Advancing Carbon Dioxide Removal and Utilization Through Electrochemical Processes

Nadezda Kongi[1,*]

[1]*RedoxNRG OÜ*
**nadja@redoxnrg.com*

Utilizing electrochemical methods for carbon capture and release under ambient conditions has emerged as a promising alternative to traditional amine scrubbing techniques.[1] By employing electrochemical processes, either through the utilization of organic redox-active compounds or pH adjustments, significant advancements in energy efficiency, scalability, and safety have been observed. However, current electrochemical direct air capture (EDAC) systems often face challenges related to sensitivity to oxygen, limiting their practical application.[2,3] To overcome this obstacle, RedoxNRG is pioneering a novel approach to electrochemical CO_2 capture and concentration, focusing on the development of robust conductive and redox-active metal-organic frameworks. Importantly, our efforts prioritize the avoidance of critical raw materials in our electrosorbents and emphasize the pursuit of more efficient synthesis methods to enhance scalability. Furthermore, in addressing the need for safe and permanent CO_2 storage, our integrated process directs captured CO_2 to an electrolyzer, where it is converted into valuable feedstocks. This strategy not only mitigates atmospheric CO_2 levels but also efficiently stores intermittent renewable energy, thereby facilitating a transition towards a more sustainable industrial paradigm. By harnessing renewable electricity for the electrochemical capture and conversion of CO_2, our approach offers an environmentally friendly means of producing valuable chemicals and fuels, including carbon monoxide, formic acid, and methanol. Through the transformation of CO_2 into value-added products, EDAC stands to play an important role in driving the shift away from reliance on fossil fuels towards a more sustainable future.

References

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