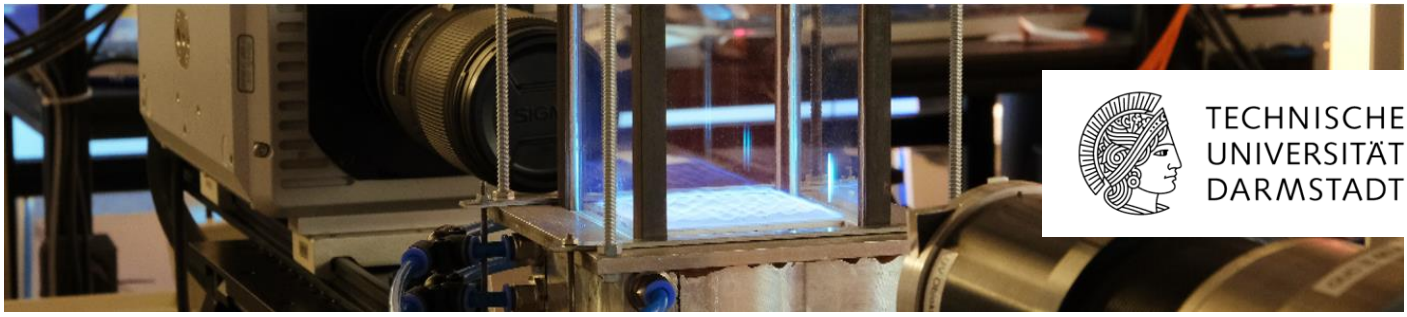

TECHNISCHE UNIVERSITÄT DARMSTADT

Master thesis / ADP

Construction and commissioning of a flat flame burner for studying premixed NH_3/H_2 combustion

Konstruktion und Inbetriebsnahme eines Flachflammenbrenners zur Untersuchung der Verbrennung von vorgemischtem NH_3/H_2

Motivation

The institute of Reactive Flows and Diagnostics focuses on fundamental combustion research and has established world-class combustion laboratories with novel optical diagnostics methods. Advanced imaging methods combing modern lasers and cameras enable understanding complex processes in gas and solid combustion.

State of the art

Reducing the carbon footprint in the energy sector has become a key challenge of this century that requires global collaborative efforts. Germany has committed to achieving carbon neutrality by 2045. Chemical storage of renewable energy such as wind and solar, followed by thermochemical conversion for energy utilization, is an important pathway to ensure a smooth transition to a carbon-neutral economy. The carbon-free nature of hydrogen (H_2) and ammonia (NH_3) has attracted considerable attention as potential substitutes for carbonaceous fuels. Both hydrogen and ammonia have very distinct combustion characteristics compared to hydrocarbons. Strategically cofiring NH_3 and H_2 appears to be well suited to remedy the difficulties in utilizing either fuel. However, NH_3 and NO_x emission and combustion instabilities are of critical importance in NH_3/H_2 combustion. To enable industrial facilities to be operated with NH_3/H_2 blends, fundamental understandings of the combustion characteristics under various conditions are urgently needed.

Objectives

For studying both emission and flame stabilization, quantitative multi-scalar data are of essential importance and provide novel insights into combustion chemistry. Simultaneous measurements of temperature and concentration of major species are only possible with combined Raman/Rayleigh scattering. However, due to incomplete spectral data libraries for high temperatures, this method requires careful calibrations in a flame with know temperature and concentrations, usually in a flat flame burner. Previous burners used for hydrocarbon fuels are not suited for operating with NH_3/H_2 fuels. A new flat flame burner needs to be constructed and tested for a large variety of operation conditions (e.g., mixtures and equivalence ratio). The boundary conditions should be carefully characterized and used to perform 1D flame simulations.

The topic is suitable for both ADP and Master theses, and the work tasks are adapted accordingly.

Tasks:

- First, you will read the lieterature and get familiar with the topics of NH_3/H_2 combustion
- Then, try to run some 1D simulations of freely propagating flames to get a better idea
- A big task comes now: design, construction, and commissioning of a new flat flame burner
- Also, you should perform experiments to characterize inlet and outlet boundary conditions
- Of course, intermediate and final presentations, writing theses or reports are also parts of your job

Requirements:

- You feel motivated by the topic of carbon-free combustion for future power generation
- You are interested in lab work and designing fancy stuff to surprise others (in a good way)
- Knowledge in Labview, Matlab, and premixed combustion fundamentals are required
- It would be great if you have worked with laser diagnostics, but it is not necessary

Are you interested?

Dann melde dich bei mir! Feel free to contact me!

Beginn: Ab dem 15.Jan.2022

Reaktive Strömungen und Messtechnik (RSM)

Reactive Flows and Diagnostics

RSM Reaktive Strömungen + Messtechnik

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