OP32

Amino acid-based ionic liquids (AAILs) investigation for an industrial CO_2-assimilating anaerobe process

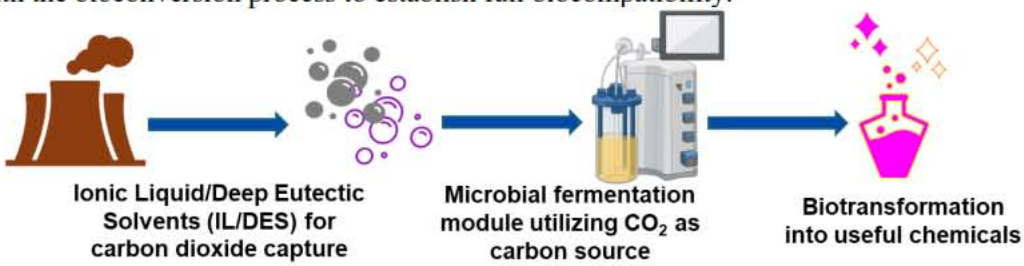
Athena Nikolopoulou[1,2], Vanessa Savvopoulou[1,2], Dionysios Vroulias[1], Theophilos Ioannides[1], Maria I. Klapa[1], Dracopoulos Vassileios[1,*]

[1]*Institute of Chemical Engineering Sciences, Foundation for Research and Technology-Hellas (FORTH/ICE-HT), GR-26504, Patras, Greece*
[2]*Department of Chemistry, University of Patras, GR-26500, Patras, Greece*
**indy@iceht.forth.gr*

The escalating levels of anthropogenic CO_2 emissions necessitate the development of efficient processes for capturing and converting CO_2 into biofuels and valuable chemicals. In this context, non-photosynthetic CO_2 bioconversion has gained significant attention in metabolic engineering and industrial biotechnology, offering an alternative to traditional biomass-based microbial processes. The development of effective CO_2 absorbents is vital and so far, various materials including ionic liquids and amino acids, have been evaluated for their CO_2 capture potential. Each offers distinct advantages and challenges, and their selection depends on factors such as absorption capacity, regeneration energy, and, in integrated setups which have not been investigated much so far, compatibility with bioconversion processes [1].

Amino acid-based ionic liquids (AAILs) and deep eutectic solvents (AADES) could be promising materials possessing efficient CO_2 capturing, showing lower energy intensive CO_2 releasing properties. In case of potential leaks at the CO_2 desorption phase, these ILs probably will not inhibit microbial growth. For this reason, AAILs comprising of glycine [Gly], histidine [His], arginine [Arg] and lysine [Lys] as anions and tetrabutylammonium [N_{4444}], tetrabutylphosphonium [P_{4444}] and cholinium [Ch] cations were synthesized through facile Bronsted acid-base reaction [2]. Their structure was verified using ATR-FTIR spectroscopy, while their thermal properties were investigated through TGA and DSC techniques. Also, AADES as hydrogen-bond acceptors (HBAs) prepared from the aforementioned AAILs using glycerol as hydrogen-bond donor (HBD) in 1:10 molar ratio to achieve lower viscosity. Finally, their CO_2 absorption capacity was determined with the use of isothermal thermogravimetric method using a pure 100% CO_2 stream.

Among all synthesized AAILs and AADES, [Ch][Gly] achieved the best CO_2 adsorption capacity of 1.86 mol CO_2 kg IL^{-1}, showing a potential use for an industrial CO_2 anaerobe process. We are in the process of testing it in sequence with the bioconversion process to establish full biocompatibility.



Acknowledgements

This work has been financially supported by the project "Integrated sustainable process for ionic liquid based carbon dioxide capture and its subsequent biotransformation into fuels and useful chemicals from extremophiles" CO2-BION , No. 16103 of the Hellenic Foundation for Research and Innovation (HFRI)-implemented Greece 2.0 National Recovery and Resilience Plan, Subproject 1: Basic Research Financing (Horizontal support for all Sciences).

References

[1] Sistla, Y. S., & Khanna, A. (2015). CO_2 absorption studies in amino acid-anion based ionic liquids. *Chemical Engineering Journal, 273, 268–276.* doi:10.1016/j.cej.2014.09.043

[2] Guzmán, J., Ortega-Guevara, C., de León, R. G., & Martínez-Palou, R. (2017). Absorption of CO2 with Amino Acid-Based Ionic Liquids and Corresponding Amino Acid Precursors. *Chemical Engineering & Technology, 40(12), 2339–2345.* doi:10.1002/ceat.201600593