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Sulphur dioxide removal from gas streams using a sorbent powder in a dielectric barrier discharge

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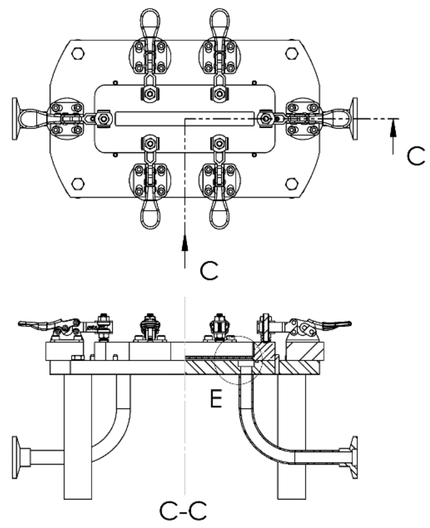
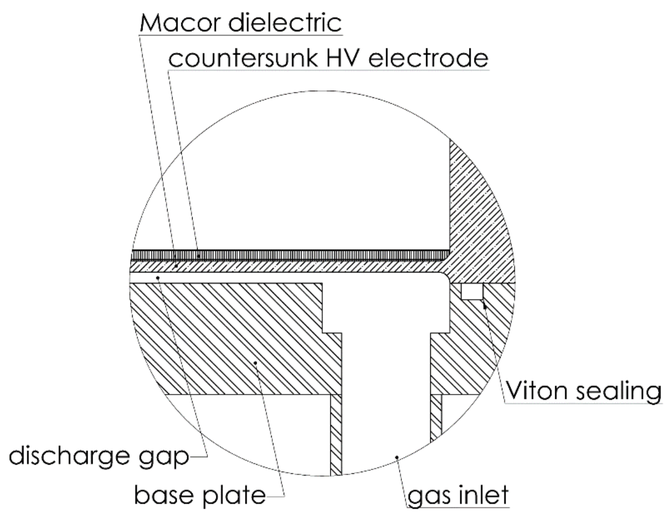
1. Introduction

Emissions of sulphur dioxide (SO_2) are highly problematic for climate, health and buildings. The amount of SO_2 emitted each year, however, is currently increasing. One main origin of SO_2 emissions is the transportation sector. Further, a significantly increasing source is the use of biomass for energy production. Dielectric barrier discharge plasmas are able to completely remove the SO_2 from exhaust gas streams. This process becomes especially effective if the plasma discharges is directly combined with a cheap powder sorbent like as limestone ($CaCO_3$). The combination of a quadrupole mass spectrometer and an electrochemical sensor system was used to determine the influence of the treatment on the composition of the gas streams.
A Raman spectrometer was used to analyze the powder sorbent after the plasma treatment.

2. Plasma reactor

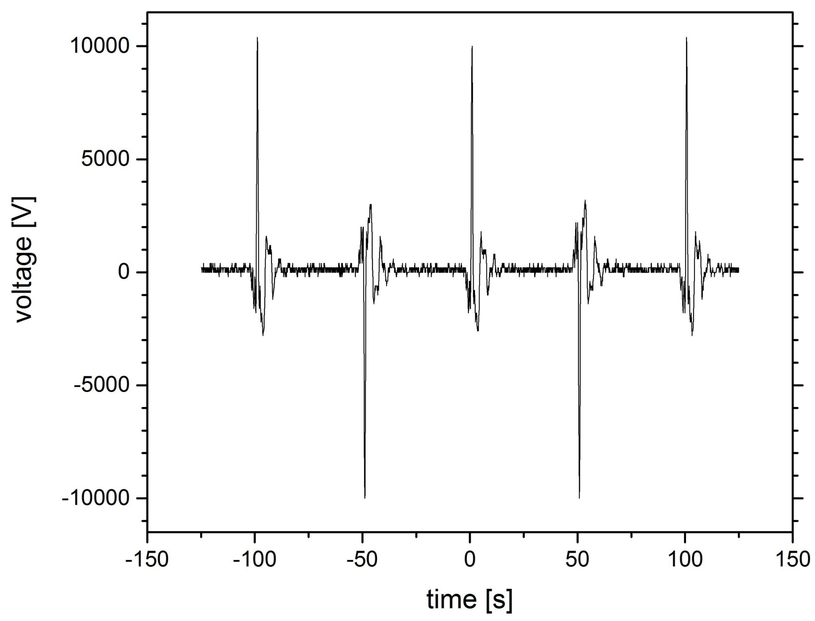




3. Experiments and results

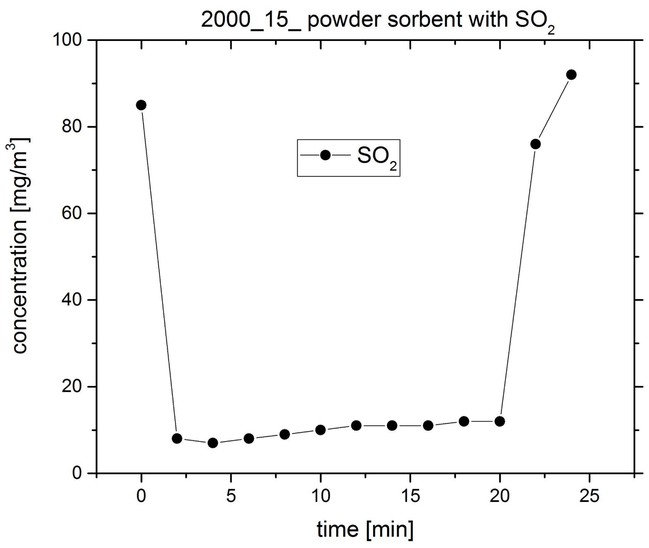
Pulsed plasma

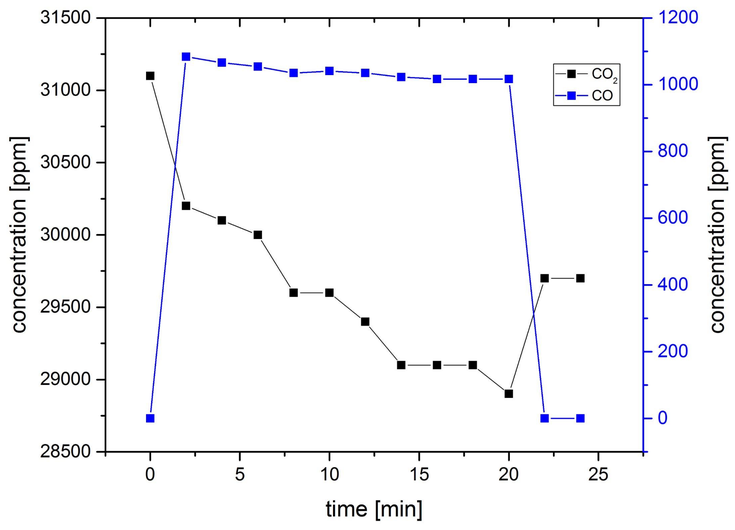
Pulse voltage source, serial number 040-3, *Ingenieurbüro Dr. Jürgen Klein*



Motor engine test stand with test gas

- Exhaust gas stream addition of 100 ppm SO_2 in synthetic air (54 L/h)
- Motor data: 2000 rpm, engine torque 15 Nm, 36 mg/m^3 of soot
- Calcium carbonate (99.95 %) as powder sorbent
- Pulsed plasma treatment 11.333 kV and 20 kHz
- Analyzing of the gas streams with electrochemical sensor systems

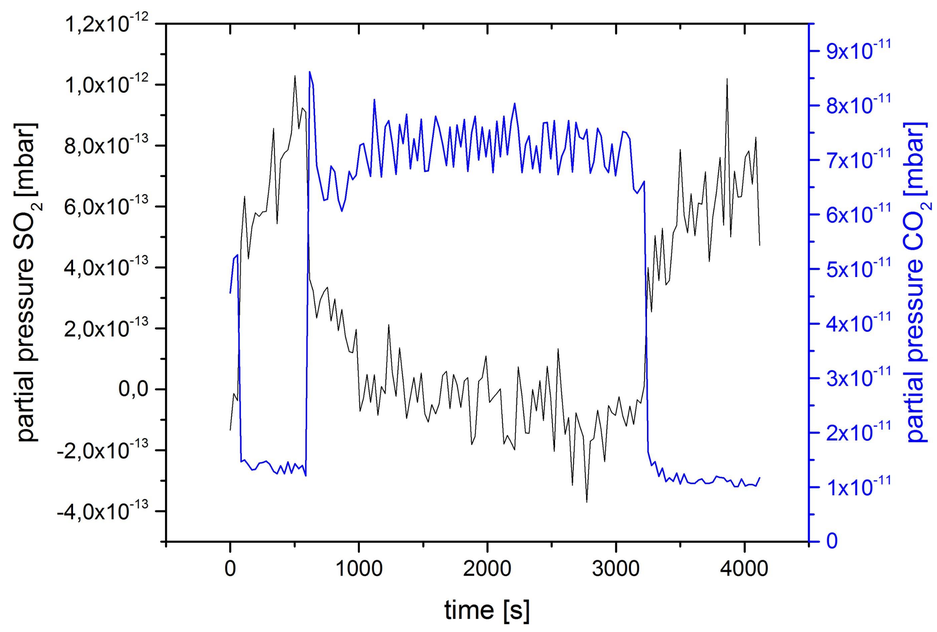




➡ Decrease of SO_2
Increase of CO, NO, NO_2

Test gas

- Gas stream with 100 ppm SO_2 in synthetic air (3.13 Ln/min)
- Calcium carbonate (99.95 %) as powder sorbent
- Pulsed plasma treatment 11.333 kV and 20 kHz
- Analysis of the gas stream via quadrupole mass spectrometer



➡ Decrease of SO_2
Increase of CO_2

Raman spectrum

Senterra Raman-Mikroskop (532 nm), *Bruker Optik GmbH*

➡ Decrease of SO_2
Increase of CO, NO, NO_2

4. Summary

- The reduction of SO_2 via a plasma treatment in combination with powder sorbent achieve excellent results (**100 % reduction**)
- Formation of $CaSO_4$

Atom- und Molekülphysik an Oberflächen

http://www.iept.tu-clausthal.de/
http://www.czm.tu-clasuthal.de/

5. Acknowledgements

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- Biothan

Plasma-Enhanced Reactions