical stability, and affordability, aligning well with green chemistry principles [1]. On the other hand, the application of CO_2 as a safe, renewable carbon feedstock for chemical and fuel production has emerged as a prominent research area. It leverages CO_2 as a C1 building block in place of fossil resources, thereby reintegrating carbon into the value chain and supporting circular economy goals [2]. In this work, alginate aerogels were explored for CO_2 conversion into CO [3] (through electrochemical reduction). The aerogels were prepared by the sol gel method and impregnation with zinc metallic particles and copper nanowires [4] to be used as cathodes for the co-electrolysis of CO_2 and water (Figure 1). The present work reports a strategy to tune the pore sizes of the catalytic electrodes by the use of reticulating agents. Productivities and faradaic efficiencies of the porous materials with the different reticulating agents are compared and interpreted in respect to their surface characterization e.g. BET surface areas and morphology determined by SEM. The main advantages brought to the process were discussed, including the impact of alginate-based aerogel supports on efficiency, process selectivity, highlighting their potential in CO_2 utilization technologies.

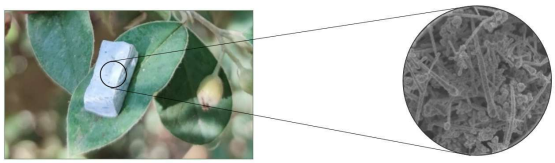

Figure 1: Application of the nanowires in alginate aerogels.

Keywords: CO_2 Electroreduction; Bio-based Aerogels; Green Chemistry; CO_2 Utilization.

Acknowledgements: This work received funding from FCT (Fundação para a Ciência e Tecnologia, I.P.) under the projects LA/P/0037/2020, UIDP/50025/2020 and UIDB/50025/2020 of the Associate Laboratory Institute of Nanostructures, Nanomodelling and Nanofabrication—i3N, from FCT/MCTES LA/P/0008/2020, UIDP/50006/2020, UIDB/50006/2020 of the Associate Laboratory of Green Chemistry, LAQV, and by the projects CO2RED (PTDC/EQU-EPQ/2195/2021) and M-ECO2 - Industrial cluster for advanced biofuel production, Ref. C644930471-00000041, co-financed by PRR - Recovery and Resilience Plan of the European Union (Next Generation EU).

References

[1] Paninho, A.B., Mustapa, A.N., Mahmudov, K.T., Pombeiro, A. J., et al, *Catalysts* 11 (2021) 872.
[2] Artz, J., Müller, T. E., Thenert, K., Kleinekorte, J., et al, *Chemical reviews* 118 (2018) 434-504.
[3] Messias, S., Sousa, M.M., et al, A.S.R. *Reaction Chemistry & Engineering* 4 (2019), 1982-1990. Nunes, D., Pimentel, A., et al, R. *Journal of Materials Chemistry C 2* (2014) 6097-6103.