Università degli Studi di Napoli Federico II

PhD in Biotechnology - 38th cycle

Dr. Marikagiusy Di Giacomo

Development of biocatalytic processes for CO_2 capture and utilization

Tutor: Prof. Antonio Marzocchella

Department: Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Piazzale V. Tecchio 80, 80125, Napoli.

Efficient carbon capture and utilization (CCU) processes have been developed as on of the main strategies to limit CO2 emissions and obtain valuable CO_2-based chemicals, synthetic fuels, and construction materials. The present PhD project aims to develop new biocatalytic technologies to expand the possible CCU processes including versatile processes not limited by large heat and H_2 consumption. Enzymatic reactive absorption (ERA) of CO_2 based on the use of carbonic anhydrase (CA) provide bicarbonate as intermediate product for CO2 storage or use[1]. Recently, the co-factor-free enzymatic carboxylation (EC) phenols (derived from lignocellulose) has been proposed as a novel biocatalytic CO_2 utilization process[2]. Indeed, the carboxylation reaction is promoted by the bicarbonate excess (up to 2M). The main goal of the project is the optimization of process parameters for combined ERA and EC, and the development of the main enabling technologies (decarboxylase immobilization, EC bioreactor design). Covalent mechanism of enzyme immobilization will considered to ensure biocatalyst activity and stability in the presence of high concentration of bicarbonate ions in the liquid solvent.

References

1. Russo M.E., et al. Immobilization of carbonic anhydrase for CO2 capture and utilization. Appl Microbiol Biotechnol (2022).
2. Pesci, L. *et al.* Biocatalytic carboxylation of phenol derivatives: Kinetics and thermodynamics of the biological Kolbe-Schmitt synthesis. *FEBS J.* **282**, 1334–1345 (2015).