



# PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

**THEMATIC Research Field: OPEN SOURCE CFD MODELS FOR THE DESIGN OF INNOVATIVE GAS DISTRIBUTORS IN POLYMER ELECTROLYTE FUEL CELLS**

**Monthly net income of PhDscholarship (max 36 months)**

**€ 1500.0**

In case of a change of the welfare rates during the three-year period, the amount could be modified.

## Context of the research activity

**Motivation and objectives of the research in this field**

Hydrogen fed polymer electrolyte fuel cells (PEMFC) will play a crucial role in the decarbonization of the transport sector, specifically regarding heavy duty, maritime and rail applications.

At the state-of-the-art of the technology, performance and durability of PEMFC stacks is still a concern specifically when operated under high power density, which is a requirement to reduce the cost of the system.

As demonstrated in the automotive field, the design of the air and hydrogen distributor is one of the key components to achieve this ambitious target. An optimal distribution of reactants over the active surface allows a proper water management, avoiding local condensation or membrane dehydration.

Design of the flow field in the distributor is performed by means of computational fluid dynamics along experimental characterization with spatial resolution, i.e. segmented cells.

This P.h.D. project aims to develop an open source CFD code to simulate PEMFC performance to invent innovative geometries that guarantee high power density operation. Main activities in the project include:



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|   | <ul style="list-style-type: none"> <li>· Definition and implementation of the code in open source environment</li> <li>· Comparison of the simulation results against commercial codes, analytical solutions or available benchmarks</li> <li>· Model validation by means of dedicated experimental data collected in state-of-the-art flow field geometries</li> <li>· Model reduction to mitigate the computational requirements</li> </ul>          |
| <b>Methods and techniques that will be developed and used to carry out the research</b> | This Ph.D. project aims to develop an open source three-dimensional dynamic CFD code to simulate PEMFC performance for comparison with commercial benchmarks available at the CFD laboratory of the Department of Energy. For model validation, specific experiments will be carried out in the experimental infrastructures of MRT Fuel Cell in the Department of Energy or the Pro-e-Storage, laboratory for prototyping of electrochemical systems. |
| <b>Educational objectives</b>   | Educational objectives consist in the developing of modelling tools to enhance scientific understanding of hydrogen fuel cell technology. Literature review and model validation on experimental data strengthen the prediction capability of the results  |
| <b>Job opportunities</b>  | Job opportunities for a successful Ph.D candidate include both industrial and academical research or specific job positions as fuel cell specialist, a new professional career that is growing in numbers as products get closer to mass production.   |
| <b>Composition of the research group</b>  | 5 Full Professors<br>8 Associated Professors<br>8 Assistant Professors<br>15 PhD Students  |
| <b>Name of the research directors</b>   | 4  |

| <b>Contacts</b>  |
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| Additional support - Financial aid per PhD student per year (gross amount) |    |
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| Housing - Foreign Students   | -- |
| Housing - Out-of-town residents (more than 80Km out of Milano)             | -- |

| Scholarship Increase for a period abroad |          |
|--|----------|
| Amount monthly                           | 750,00 € |
| By number of months                      | 6        |

| Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information   |
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| <p>Educational activities:<br/>Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.</p> <p>Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations. Computer availability: individual use. Desk availability: individual use.</p> <p>Awards: Awards will be recognized to the PhD candidate up to Euro 1.500,00 (gross amount) per year, in case of exceptional achievements in the research project, subject to the evaluation of the research director</p> |