

PlasCO₂

Plasmainduzierte Generierung von Kohlenmonoxid aus Kohlendioxid und dessen chemische Verwertung

The PlasCO₂-Team, Marc Oliver Kristen

September 28-29, 2023
CO₂-WIN-Abschlusskonferenz
Berlin



SPONSORED BY THE



Fz: 033RC030



PlasCO₂ – the principle



(Renewable) electricity
in stead of process heat



- High flexibility
- Production „at the push of a button“

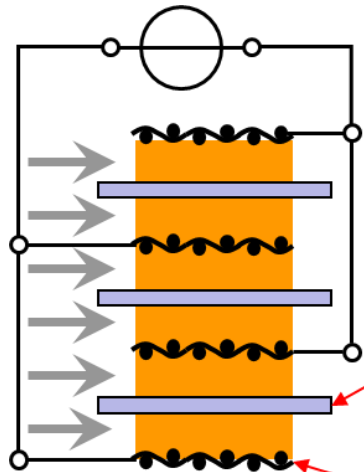


- Continuous flow (residence time in milli seconds)
- No use of rare materials
- Simple set up
- Spez. energy input is tunable and scalable
- Moderate gas temperatures (< 100°C), but high activation energy

PlasCO₂ – the concept (2021-2025)

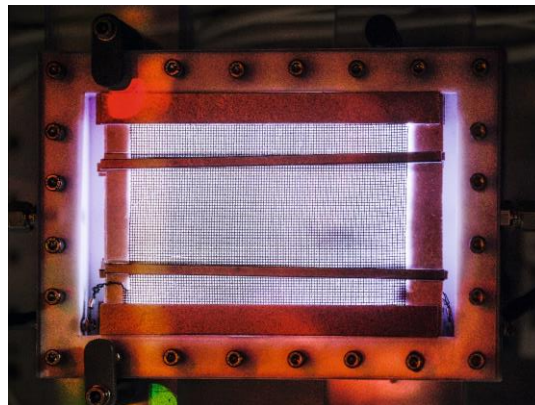
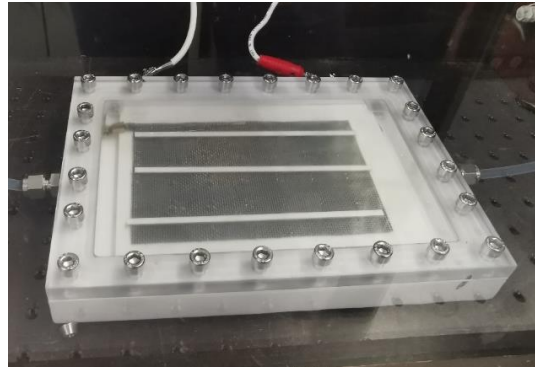
- Production of synthesis gas (CO/H₂) “at the push of a button”
- Plasma activation of CO₂ and H₂
- Proof of principle in BMBF funded project “KataPlasma” (Fz: 03XP0060)
- Project goals of **PlasCO₂**:
 - Optimization of plasma reactor and reaction conditions
 - Combination of plasma reactor with follow up reactions (here: hydroformylation), in sequent and simultaneously
 - Building a pilot plant

PlasCO₂ – the plasma reactor

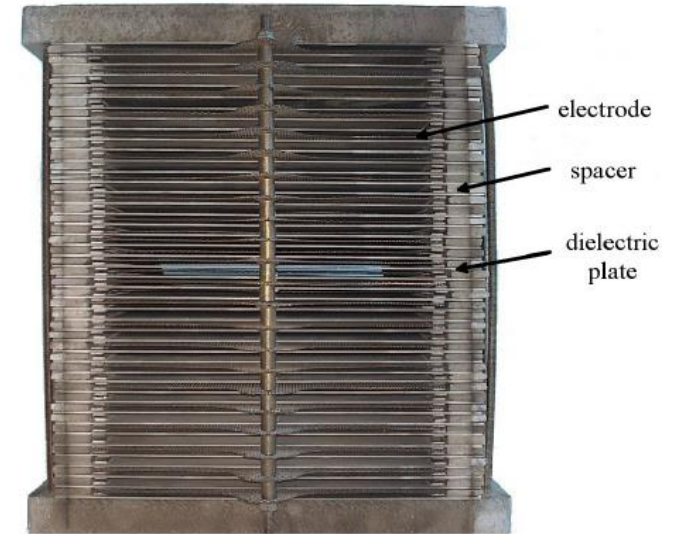
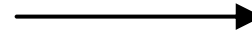


Dielectric plates

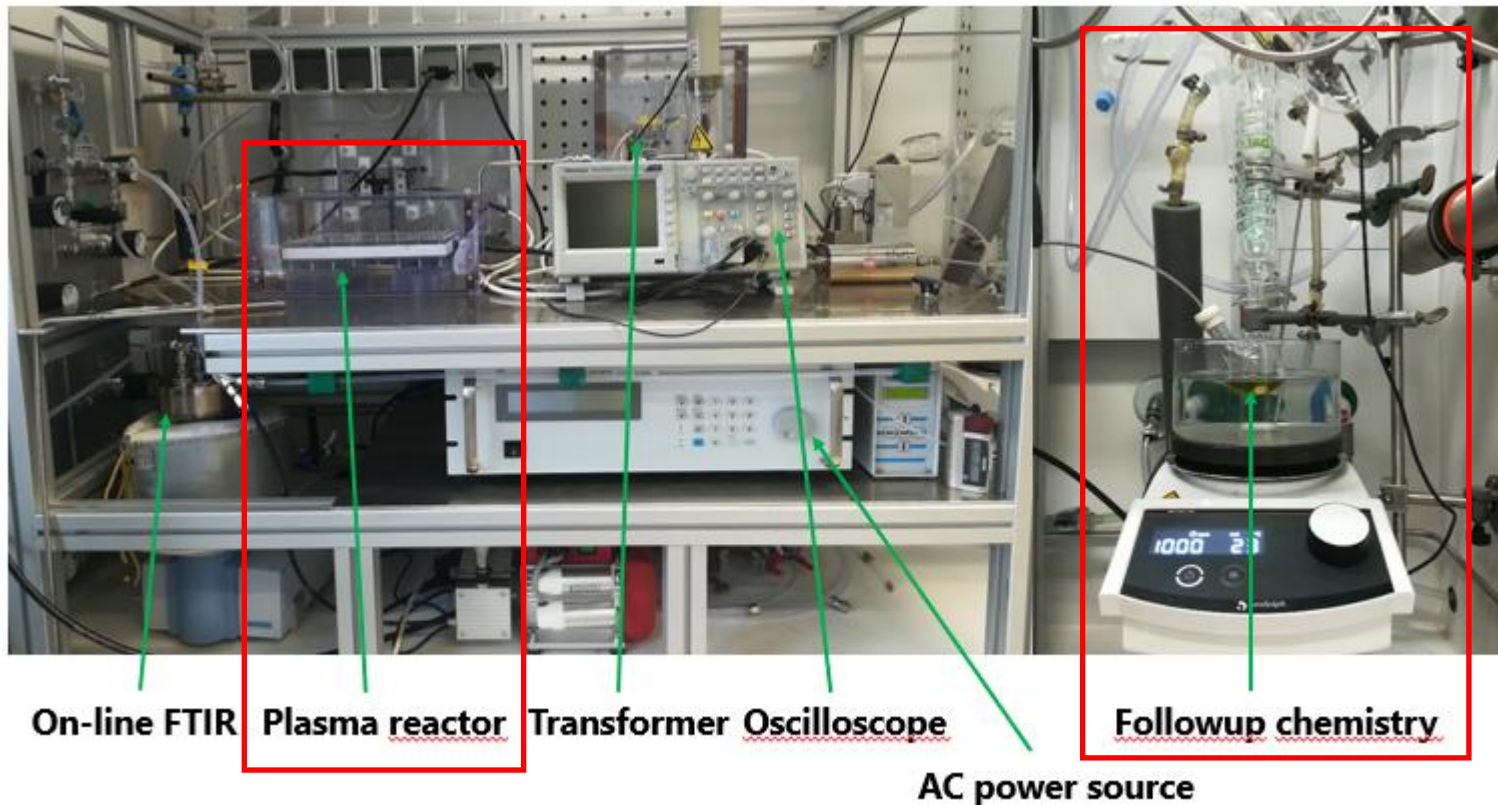
Grid electrodes



Easy scalability



PlasCO₂ – validation and demonstration



Set up at LIKAT

Operation of plasma reactors:

- Integration of catalysts in plasma reactor
- Plasma reactor with subsequent reaction unit for hydroformylation
- or direct synthesis in plasma reactor with simultaneous feed of organic substrates

PlasCO₂ – in the news

- Elements: The innovation magazine by Evonik (2/2022): https://elements.evonik.de/wp-content/uploads/2023/01/EVMAG_0322_DE_4853_Plasma.pdf
- Press release, January 2023 with extremely positive media feedback: <https://c4-chemicals.evonik.com/en/plasco2-project-greenhouse-gas-transformed-into-a-raw-material-186720.html>
- Radio broadcast: WDR 5, Quarks, 31. August 2023, from 57:00: <https://www1.wdr.de/mediathek/audio/wdr5/quarks/index.html>

Wie funktioniert der Strommarkt? - Nudging in der Mensa - Luchse

WDR 5 Quarks - Wissenschaft und mehr | 31.08.2023 | 01:03:52 Std. | Verfügbar bis 30.08.2028 | WDR 5

Wie funktioniert der Strommarkt?; Australien: Grippe-Welle trifft besonders Kinder; Wie beeinflussen Emojis unsere Kommunikation?; Sommer 23 - War das Wetter noch "normal"?; Nudging in der Mensa: Wie CO₂-Angaben das Essverhalten beeinflussen; Blaulichtfilterbrillen - Sinnvoll oder nur ein Hype?; Rückkehr der Luchse - der einzigen deutschen Raubkatze; [Wie die Chemieindustrie CO₂ als Rohstoff nutzen will](#); Moderation: Stephanie Klaus.

PLASMAREAKTOREN

48 Chemie auf Knopfdruck

Mithilfe eines Plasmareaktors lässt sich bedarfsgerecht und ohne großen Aufwand Synthesegas herstellen. Ein Laborbesuch bei den Wissenschaftlern, die gemeinsam mit Evonik die Entwicklung vorantreiben



Press release



PlasCO₂ project: Greenhouse gas transformed into a raw material

January 24, 2022

Main press contact
Michael Richter
Head of Market Communications
Performance Materials
Phone: +49 201 177 4325
michael.richter@evonik.com

- Evonik is working with three partners on processes for using CO₂ by means of plasma reactors
- Innovative process could significantly reduce energy requirements for the production important chemical products
- German Federal Ministry of Education and Research funds project with more than 1.8 million euros

Marl (Germany). Evonik has launched the PlasCO₂ project together with three partners. The aim is to use carbon dioxide (CO₂) as a raw material in the production of C4 chemicals. The German Federal Ministry of Education and Research is funding the project with more than €1.8 million. PlasCO₂ stands for 'Plasma-induced

PlasCO₂ – regulatory aspects, criteria for use case, business case

- (Fortunately) no regulatory boundaries (yet)
- Main criterium was the fit to existing products of Evonik: Providing sustainable synthesis gas for hydroformylation
- Activate CO₂ only as much as necessary to start chemistry
- Use a mild activation method
- For a successful business case the two main requirements are:
 - Availability of (renewable) energy/electricity: enough, cheap, as continuous as possible, CO₂-free
 - Availability of green hydrogen

PlasCO₂ – innovations and technology areas

- Low temperature plasma used for CO₂ activation and CO formation
 - Optimization of conditions for syngas production by plasma (ongoing)
 - Coupling of plasma-based synthesis gas production and catalysis in one set up (ongoing)

 - Synthesis gas production at the push of a button from CO₂ (and hydrogen)
 - First application of low temperature plasma reactors in catalysis (opens more doors for “activations” in chemistry)
 - Enabling the decentralized production of synthesis gas at a (small) production site
- **CO₂-footprint** of oxo-products (kg CO₂/eq.) can be **decreased by up to 30%**. For the global market, a potential of **annually 6 Mio. t CO₂** has been identified.



EVONIK

Leading Beyond Chemistry