Bachelor/Master Thesis

Spectroscopic Characterization of the Inductive Plasma Generator IPG4 for Environmental Applications

Keywords: Green Energy, Inductive Plasma, Greenhouse Gas Recycling, Space Technology Transfer

Motivation:
Since the pre-industrial era, human activities have caused a significant and measurable global warming. The mitigation of climate change is one of the world’s most pressing near-future problems. While renewable energy and battery-electric transportation receive much attention these days, the need for cross-sectoral greenhouse gas recycling is bigger than ever. The general concept behind this is the use of available renewable excess power for the conversion of atmospheric CO\textsubscript{2} into high-value synthesis gases or liquid chemicals for reutilization. This way, a carbon dioxide cycle is established, reducing the net greenhouse gas emissions. Recently, the plasma-assisted reduction of CO\textsubscript{2} has gained interest due to its potential of efficient carbon dioxide dissociation. The inductive plasma generator IPG4 at the Institute of Space Systems (IRS) is a high-power plasma source, which can be operated with various gases and gas mixtures, especially oxygen and CO\textsubscript{2}. Over the next years, IPG4 will be used to investigate the plasma-catalytic dissociation of CO\textsubscript{2} for greenhouse gas recycling. As a first step, a characterization of the plasma is required. To assess the plasma parameters, i.e. species temperatures, number densities and dissociation degree, optical diagnostics are well suited, because they are non-intrusive and, thus, do not disturb the plasma jet. Here, Optical Emission Spectroscopy (OES) is used for the first analysis as it covers a broad spectral range. For deeper investigations of the translational temperature and specific number density of atomic oxygen, TDLAS (Tunable Diode Laser Absorption Spectroscopy) shall be implemented.

Task:
- Familiarize with the concept of optical/spectroscopic plasma diagnostics, especially laser absorption spectroscopy
- Set up of the TDLAS (Tunable Diode Laser Absorption Spectroscopy) system
- Support of test measurements with the inductive plasma generator IPG4
- Data analysis
- Documentation

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Starting date: flexible