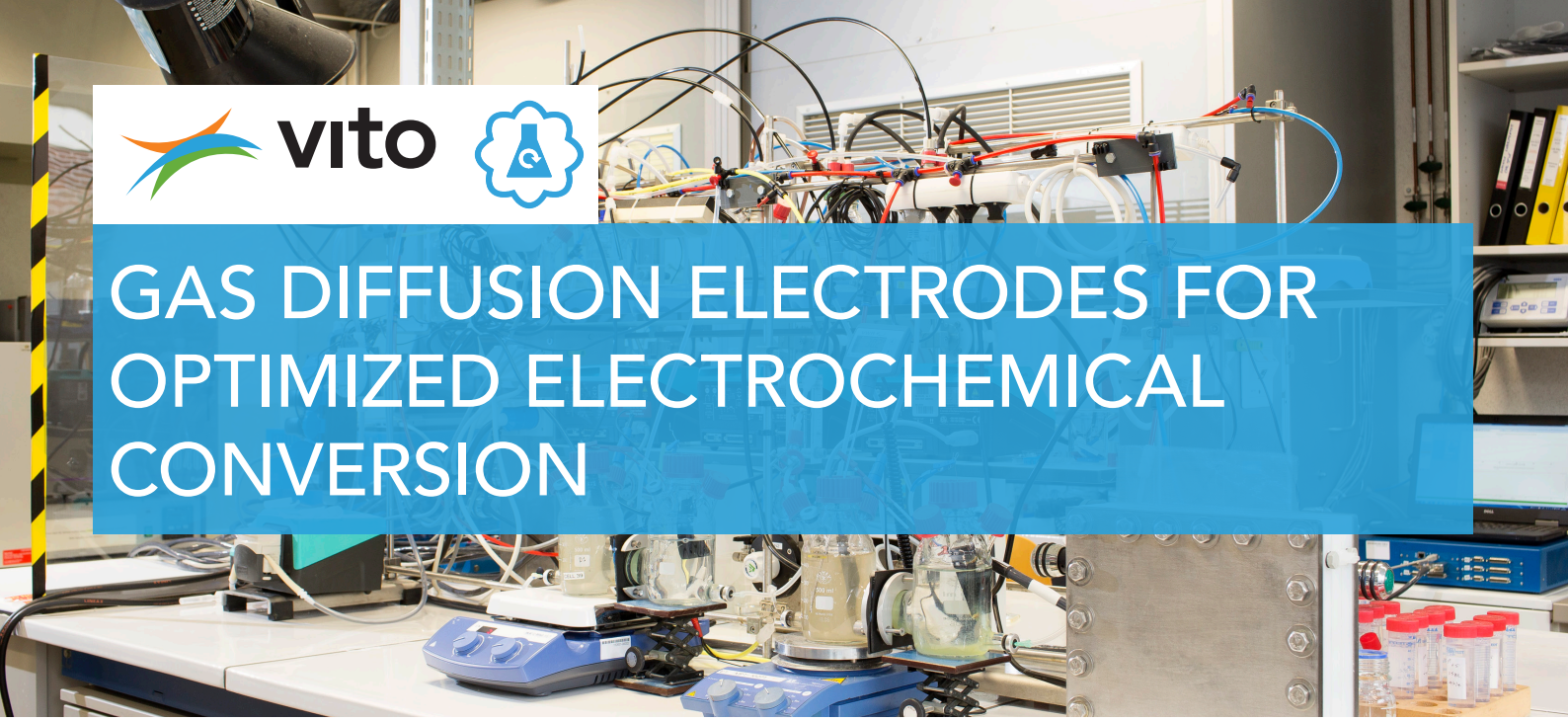


GAS DIFFUSION ELECTRODES FOR OPTIMIZED ELECTROCHEMICAL CONVERSION

Beating (bio)electrochemical challenges

When optimizing of (bio)electrochemical processes is the goal, several challenges need to be overcome. To name only some of them:

- high costs of platinized electrodes;
- rapid catalyst corrosion and low product quality due to non-optimised electrodes;
- difficult upscaling, as well as the shift from batch to continuous production.

Combined expertise in conversion and electrodes

At VITO, we offer proven solutions to optimize your electrochemical and bio-electrochemical processes.

- We design, develop and manufacture electrodes for your application based on our in-house cold rolling manufacturing technology;
- we design and optimize electrochemical conversions, using our patented gas diffusion electrodes (GDE);
- VITO's GDE, tailored for systems with aqueous electrolytes and a gas-water interface, are characterized by customized pore diameters in the polymer-bound active layer, mechanical robustness and low water permeability.

Working together from lab to pilot scale, we can:

- optimize the use of catalysts and raw materials;
- reduce waste and costs;
- recover energy and chemicals from waste streams.

Electrifying the chemical industry

Technologies related to gas diffusion electrodes offer solutions for the wastewater treatment industry, and play a key role in the electrification of the chemical industry as well as the electroconversion of CO_2 into chemicals. These applications find usage in industries, research labs and the academic world.

Our assets for you

A unique combination of expertise and networking

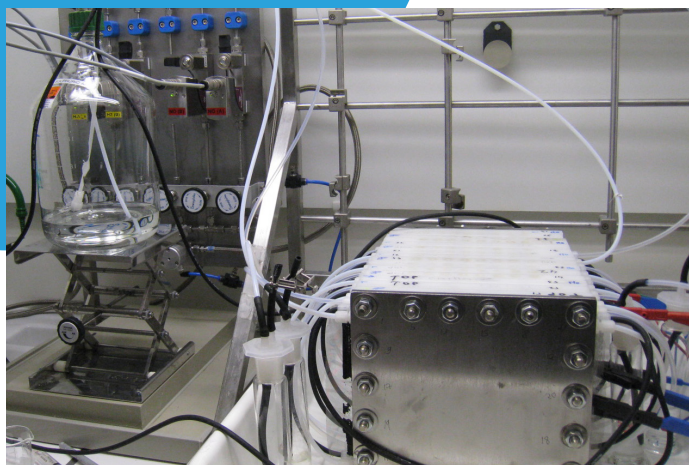
- Combining know how in both electrochemical conversion and electro-separation;
- Extensive expertise in developing electrodes (submerged / gas diffusion) in different configurations (planar, tubular etc.);
- Expertise in biocatalysis and heterogenous catalysis, with a focus on electroreduction reactions to convert CO_2 into chemicals;
- Expertise in electrode up-scaling, developing electrodes from 10 cm² to 1 m²;
- Extended knowledge in membrane technology, expertise in combining membranes with electrodes.

State-of-the-art infrastructure from lab to pilot scale

- VITO carries out feasibility studies and advises in setting up electrochemical conversion plants;
- In-house state-of-the-art lab infrastructure, developing electrodes from cm² to m² scale;
- Our electrodes can be developed using commercial catalyst materials or materials supplied by the customer;
- GMP certified ATEX design pilot units, to manufacture gas diffusion electrodes.

A tailor made approach, fit for purpose

- For each specific R&D issue, we design tailor made electrodes, from lab scale to pilot scale, coupling conversion with separation. We jointly work on a solution for your specific challenges, a solution requiring the least possible process steps, in order to shorten the path to industrial upscaling.



Some examples

- We initiate and participate in **(co-)funded consortia/ projects** with international partners from universities, industry, federations and government. Some of the projects we participate(d) in are ENOP, Get-A-Met, CHPM2030, Conducmem and OCPEC;
- successful **low cost production of air cathodes for Microbial Fuel Cells** with VITO developed VITO CORE® and VITO CASE® technology;
- production of **tubular gas diffusion electrodes** for a designer lamp based on microbial fuel cell technology;
- development of a large **segmented electrode array** using a newly developed VITO design (patent pending).

Our patented technologies provide off-the-shelf answers for specific challenges, ready for industrial licensing and implementation:

- **VITO CORE®** (EP2770565A1), a multilayered electrode consisting of a current collector (stainless steel gauze), an active layer (PTFE bonded catalyst particles) and a hydrophilic gas diffusion layer manufactured by cold rolling process **VITO CASE®** (EP20110740582B1), a multilayered electrode consisting of a current collector (stainless steel gauze), an active layer (PTFE bonded catalyst particles) and a hydrophilic gas diffusion layer manufactured by casting process;
- **additive-free and low-cost** electroprecipitation of metals to valuable oxides/carbonates from waste streams & Electrosynthesis of nanocrystals with **tunable size and uniform size distribution** (EP3042981A1).

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