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ELECTROLYSIS FOR A BETTER TOMORROW!

Topic - „Scaling-up low temperature CO_2 electrolysis to industrial levels".

Abstract:

The transition to a sustainable energy landscape demands innovative solutions for the utilisation of carbon dioxide (CO_2). Among these, low-temperature CO_2 electrolysis has emerged as a promising pathway for converting CO_2 into valuable chemicals and fuels. In this presentation, Tamás will explore the challenges and opportunities associated with scaling up CO_2 electrolysis to industrial levels.

Electrochemical reduction of CO_2 offers the dual benefit of reducing carbon emissions while producing useful products. However, current electrochemical CO_2 reduction technologies often face limitations in energy efficiency or in selectivity of useful products. Low-temperature CO_2 electrolyzers operate at moderate temperatures and pressures, and with appropriate cell design, they are suitable for dynamic operation and integration with intermittent renewable energy sources. Zero-gap type electrolyzer cell design is one such example; cells and cell stacks designed in this way are capable of converting CO_2 into a useful product for the chemical industry with high selectivity and industrially relevant current densities at low cell voltages, resulting in high energy efficiency (e.g. into carbon monoxide (CO), which can be used as additional chemical raw materials or in the form of syngas for production of fuels and chemicals).

During scale-up, technologies similar to zero-gap CO_2 electrolyzers - such as water electrolyzer cells or fuel cells - can be integrated in an appropriate way: the solutions, experience, and production lines that have been proven there can be a significant advantage in the course of development. After careful evaluation of component availability and machining capacity we scaled up our single electrolyzer cell to a geometric area of 2500 cm^2. Further increase in electrolyzer capacity was achieved by stacking these quarter square metre (QSM) cells. Our CFD-assisted design allows up to 100 cells to be stacked into a single unit.

As part of a system design to demonstrate the technology (TRL6), a containerised unit with a CO production capacity of 100 tonnes of CO per year was designed and built.
During a feasibility study for a plant with a CO conversion capacity of 20 tonnes per day, we answered engineering questions ranging from selection of system components to a 3D layout design.

Innovations in catalysts, cell design, and system integration are essential. Collaborations between academia, industry, and policymakers are vital for realizing large-scale CO_2 electrolysis. Scaling up low-temperature CO_2 electrolysis requires concerted efforts to enhance performance, stability, and economic viability. By addressing technical challenges, we can pave the way for sustainable carbon utilization on an industrial scale.