



PhD in CHIMICA INDUSTRIALE E INGEGNERIA CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 38th cycle

PNRR_351_DOTT_RICERCA Research Field: INTENSIFICATION OF CATALYTIC
PROCESSES FOR ADVANCED LOW-CARBON TECHNOLOGIES

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

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

The project aims at the development of more efficient and cleaner processes for energy conversion applications. Main goal is the development of new materials and chemical reactor designs for the production of H₂ from green or bio-energy carriers (e.g. biogas and green ammonia). Intensification of the process is pursued through the development of highly active materials, improved heat and mass transfer properties, electrification of the chemical reactor for heat direct heat supply by Joule effect.

Connections with PNRR: the research objectives are fully consistent with Mission 2 - Green revolution of the PNRR agenda, and in particular M2C1 (Circular economy target - See research on biomass conversion), M2C2 (Renewable energy, Hydrogen, sustainable mobility - see projects on production or conversion of renewable energy carriers and fuels), M2C3 (Energy efficiency - see projects on small scale fuels processors for combined heat and power systems).

Methods and techniques that will be developed and used to carry out the research

The methods of investigation include the development and characterization of catalytic materials, where the key to intensification is the obtainment of highly dispersed metal/support materials that maintain the structure under reacting conditions. The catalytic performance is studied



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| | <p>through lab-scale testing rigs operating both under steady-state and transient conditions; the experimental investigation, coupled with modelling techniques allows to extract kinetic models of the reactions. These can then be coupled with models of advanced reactors configurations (e.g. structured reactors with improved heat and mass transfer properties). The scaling up of the experimental investigation and of the modelling analysis are involved in the final verification of the technologies. In the case of CO₂ conversion processes, high pressure testing is also an important requisite of the investigation. The strategies to intensification and efficiency improvement are: development of advanced materials, use of structured internals with high heat conduction properties and high mass transfer properties, exploitation of biomass and CO₂ as C-feedstock for fuels and chemicals, use of renewable electric energy for direct heating of chemical reactors. The collaboration with international research centres will be exploited for the development of advanced structured catalysts by 3D-printing (SUPSI), the advanced characterization of catalytic materials (KTI), the pilot-scale testing of catalyst and reactors (NTNU).</p> |
| <p>Educational objectives</p> | <ul style="list-style-type: none"> • Developing highly qualified young researcher on the general topics of process decarbonization and energy transition • Developing an in depth competence in the kinetic investigation of catalytic processes; • Developing a competence in the scaling-up of catalytic processes • Developing know-how on intensification of catalytic processes with coupling with renewable energy • Modeling of catalytic reactions, reactors, processes |
| <p>Job opportunities</p> | <ul style="list-style-type: none"> • R&D activities in chemical and energy companies • Catalyst manufacturers • Gas/biogas companies Engineering companies |
| <p>Composition of the research group</p> | <p>5 Full Professors</p> |



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| | 4 Associated Professors 3 Assistant Professors 25 PhD Students |
| Name of the research directors | Prof. Tronconi, Prof. Groppi, Prof.ssa Beretta |

| Contacts | |
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| <p><i>Prof. Enrico Tronconi, prof. Gianpiero Groppi, prof. Alessandra Beretta</i> www.lccp.polimi.it https://www.intent.polimi.it/</p> | |

| 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 | |
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| Amount monthly | 700.0 € |
| By number of months | 6 |

| National Operational Program for Research and Innovation | |
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| Company where the candidate will attend the stage (name and brief description) | |
| By number of months at the company | 0 |
| Institution or company where the candidate will spend the period abroad (name and brief description) | The candidate will be introduced within the well established network of international partnerships of the LCCP group. Within the present project, partners of choice are: SUPSI - Scuola Universitaria professionale della Svizzera Italiana (on going research cooperation on 3D printed structured catalysts); Karlsruhe Institute of Technology, Karlsruhe, Germany (on going research cooperation on metal-supported catalyst preparation and characterization); NTNU, Trondheim, Norway (on going research coo |
| By number of months abroad | 6 |

| Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information |
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| <p>Confidentiality: since this is a thematic scholarship, the management of Confidential Information, Results and their publication is subordinate to the restrictions agreed upon with the funding company. Upon acceptance of the scholarship, the beneficiary must sign a specific commitment.</p> <p>Individual budget for research (during the 3 years): about 5.400 euro</p> <p>Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial of 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 regulation.</p> |