Simulation of hydrogen-flame propagation and stabilization in porous media

PhD position
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In the framework of the SCIROCCO (Simulation and Control of Renewable Combustion) program founded by an ERC advanced grant starting in October 2019, we are looking for PhD candidates.

Context:

Many renewable sources of energy such as sun and wind can only be delivered intermittently. In order to match production with demand, the development of **storage capacities** is mandatory. The storage of electricity is a major issue for which most known solutions are short-term (e.g. batteries, spinning wheels, etc.). Long-term solutions such as water pumping or pressurized gases typically don't scale well because of either limited adequate sites or low energy density. In the framework of SCIROCCO a strategy called **'Power to Gas (PtG)'** is considered. PtG is the conversion of electricity into fuel through electrochemical processes, the simplest of which is the production of **hydrogen (H_2) via electrolysis** of water.
We will consider the use of this hydrogen directly in combustion devices to produce heat. The typical objective is the production of domestic heat (cooking, central heating, etc.) but many other applications can be considered. In order to tamper the reactivity of hydrogen, its combustion inside a porous media is considered. The challenges are the fundamental understanding of flame dynamics with a strong coupling with heat transfer.

Objectives and program:

The objective of the PhD is to develop high-fidelity numerical simulations of flame dynamics in porous media (mostly Direct Numerical Simulations). Two of the main challenges will be (1) the mitigation of pollutant emissions because hydrogen flames are known to produce NOx, and (2) the validation of chemical kinetics for flames with large heat losses and mostly burning in the proximity of a solid surface. The development and validation of heterogeneous kinetics models might end up being necessary.

The PhD students will benefit from the expertise of the team in numerical simulation, in particular with the tool AVBP, which will be provided by CERFACS. This work will also be conducted in tandem with an experiment already operated at IMFT, which will serve as a test case and a validation database.

Team :

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