▶ CNRS & UNIVERSITY OF ORLEANS ENERGY PROPULSION ENVIRONMENT SAFETY

LABEX CAPRYSSES

The Excellency laboratory CAPRYSSES is composed of the ICARE laboratory of the CNRS in Orleans and the PRISME laboratory of the University of Orleans. About 100 research staff is conducting advanced multidisciplinary research on clean and safe systems for energy generation and car and aerospace engines, jointly with the relevant industrial partners.

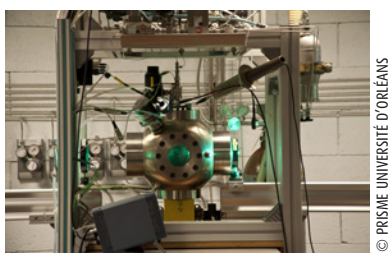
The The objective of CAPRYSSES is to improve the quality and safety of energy and propulsion systems where the chemical conversion of energy is present and necessitates the mastering of couplings between chemical kinetics and fluid dynamics. This objective mainly concerns phenomena relevant for internal combustion engines, stationary or aeronautical gas turbines, space propulsion systems and industrial risk situations linked to chemical explosions. Characterizing and modeling such complex systems, basis for all innovations in these domains, will improve their energetic and environmental performances and their safety. The exceptional experimental facilities of CAPRYSSES are used to this aim together with advanced numerical simulations. The LABEX CAPRYSSES contributes structuring the R&D potential of the Orléans-Bourges region in the domains of clean and safe energy and propulsion systems. It rationalizes the use of their experimental facilities, reinforces national, European and international co-operations and strengthen the partnerships with the relevant economic sectors.

A main topic of research of CAPRYSSES deals with the reduction of greenhouse gases emissions from car engines. For this purpose new combustion modes are currently being developed that will likely require fuel reformulations. Furthermore, regulations impose blending actual fuels with biofuel up to 20%. Consequently, it is mandatory to study the impact of biofuel addition on fundamental combustion parameters and especially on pollutant emissions.

The reduction of particle emissions from combustion is one of the issues interesting CAPRYSSES researchers. These studies appear critical due to the environmental impact of such emissions. It is thus necessary to develop different means to study and control the emissions of particles and also the formation of polycyclic aromatic hydrocarbons which are generated in incomplete combustion at moderate temperatures.

© ICARE, CNRS

Premixed propane-air turbulent flame in the high pressure combustion chamber of ICARE



© PRISME UNIVERSITÉ D'ORLÉANS

High pressure spherical combustion chamber facility of PRISME for flame propagation studies

The optimization of internal combustion engines in terms of fuel efficiency and emission reductions remains at the center of current interest in order to be able to meet the challenges related to vehicle fuel consumption as low as 2liters/100km in 2020. In addition, the use of alternative fuels (produced from biomass or other sources) will also be a key element for achieving sustainable well-to-wheel CO2 emissions, and for reducing our dependency on fossil resources.

For clean energy generation from waste organic resources, innovative processes are developed by CAPYSSES researchers. These processes are also examples for the development of the circular economy approach. They concern gasification in supercritical water for humid waste materials (such as sewage sludge) and pyrolysis and thermal gasification for solid waste resources (such as used tires, biomass residues). These processes permit to generate syngas or hydrogen from organic waste materials without wasting energy to dry them in the case of sewage sludge.

Another good example **is the studies on mineral carbonation for CO2 sequestration in the cement industry**. In 2010, the cement industry as a single emitter accounted for around 5% of global carbon dioxide (CO2) emissions. Mineral carbonation (MT) involves reactions of CO2 with a mineral compound and forms permanent carbonates. This process has attracted much attention in recent years for the development of Carbon Capture and Sequestration (CCS) technologies. MT is one of the post-combustion carbon capture approaches which have been suggested as the most suitable CCS method for the cement industry, due to the ineffectiveness of the pre-combustion method and the higher capital cost of the oxyfuel combustion method which requires a more substantial change to the cement plant. Some technical and economic barriers exist however for implementing the MT technology, which are originated from the lack of fundamental understanding of reaction mechanisms and, subsequently, difficulties in scaling up the process and optimizing the energetic and economic balances. The studies conducted in CAPRYSSES are aiming to solve such problems. ■

CONTACT

iskender.gokalp@cnrs-orleans.fr

LABEX CAPRYSSES (Université d'Orléans et CNRS)

ICARE-CNRS,
1C Avenue de la recherche scientifique
45071 Orléans cedex 2
Tel: +33-689097662
www.cnrs-orleans.fr/icare
www.univ-orleans.fr/prisme

PRESS RELEASE