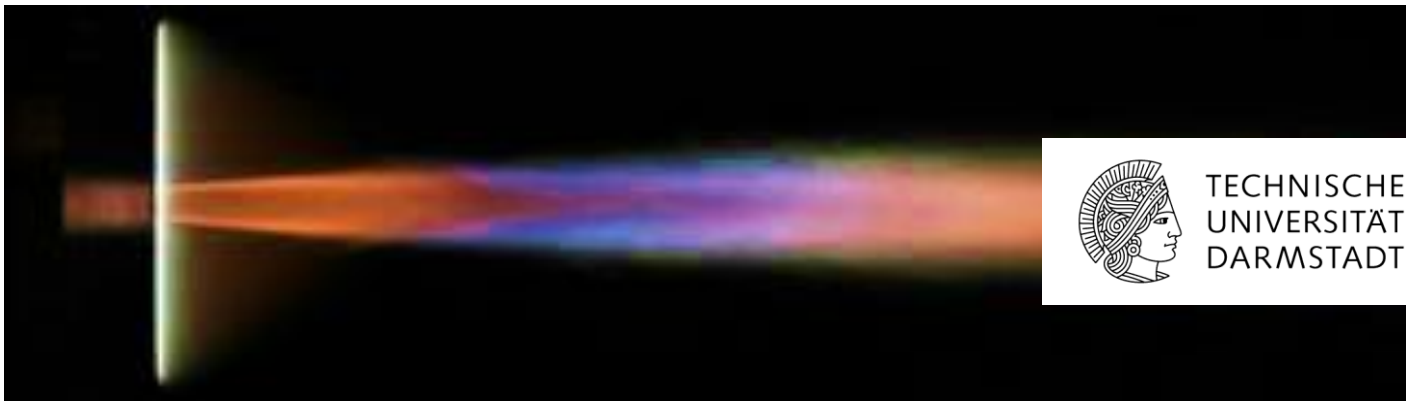


ADP/Bachelor thesis/Master thesis

Design, construction, and characterization of a laminar slot burner assisted by a nanosecond plasma generator

Entwicklung, Konstruktion und Charakterisierung eines laminaren Schlitzbrenners unterstützt durch einen Nanosekunden-Plasma-Generator

Reaktive Strömungen und Messtechnik (RSM)

Reactive Flows and Diagnostics

Tao Li, Dr. -Ing.

L1|08 **112**
Otto-Berndt-Straße. 3
64287 Darmstadt

Tel. +49 6151 16 - **28897**
tao.li@rsm.tu-darmstadt.de

12. Februar 2023

Motivation

Chemical energy carriers are essential building blocks for a future carbon-free energy economy, mitigating wind and solar energy fluctuations due to weather and geographical limitations. One suitable candidate is ammonia (NH_3) which can be synthesized with renewable energy and are employable for mobile and remote applications. However, pure NH3 is subject to high ignition temperatures, lower laminar burning velocities, narrow flammability limits, and lower extinction strain rates. One very promising technology to overcome these difficulties is to use plasma to enhance ignition and flame. Recent experiments also showed that NOx emission could be largely reduced by introducing plasma into combustion. To better understand the mechanism of plasma impact on reactions, fundamental experiments under well-defined boundary conditions are highly desired.

Objectives

This project aims to set up a laminar slot burner (LSB) with the assistance of nanosecond plasma discharges. A schematic layout of a conventional LSB is shown in Fig.1 [Boushaki et al.]. The LSB consists of three main parts: a mixer, a homogenizer, and a convergent nozzle. A premixed laminar flame can be stabilized on the burner exist. This existing concept should be adapted for plasma generation with a dielectric barrier discharge (DBD). The DBD should be installed in the position of the parallel nozzle, which mainly consists of two electrodes, a nanosecond high-voltage plasma pulse generator, and corresponding control units. The designed plasma-assisted LSB should have optical access into the nozzle to characterize the plasma homogeneity. This work aims to design, construct and test this burner in the combustion laboratory of RSM.

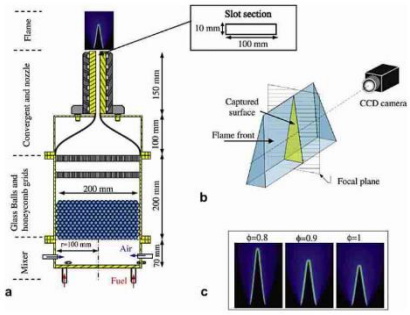
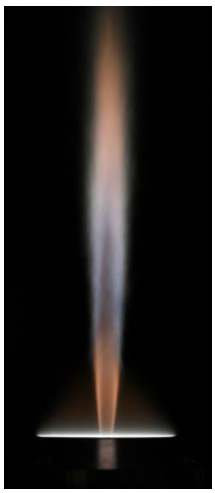


Fig.1. (a) Schematic of the slot burner, (b) Schematic of flame shapes, and (c) CH_4/air flame image examples [Boushaki et al.].



Tasks:

- Review the literature on the relevant topics of plasma-assisted combustion
- Design and construction of the optical slot burner with additional DBD assistance
- Experimentally characterization of the flame shape and plasma performance
- Data evaluation and documentation of experiments
- Intermediate and final presentations, writing final theses

Requirements:

- Interest in lab work, Knowledge in Siemens NX, Labview, and Matlab or Python is preferred.

Are you interested? Feel free to contact me! (This work can be conducted either in English or German)