**CO2 crossover in electrochemical CO2 reduction cells suited for long-time operation at industrially relevant operating conditions**

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**Highlights**

* Electrochemical CO2 reduction at 300 mA/cm² at Faradaic Efficiencies > 80%
* Stable operation for 7000+ hours
* Reduction of CO2-crossover by more than 95%

**1. Introduction**

The electrochemical CO2 reduction allows to create valuable products from “waste” CO2 coming from industrial processes, and cheap, renewable energies. Among the different possible electrolysis products, CO is the most promising for industrial application in the near future and thus, has drawn a lot of interest. By now the technology has passed the fundamental catalytical research stage, and different setups have been reported that perform stable, at high faradaic efficiencies for over 1000 hours at industrially relevant current densities [1,2]. In order to keep up with the rapid industrial application plans [3], research is shifting from catalyst design to engineering the electrolysis process and to upscaling of the setups.

**2. Methods**

The electrochemical experiments were performed in a commercially available flow cell. The different gas streams were quantified, and their composition analyzed via gas chromatography.

**3. Results and discussion**

Among the stable systems published, the mixed-electrolyte approach detailed in [1] is especially suited for rapid scaling and industrial application, since it does not require expensive ion-selective membranes and is not based on novel, research-level materials. By improving the GDE and the overall system setup, the cell could be operated stably at more than 80% faradaic efficiency for 7000 hours at current densities of 300 mA/cm² (Figure 1).



**Figure 1.** Faradaic efficiencies of a CO2-electolysis cell operating stably for over 7000 hours

As the technology moves towards industrial application, the transport of CO2 across the cell becomes an important issue, that has been mostly neglected so far. Due to the formation and neutralization of carbonates, this transport is intrinsic to CO2 electrolysis and needs to be dealt with [1,2,4]. Here different approaches to minimize the CO2 transport across the electrolysis cell are introduced, discussed and tested. All methods keep the advantages of a mixed-electrolyte system and work with the previously tested cathodes. By implementing these methods, the CO2 transport could be reduced by over 95% (Figure 2).



**Figure 2.** CO2 content in the anode gas for different setups. Compared to the standard, reference case, the crossover could be reduced by more than 95%.

**4. Conclusions**

CO2 electrolysis cells with liquid electrolytes are a viable candidate for near-time industrial application. As in all current approaches, the CO2 transport across the cell needs to be accounted for and solving this problem is crucial for a successful industrial implementation of this process. The results here show, that an adequate design of the electrolysis setup can achieve this target while maintaining industrially relevant operating conditions without relying on ion-selective membranes.

**References**

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