Master-Thesis/Bachelor-Thesis/ADP

Non-Equilibrium CO_2 Conversion in Dielectric Barrier Discharge Plasmas

TECHNISCHE UNIVERSITÄT DARMSTADT

RSM Reaktive Strömungen + Messtechnik

Motivation & Background

The continuous rise in atmospheric CO_2 levels presents a critical environmental challenge and motivates the development of sustainable carbon utilization technologies. Conventional thermocatalytic CO_2 conversion typically relies on high temperatures and substantial energy input, which limits overall efficiency and scalability. Plasma-assisted CO_2 conversion, particularly using dielectric barrier discharge (DBD) systems, offers an alternative non-equilibrium approach in which energetic electrons activate and dissociate CO_2 molecules while the bulk gas remains near ambient temperature. This unique operating regime enables coupling to renewable electricity sources and opens pathways for decentralized chemical production. At the same time, the non-equilibrium nature of DBD plasmas leads to complex reaction pathways, energy losses, and strong interactions between plasma, reactor design, and catalysts. A systematic experimental investigation is therefore required to better understand and optimize these processes.

Main Objectives (Bachelor level): Experimentally study CO_2 conversion in a DBD plasma reactor, focusing on the influence of key operating parameters (e.g. power, frequency, gas composition) on conversion and energy efficiency.

Main Objectives (Master level): Develop optical diagnostics for a deeper understanding of non-equilibrium reaction mechanisms in DBD CO_2 plasmas, including plasma–catalyst interactions and reactor design effects, with the goal of improving energy efficiency and product selectivity.

Assignments

- Design, set up, and operate a DBD plasma reactor for CO_2 conversion experiments (Bachelor/Master).
- Systematically investigate the effect of operating parameters on CO_2 conversion, energy efficiency, and product distribution (Bachelor /Master).
- Integrate and evaluate catalytic materials in the DBD reactor and analyze plasma–catalyst synergies (Master).
- Analyze experimental data to identify limiting mechanisms and propose optimization strategies for non-equilibrium CO_2 conversion (Master).

Focus Areas

Experiment	●●●
Construction	●●○
Modelling	○○○
Data analysis	●●○

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Start From

Flexible

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