POLITECNICO DI MILANO

PhD in CHIMICA INDUSTRIALE E INGEGNERIA CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 41st cycle

THEMATIC Research Field: EXPERIMENTAL AND NUMERICAL INVESTIGATION OF ADVANCED ELECTRIFIED REACTORS FOR ENDOTHERMIC CATALYTIC REACTIONS

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	The ongoing global transition toward sustainable energy systems has created a pressing need for innovative chemical reactor technologies that are more efficient, flexible, and environmentally friendly. One of the key drivers of this effort is the electrification of catalytic reactors, which offers the potential for deep decarbonization by allowing direct integration with renewable energy sources, enabling the design of innovative processes. In this context, 3D structured cellular substrates (e.g., foams, periodically open cellular structures – POCS) can be used as electric resistor present significant advantages over conventional designs, allowing i.e. more efficient heating and rapid temperature variation within the catalytic bed. Such structures can be catalytically activated either by washcoating, acting as catalyst supports, or by packing their voids with catalytic particles The scope of this research is the experimental and numerical investigation of new catalytic reactors based on volumetric joule heating by means of 3D cellular structures made of technical ceramics. This electrified reactor concept will be first applied in the context of an industrially relevant endothermic processes for the CO2 valorization such as Reverse Water Gas Shift for the production of syngas, that can be exploited i.e. for methanol or synthetic fuels production, and combined CO_2 capture and upgrading into syngas in a cyclic

	process, where electrification is the key to allow rapid temperature changes required by the different process stages.
Methods and techniques that will be developed and used to carry out the research	The research activity will focus on the experimental and numerical assessment of the performances of an innovative reactor and processes for CO_2 valorization. The skills that will be developed by the candidate fall within expertise of chemical reaction engineering. In particular the candidate, to successfully complete the research program will master: •Catalyst synthesis and characterization •Kinetic testing of catalyst • testing on lab-scale electrified reactors •Advanced mathematical modelling of reactors, aimed at conceptual scale-up of the system.
Educational objectives	The candidate will gain high-level knowledge ofexperimental testing and modelling of advanced catalyticreactors and catalytic processes for the production of keyenergy vectors and CO_2 valorization.
Job opportunities	Graduates from the Ph.D program will find abundant opportunities in research institutions, chemical industries, energy companies, consultancy companies in the field of electrification and decarbonization, catalyst manufacturers, car manufacturers.
Composition of the research group	7 Full Professors 4 Associated Professors 4 Assistant Professors 15 PhD Students
Name of the research directors	Gianpieroproff. Groppi, Matteo Ambrosetti

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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Educational activities (funding for participation in courses, summer schools, workshops and conferences) - financial aid per PhD student per year: 1st year: around 2.000 euros per student 2nd year: around 2.000 euros per student 3rd year: around 2.000 euros per student **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.