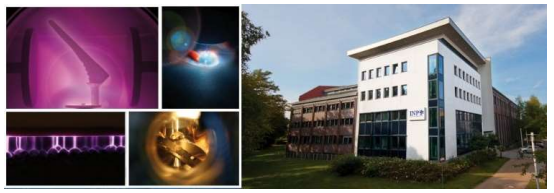
PlasCO2

Plasma-induced generation of CO from CO_2 and its chemical usage

The PlasCO2-Team feat. Marc Oliver Kristen

June 8, 2021
CO_2-WIN conference

INP Greifswald



Katalysis LIKAT
Leibniz-Institut für Katalyse e.V.

Rafflenbeul Anlagen Bau GmbH

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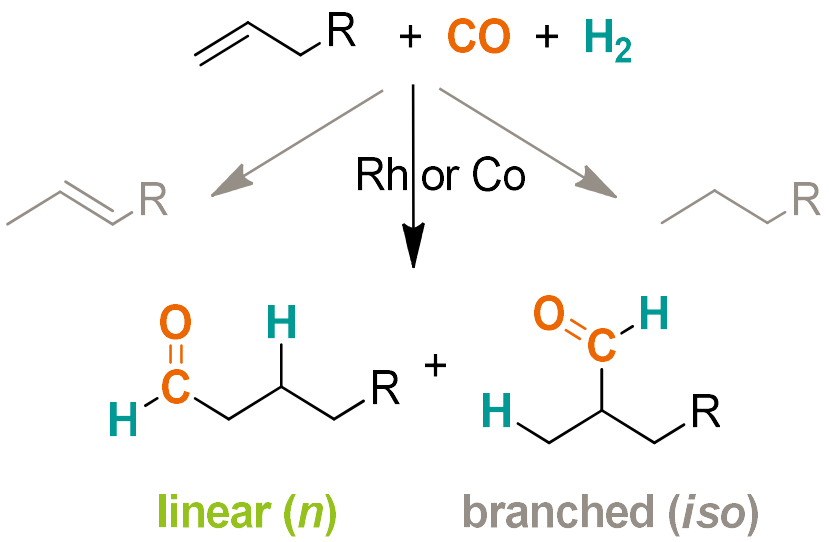
Hydroformylation



- Discovered at Ruhrchemie 1938
- Most important homogeneous catalytic reaction (> 12 Mio. t/y)
- 100 % atom economy

PlasCO2 – The Idea

- Generation of syngas (CO/H_2) “on demand”
- Not homogeneous, not heterogeneous, but plasma activation of CO_2 and H_2
- Proof of principle in BMBF funded project “KataPlasma” (Fz: 03XP0060)
- Goals of PlasCO2:
  - Improve plasma reactor and conditions
  - Combine plasma reactor with follow up chemistry (hydroformylation), in sequence and in one reactor
  - Go to pilot plant scale

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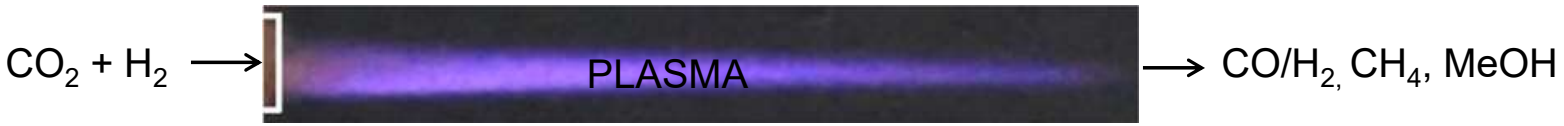
PlasCO2 – The Principle

(Renewable) electricity
Instead of thermal energy

Fast switch-on/switch-off process

- Production and grif flexibility
- Production-on-demand



- Continuous flow (milliseconds-seconds residence time)
- No requirement of rare materials
- Simple design
- Power consumption can be scaled and adjusted
- Moderate gas temperatures, but initialization of processes with high activation energies

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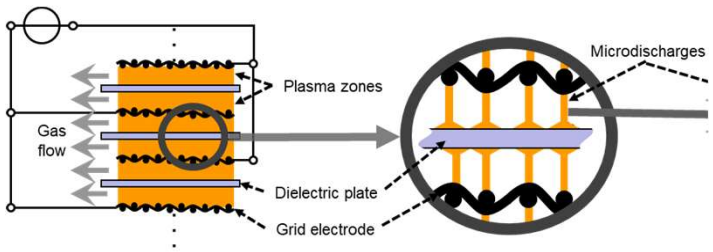
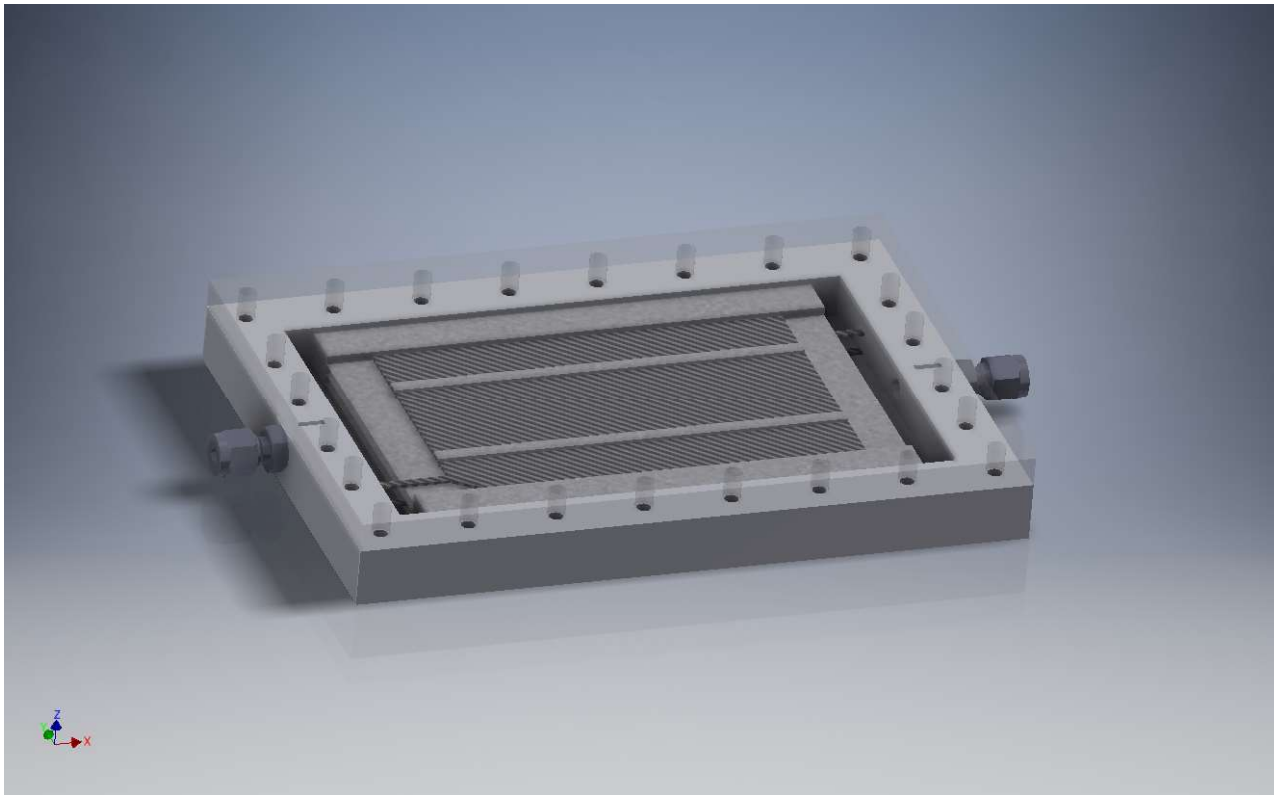
PlasCO2 – The initial Setup (LIKAT)

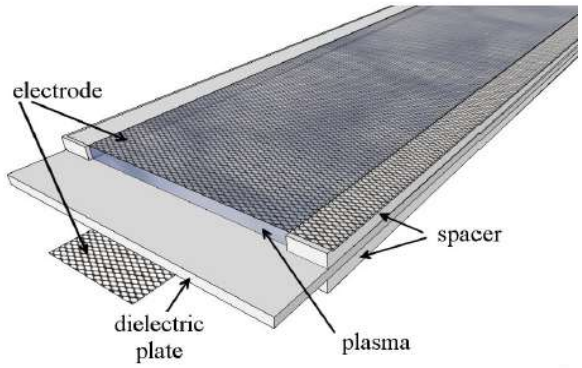
Lab Reactor (INP)

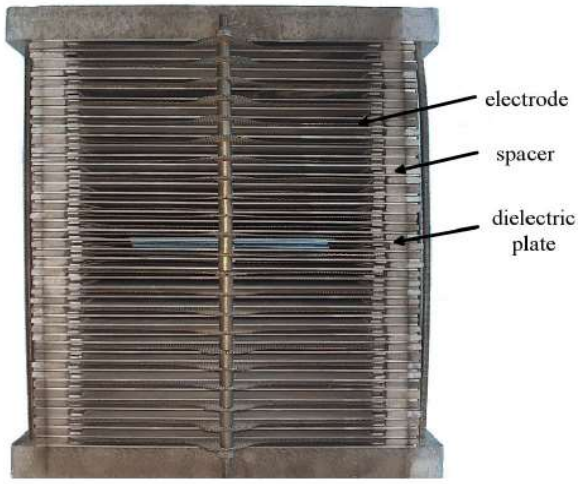
- Stack reactor consisting of 5 discharge gaps
- Volume Dielectric Barrier Discharge
- Grid electrodes and dielectric plates
- Filamentary plasma (short-lived micro discharges)
- 230 x 160 x 30 mm^2





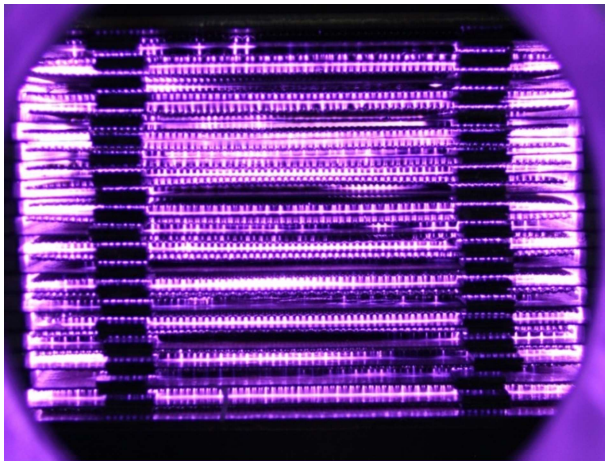
Scalability (INP)





Dielectric Barrier Discharge

- Two grid electrodes
- Dielectric plate
- Example with spacer



- For upscaling the number of elements can be increased (example with 44 stacks)

R. Brandenburg et al. Contrib. Plas. Phys. 54 (2014) 202 – 214
M. Schmidt, R. Basner, R. Brandenburg Plas. Chem. Plas. Proc. 33, 1 (2013) 323-335
R. Brandenburg PSST 26 (2017) 053001

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Construction expertise at Rafflenbeul

Non-thermal plasma unit of a plasma-catalytic air cleaning system

- Expertise in building low temperature plasma reactor at commercial scale
- As of today, mostly for air cleaning systems
- Syngas production will be a new field of application with extended business opportunities for Rafflenbeul

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PlasCO2 – The desired Impact

- Important and large-scale Syngas (CO/H_2) will be produced from renewable resources
- Low consumption of (renewable) energy
- Easy scaleup, according to need
- Decentralised production
- Avoidance of CO transport

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PlasCO2 – The Team

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- Rafflenbeul: Lutz Rafflenbeul, Hannah Gabele, Bernd Hansel
- Evonik: Robert Franke, Bernd Hannebauer, lab crew
- PTJ: Enrico Barsch

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