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UNIVERSITE D'ORLEANS

Postdoctorate proposal

Laboratoire ICARE

Institut de Combustion Aérothermique Réactivité Environnement

1C, avenue de la recherche scientifique

45071 Orléans Cedex 2

France

Subject :

Raman spectroscopy in counterflow CH_4/air, CH_4/CO_2/air and CH_4/H_2/air flames, at high pressure (until 1 MPa), for the determination of temperature and major species profiles.

Duration : 12 months

Description :

The optimisation of combustion processes, in words of energetic efficiency and reduction of pollutants formation, require a detailed knowledge of the kinetics governing combustion. In fact, most of the energy production systems work at high pressure (> 1 atm.) and it is well known that pressure impacts the combustion kinetics. In that aim, since 2008, was developed at ICARE a new facility based on twin counterflow burners installed inside a high pressure chamber, coupled with different optical and laser diagnostic techniques. The counterflow configuration allows expanding the flame structure studies at pressures higher than 1 atm with the help of laser diagnostic techniques in order to get species profiles with a good spatial resolution. Until now, methane (as the major component of natural gas), biogas (CH_4 + CO_2) and hythane® (80% CH_4 + 20 % H_2) have already been studied. Premixed laminar CH_4/air, CH_4/CO_2/air and CH_4/H_2/air flames have been stabilised until 1 MPa during PhD studies where OH and NO were detected and quantitatively measured by Laser Induced Fluorescence (LIF). The spatial profiles of these species were compared with simulated ones (using commercial codes : Chemkin, Oppdif) considering an hypothesis of adiabaticity (valuable as soon as it concerns equidiffusive mixtures). Despite the agreement obtained between experimental and simulated profiles, and before studying other more complex and potentially non equidiffusive fuel mixtures, it appears necessary to experimentally measure the flame temperature in order to assess or not the adiabatic criteria of the flames. This will be the aim of the present study proposed to the postdoctorate.
Among all the techniques used for temperature measurements in flames at high pressure, Raman spectroscopy appears to be one of the most accurate and reliable. The subject of the study will concern the experimental determination of temperature and major species profiles by Raman spectroscopy in the flames previously studied by LIF. Then, as part of a collaboration with the CORIA laboratory in Rouen, the task of the posdoctorate will concern the installation, the organisation and the driving of the Raman spectroscopy measurements. He or she will work in collaboration with a PhD student (from the CORIA lab) whose study concerns the continuation of the development of Raman scattering technique in combustion, initiated by G. Cleon and A. Lo during their thesis at the CORIA lab.

The project should proceed as follows :
- Installation of the Raman spectroscopy technique
- Measurements and post-treatments for the temperature and major species profiles determinations
- Simulation

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Profile of the candidate:

- Skills in the use and installation of laser diagnostic techniques (Raman spectroscopy, LIF) in gaseous phase reactive systems (combustion, plasmas,…).
- Personal experience in the following fields would be appreciated : combustion, flames, chemical kinetics

Coordinators of the project :

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Applications must be sent by email to the coordinators and should contain :
- a cover letter
- a CV
- the names of 2 persons as references.