UNIVERSITÉ BOURGOGNE EUROPE

DRIVE

école doctorale **sciences pour l'ingénieur et microtechniques** SPIM

Thesis Title:

Impact of hydrogen chemical kinetics on the combustion of biofuels at high pressure

Host Laboratory:

Laboratoire DRIVE
49 rue Mademoiselle Bourgeois
58000 Nevers – France

Specialization of the Doctorate: Energetics

Keywords: Hydrogen, Biofuels, Chemical Kinetic, Combustion, Shock Tube, Premixed flame, Kinetic Modelling

Detailed Description of the Thesis:

Although the share of electric vehicles will keep growing, the demand for gasoline, kerosene and diesel to power the existing fleet of vehicles will remain substantial. This is also true for the foreseeable future, as the engines of heavy-duty vehicles, ships and planes, as well as construction machinery, emergency power generators will continue to rely on liquid fuels because of their high energy density. Biofuels, derived from biomass, are recognized as viable renewable energy sources, offering pathways for mitigating carbon dioxide (CO_2) emissions and reducing reliance on fossil fuels. Concurrently, hydrogen (H_2) is gaining prominence as a zero-carbon energy carrier, characterized by its low ignition energy, wide flammability limits, and high burning velocity. Blends of hydrogen with biofuels, termed Hydrogen-Enriched Biofuels (HEBioF), represent low-carbon fuel alternatives that are being extensively investigated as promising substitutes for conventional fuels across global land, marine, and aeronautical transportation sectors.

The primary objective of this thesis is to comprehensively investigate the influence of hydrogen chemical kinetics on the high-pressure combustion behavior of selected biofuels, simulating conditions prevalent within internal combustion engines.

This research will primarily be conducted at the DRIVE laboratory (ISAT, Université Bourgogne Europe, Nevers), complemented by a six-month experimental campaign at the PC2A laboratory (Université de Lille). Specifically, auto-ignition delay times of the biofuel/H_2 mixtures will be determined utilizing a high-pressure shock tube facility at DRIVE. Concurrently, the species formed during the combustion of biofuels in premixed flames will be characterized using gas chromatography at PC2A. The resultant experimental data will serve as a basis for the development of a detailed kinetic model, thereby enhancing the understanding of high-pressure combustion mechanisms of biofuel/H_2 mixtures. The anticipated outcomes of this project hold substantial value for evaluating the practical applicability of these fuel blends in internal combustion engines, and for advancing strategies to optimize energy efficiency and mitigate pollutant emissions associated with these future fuels.

Thesis Timeline:

0-4 months: Comprehensive literature review, utilizing academic databases (e.g., Web of Science), to inform the selection of appropriate biofuels for the study.

4-12 months: Measurement of auto-ignition delay times for biofuel/H_2 mixtures via a high-pressure shock tube at the DRIVE laboratory.

12-18 months: Characterization of species formed during the combustion of biofuels in premixed flames using gas chromatography at the PC2A laboratory

30-36 months: Thesis manuscript preparation, scientific publication dissemination, and conference presentations.

36th month: Thesis defense.

Requested Profile:

• Engineer/Master's in chemistry, energy

• Fluent in English, ability to work in a team

• Send CV, cover letter, letters of recommendation from supervisors, transcripts from the first and second year of Master's degree or last two years of engineering degree to the supervisors and thesis director.

Funding:

Application to be sent before **30/06/2025** (Interview to be scheduled around 04/07/2025)
Start of contract: October 1, 2025

Gross monthly salary: €2300

Thesis direction:

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Thesis supervision: Co-supervisors:

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