Addressing the stability challenges of Gas Diffusion Electrodes in the presence of ILs-based solutions for the continuous Electrochemical Reduction of CO_2

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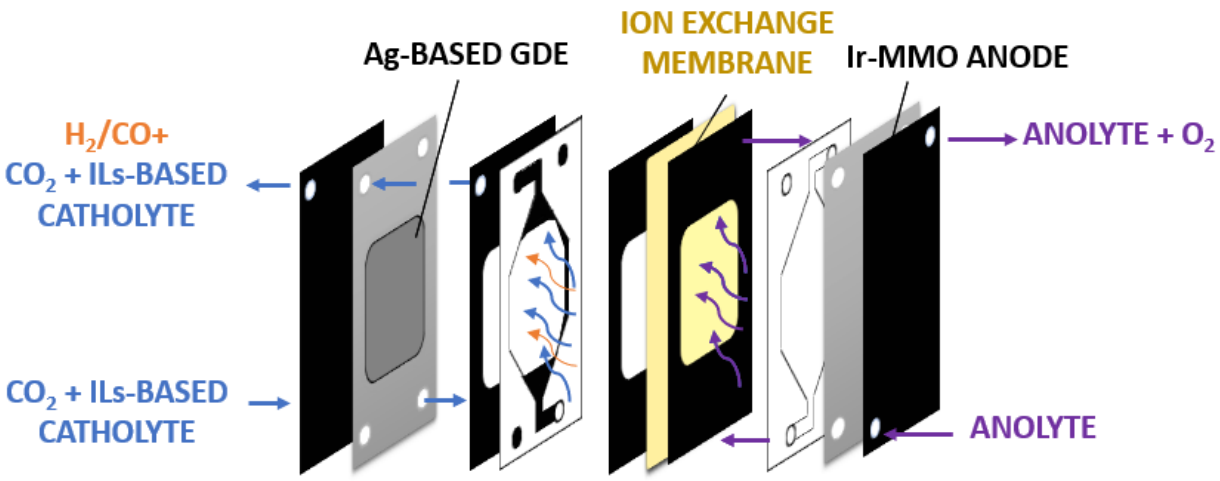
Nowadays, it has become clear that the ever-increasing concentration of carbon dioxide (CO_2) in the atmosphere is a threat to global security[1]. Therefore, the adverse climate events remind us that a transition towards a carbon neutral economy is more necessary than ever. Several approaches have been proposed to convert CO_2 to valuable products and, among these, the electrochemical reduction of CO_2 (ECR-CO_2) represents one of the most promising alternatives. Herein, the ECR-CO_2 has been carried out for the first-time employing silver based-gas diffusion electrodes (GDEs) within a continuous flow cell and in the presence of ionic liquids (ILs)-based solutions, which have been known to boost CO_2-derived products[2]. As reported in the literature, the instability of GDEs is initiated by the high overpotentials needed during the CO_2 reduction reactions and usually culminates in flooding[3]. This eventually has a negative impact on the product selectivity as well as limits the perspectives of scalability. In particular, in this work, different stability issues have been faced and visualized, for example, in the blackening of typical carbon-based gas diffusion layers (GDLs) and in the degradation/colour changes of ILs-electrolyte. Interestingly, by switching to non-carbon based GDLs it has been possible to reach and maintain a steady-state production of carbon monoxide (CO) both at -10 mA cm^{-2} and at -20 mA cm^{-2} for at least 40 minutes, with a H_2/CO ratio slightly above 2 in the former case. Field Emission Scanning Electron Microscopy (FESEM) and Electrochemical Impedance Spectroscopy (EIS) techniques have been employed to carry out the physicochemical characterization of the electrodes and to assess the electrochemical interfaces within the system, respectively. The observed findings definitely encourage us to proceeding with our study on GDL-supported catalyst for the continuous ECR-CO_2 in the presence of ILs solutions and offers openings for a large-scale deployment.



Acknowledgments

The financial support of the SUNCOCHEM project (Grant Agreement No 862192) of the European Union's Horizon 2020 Research and Innovation Action programme is acknowledged.

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