

### Call for Thesis Applications - DECODE European Project

	Reconstruction and characterization of the cathode catalyst layer of PEM fuel cells by numerical simulation.
<b>Laboratory</b>	Institut de Mécanique des Fluides de Toulouse (Toulouse Fluid Mechanics Institut)

#### **Field of research:**

Advanced solutions for hydrogen and fuel cells for the energy transition

#### **Subject :**

The proton exchange membrane fuel cell (PEMFC) is today considered a very relevant solution for the production of carbon-free electrical energy, both for transport and stationary applications. However, there is a need to further improve their performance and durability. This is the general objective of the European DECODE project in which this thesis project is part. In order to limit the number of tests during the design and development of a fuel cell, this project proposes to develop an entirely digital design support chain. The idea is to digitally reconstruct the fuel cell by simulating the manufacturing processes of each constituent component of the fuel cell as well as their assembly. The component considered in this thesis is the cathode catalyst layer. It is an essential nanoporous layer because it is the seat of the electrochemical reaction.

Thus, the objective of the thesis is to construct digitally catalyst layers by simulating their manufacturing process based on the spreading and drying of a colloidal suspension, called ink, of carbon grains loaded with platinum nanoparticles (catalyst). The idea is to be able to study the impact of the composition of the ink on the reconstructed catalyst layer in order to optimize its properties. To do this, in a second step, the main transport properties (diffusivity, thermal, electronic and proton conductivities) will be determined by numerical simulations of the transport phenomena concerned on the reconstructed porous catalyst layer structures.

#### **Training:**

This subject being mainly based on modelling work and the realization of numerical simulations, it is suitable for candidates at M2 level / engineering school trained in scientific calculation with applications in the field of transfers and/or fluid mechanics.

#### **Context :**

The doctoral student will be based at the Institute of Fluid Mechanics in Toulouse. The work will be carried out in close collaboration with CEA-LITEN (Grenoble) as well as in interactions with other partners of the European DECODE project. The doctoral student will participate very directly in this project via these interactions as well as during project progress meetings.

**Desired starting date:** 1/07/2024

**Gross monthly salary :** around 2100 €

#### **University / Doctoral school :**

INP Toulouse, ED Mécanique, Energétique, Génie Civil, Procédés (MEGEP)

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