POLITECNICO DI MILANO

PhD in CHIMICA INDUSTRIALE E INGEGNERIA CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 39th cycle

THEMATIC Research Field: STUDY OF ELECTRIFIED STRUCTURED REACTORS FOR CATALYTIC AMMONIA DECOMPOSITION

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	Ammonia decomposition is considered a key process to unlock hydrogen usage, overcoming one of the problems associated with its storage and distribution. Ammonia decomposition has several challenges, including the design of an active catalyst and efficient decomposition reactors. Catalytic reactors where the heat of reaction is provided by electric energy play a key role in the development of low-carbon H2 technologies towards progressive decarbonization of industrial processes. The application of these concepts to ammonia decomposition enables a completely decarbonized hydrogen production and distribution if e-NH3 is considered as a feedstock. Moreover, these systems enable also design of small-scale units enabling development of distributed processes and technologies that match distributed hydrogen demand. In this context, Joule-heating of structured catalysts made of proper materials (e.g., Silicon Carbide) was demonstrated among the most effective methodologies by the LCCP research group, and was recently applied to H_2 production through methane steam reforming process or CO2 valorization with methane dry reforming and reverse water gas shift. In parallel, a rig was assembled which enables pure ammonia feed and where kinetic tests of different catalyst formulations for ammonia decomposition

	have been already carried out. The objective of this research will be the testing, modelling and scale-up of a novel reactor configuration patented by LCCP in cooperation with an external company. The validation of advantages provided by this novel configuration will be proved at laboratory scale and then, scale-up considerations will be performed in view of a pilot-scale testing expected in 2026.
Methods and techniques that will be developed and used to carry out the research	The candidate will first accomplish a critical analysis of the possible materials for design of an electrified reactor, performing characterization in terms of thermal and electric conductivity aimed at understanding the material stability and possible interactions in a reactive environment. The candidate will perform kinetic investigation tests in order to characterize possible catalytic formulations for the scale-up of the reactor concept. Experimental testing of the advanced reactor configurations will be performed by adapting existing rigs at LCCP laboratories. The student will be called to design a reactor based on the proposed configuration, perform catalytic activation of the materials and execute in person reactive tests. In parallel, the candidate will develop adequate reactor models that will include heat and mass transfer and catalyst kinetics to allow the analysis of the experimental output. Upon validation, the mathematical model will be used to design scaled-up units based on an optimized geometrical configuration. In the last year of the research, the candidate is expected to carry out experimental tests at an industrial site where an existing pilot-scale reactor will be adapted to the new reactor configuration.
Educational objectives	The candidate will gain high-level knowledge of experimental testing and modelling of advanced catalytic reactors and catalytic processes for the production of key energy vectors
Job opportunities	The skills acquired by the candidate during the PhD

	programme will be useful for possible jobs in R&D roles of companies active in chemical processes design, catalyst manufacturers, EPC, oil and gas
Composition of the research group	6 Full Professors 4 Associated Professors 10 Assistant Professors 20 PhD Students
Name of the research directors	Prof. Enrico Tronconi

Contacts
Telephone: 0223993264 Email: enrico.tronconi@polimi.it Web-pages of the research group: https://www.lccp.polimi.it/; www.intent.polimi.it

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

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

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.

Educational activities (funding for participation in courses, summer schools, workshops and conferences) - financial aid per PhD student per year:.
1st year: around 1.900 euros per student
2nd year: around 1.900 euros per student
3rd year: around 1.900 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.