University of Stuttgart
Institute of Space Systems

Master's Thesis

Design of a Demonstrator Experiment on Plasma-Catalytic CO_2 Conversion in PWK3

Starting Date: flexible

Motivation:

Carbon capture and utilization (CCU) is believed to play a major role in de-carbonizing industrial processes and mitigating climate change. Plasma-based CO_2 conversion is one promising way of converting carbon dioxide into valuable products or fuels, while allowing for high energy efficiencies.

At the Institute of Space Systems, the plasma wind tunnel facility PWK3, powered by the inductive plasma generator IPG4, is used to study the process of plasma-based carbon dioxide splitting. In a next step, it is planned to introduce catalytic material into the plasma jet to enhance the CO_2 splitting performance. In literature, the combination of plasma and catalyst is reported to have synergetic effects that can exceed the combined effects of plasma and catalyst alone. One major open question is, whether the catalyst really has a physical/chemical effect on the plasma (and vice versa) or if the plasma just heats up the material.

In this work, a more general question shall be investigated: Is it possible to determine and quantify effects of catalytic material inserted into the supersonic CO_2 plasma of PWK3? For this, a suitable candidate material shall be identified, based on literature and analyses. Moreover, a test setup and procedure shall be designed and demonstrated in a plasma wind tunnel experiment.

Task:

- Literature review on plasma-catalytic CO_2 splitting
- Extension of existing database on MW/RF plasma-based CO_2 splitting by plasma-catalytic experiments
- Identification of a suitable candidate material for enhanced splitting performance in PWK3
- Design of a test setup and procedure to quantitatively determine the influence of the catalytic material on the CO_2 splitting performance
- Demonstration of the designed setup in PWK3
- Documentation

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