Fraunhofer IGB Partner Portrait

CO_2EXIDE – CO_2-based electrosynthesis of ethylene oxide

Anodic generation of hydrogen peroxide from low-cost commercial carbon electrodes

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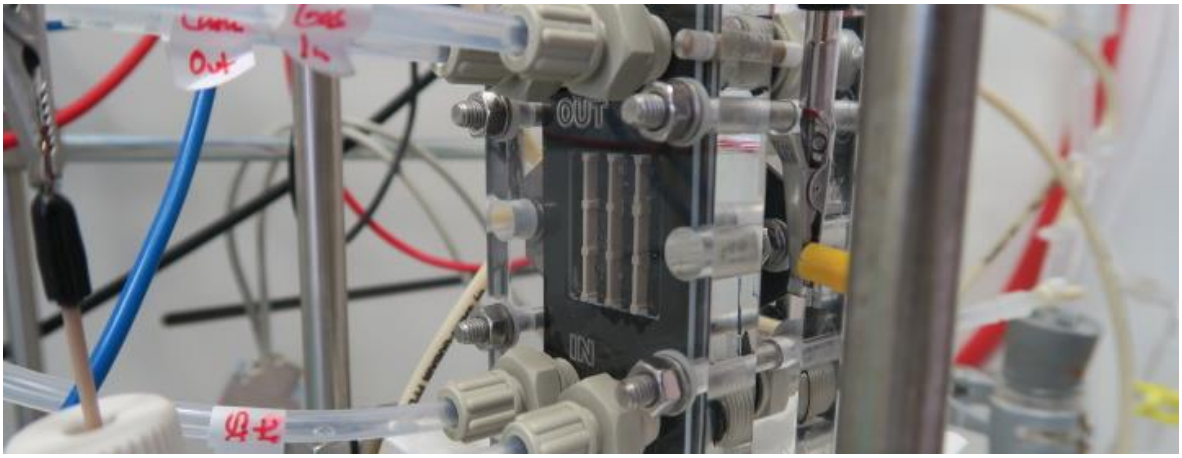
The **Fraunhofer IGB** is the coordinator of the CO2EXIDE project. The tasks of the coordinator include the monitoring of tasks and deadlines acting as an intermediary between all project partners and the European commission. Besides these administrative obligations, Fraunhofer IGB is also responsible for scientific tasks related to catalytic processes development. In particular, the process development for the electrochemical oxidation of water to hydrogen peroxide (H_2O_2) and of the subsequent catalytic epoxidation of ethylene through ethylene reaction with the generated H_2O_2.

Research Results



10 cm² electrochemical cell for water oxidation in test bench (Photo: Fraunhofer IGB 2020)

The **Fraunhofer IGB** has successfully achieved the **anodic generation of hydrogen peroxide** (H_2O_2) using low-cost commercial carbon electrodes. This process represents one

of the electrochemical half-cell reactions developed in CO2EXIDE. The other half-cell reaction is the reduction of CO_2 to ethylene. Fraunhofer IGB is also developing the **synthesis of ethylene oxide** via reaction of ethylene with H_2O_2 in a heterogeneously catalyzed process. This reaction combines the both electrochemical products generated in CO2EXIDE, namely ethylene and H_2O_2, synthesizing ethylene oxide as highly important and versatile platform chemical.

The cathodic ethylene production is being developed by the **University of Southampton (UK), ISSP University of Latvia (Latvia), AGH University of Science and Technology Krákow (Poland)**. The integration of the cathodic and anodic half-cells is being carried out by **Siemens Energy (Germany)** in a demonstrator run by a 300cm² electrode cell developed by **Schaeffler (Germany).** The long-term stability of the process with the foremost catalysts has been proven by the **Budapest University of Technology and Economics (Hungary)**. The demonstrator will use biogenic CO_2 successfully captured and purified from a biogas plant in a process developed by **AXIOM (Austria)**. According to a study of potential green CO_2 sources conducted by the **Energy Institute at the Johannes Keppler University Linz**, biogas-upgrading plants offer the highest potential for the experimental development.

The CO_2EXIDE team is now combining the Electrocatalytic Reactor Unit (ERU) with the Ethylene Enrichment Unit (EEU) and the Ethylene Epoxidation Reactor (EER) in order to demonstrate **the first production of ethylene oxide from CO_2 and water**. The demonstrator is located in Krákow at the AGH University of Science and Technology.

The **Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB** is one of 75 institutes and research units of the Fraunhofer Gesellschaft, the world's leading applied research organization. The IGB develops and optimizes processes, technologies, and products for health, sustainable chemistry and the environment. It relies on the unique combination of expertise in biology and the engineering sciences to contribute to human welfare, a sustainable economy, and an intact environment with the systems approach of bioeconomy as well as bioinspired, biointegrated and biointelligent solutions.

Working closely with partners from universities and industry, the IGB covers the entire innovation chain **from fundamental research to industrial implementation**.

The team of Fraunhofer researchers engaged in CO2EXIDE is working in the Innovation Field **“Sustainable Catalytic Processes”**, located in Straubing, Germany. The research focus of this team lies on the development of chemical, electrochemical, and biotechnological processes and their multifaceted combination, for the sustainable production of chemicals and fuels from renewable resources. Of particular interest are “Power-to-X-to-Y” process cascades, enabling the use of renewable electricity and abundant resources (CO_2, H_2O, O_2, biomass, and waste streams) for the synthesis of a broad range of complex and value-added products for the chemical and fuels industry.

https://www.igb.fraunhofer.de/en/research/catalysts.html