

## Apprenticeship - 3D modelling studies of a PEM Fuel Cell

### Description:

IFP Energies nouvelles (IFPEN) is a key entity in research and training in the fields of energy, transport, and the environment. IFPEN focuses its efforts on providing solutions to the societal and industrial challenges of energy and climate, in support of the environmental transition. Notably, IFPEN's work on sustainable mobility aims to develop solutions for efficient transport, with low environmental impact while also being cost-effective. In this context, IFPEN is interested in hydrogen-based mobility solutions.

In particular, Proton Exchange Membrane Fuel Cells (PEMFC) are emerging as a relevant solution for sustainable mobility. PEMFCs offer numerous advantages, but also present a few control requirements, in particular the need to ensure correct humidification of the proton exchange membrane, which is essential for its proper operation. On the contrary, flooding of the membrane is critical to cell ageing.

The aim is to control this phenomenon using 3D finite volume modelling, at the cell scale and then at the full stack scale. The study of the various fluids circulating in the fuel cell, as well as the chemical reactions within the stack, is carried out using a CFD simulation tool and an integrated module specifically dedicated to PEMFCs.

It is in this context that this apprenticeship comes into consideration, namely, to further develop the simulation methodology and finite volume modeling of a PEMFC fuel cell (at cell level and then at full stack level). The apprenticeship will take place as follows:

- 1/ Familiarization with current IFPEN methodologies.
- 2/ Retrieval of previous case studies and bibliography on PEMFCs and flooding.
- 3/ Simulation of a PEMFC cell, then of a complete stack.
- 4/ Evolution and updating of the methodology.
- 5/ Parametric variations of the most relevant parameters for Flooding control.

### Requested profile and skills:

Student with a 4- or 5-year engineering degree on the PWT/MOT IFP School programs.

Knowledge in Thermodynamics/Fluid Mechanics.

Knowledge in Electrochemistry/Fuel Cells is a plus.

A liking for numerical CFD simulation is essential.

Skills in the software ANSYS Fluent is another bonus.

Proactivity and autonomy.

**Keywords:** Fluid Mechanics, CFD, Fuel Cells, Hydrogen, PEMFC

**Duration and dates:** 16 months beginning September 2024.

**Practical information:** The apprenticeship will take place at IFP Energies nouvelles in Rueil-Malmaison (west of Paris).

**Interested? Send a letter of motivation and a CV to:**

**Breno MENDES ALVES**

IFP Energies Nouvelles

1 et 4, Avenue du Bois-Préau

92852 Rueil-Malmaison Cedex

e-mail : breno.mendes-alves@ifpen.fr

**Pierre VIOT**

IFP Energies Nouvelles

1 et 4, Avenue du Bois-Préau

92852 Rueil-Malmaison Cedex

e-mail : pierre.viot@ifpen.fr