



# PhD in CHIMICA INDUSTRIALE E INGEGNERIA

## CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 38th cycle

Number of scholarship offered	8
Department	DIPARTIMENTO DI CHIMICA, MATERIALI E INGEGNERIA CHIMICA "GIULIO NATTA"

### Description of the PhD Programme

*The study of basic disciplines is seen as a necessary tool for the rationalization of technologies and of their rational, safe and sustainable use. The training objective is not only trivially to provide the students with tools for the understanding, planning and managing processes and systems, but also to enable them to independently develop new technological applications and to design and to characterize new products and new services with these characteristics. The qualification of a PhD student is accomplished through the an original research work on a specific topic of the Industrial Chemistry and Chemical Engineering PhD. As an example, such specific topics may include:*

- *the chemistry of natural compounds;*
- *the development of innovative chemical processes;*
- *food safety and quality assurance;*
- *advanced materials;*
- *human health;*
- *innovative energy technologies, with particular attention to energy consumption;*
- *the development of combustion processes with low environmental impact, including the internal combustion engines;*
- *the methodologies and criteria for process and plant design and operation, considering the choice of raw materials, the cost of the process, safety issues and sustainability;*
- *the design and control of operation units and of the whole plant through mathematical modeling and computer simulation techniques;*
- *the study of processes at the microscopic scale, deepening the thermodynamics and kinetics and using other tools from electrochemistry and materials science;*
- *the study of electrochemical processes in an interdisciplinary and multidisciplinary approach which involves the chemical and metallurgic engineering, material engineering and energetics; the synthesis, characterization, process technology, and use of substances; the design based on the structures*





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

**OPEN SUBJECT Research Field: CATALYSIS FOR ENERGY AND ENVIRONMENTAL APPLICATIONS**

<b>Monthly net income of PhDscholarship (max 36 months)</b>
<b>€ 1400.0</b>
In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.

<b>Context of the research activity</b>	
<b>Motivation and objectives of the research in this field</b>	To study and develop innovative catalysts and catalytic processes for energy-related and environmental applications
<b>Methods and techniques that will be developed and used to carry out the research</b>	Testing of catalysts under laboratory conditions. Kinetics analysis and study of reaction mechanism. Analysis of the role of heat and mass transfer phenomena. Mathematical modelling of catalytic reactors
<b>Educational objectives</b>	To gain a high-level knowledge about catalytic processes for energy applications and environmental protection
<b>Job opportunities</b>	Chemical industries, energy companies, developers and users of energy conversion technologies, catalyst manufacturers, car manufacturers
<b>Composition of the research group</b>	7 Full Professors 3 Associated Professors 2 Assistant Professors 15 PhD Students
<b>Name of the research directors</b>	Tronconi, Lietti, Groppi, Beretta, Maestri, Nova

<b>Contacts</b>
Email: <a href="mailto:enrico.tronconi@polimi.it">enrico.tronconi@polimi.it</a> Ph: +39-0223993258 <a href="http://www.lccp.polimi.it">www.lccp.polimi.it</a>



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
<p><u>Educational activities</u> : financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences:            1st year: max 1900 euros per student            2nd year: max 1900 euros per student            3rd year: max 1900 euros per student</p> <p><u>Teaching assistantship:</u>            availability of founding 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.</p>



# PhD in CHIMICA INDUSTRIALE E INGEGNERIA

## CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 38th cycle

**OPEN SUBJECT Research Field: INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING**

<b>Monthly net income of PhDscholarship (max 36 months)</b>	
<b>€ 1325.0</b>	
In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.	
<b>Context of the research activity</b>	
<b>Motivation and objectives of the research in this field</b>	Topics: 1. methods and criteria for industrial processes and plants design and operation, including safety and environmental aspects; 2. industrial plant design and control by computer-based mathematical modeling and simulation methods; 3. microscopic-scale analysis of industrial processes through thermodynamics, kinetics and transport phenomena methodologies; 4. synthesis, characterization, transformation technology and application of substances; 5. design of chemical and/or biological material; 6. characterization of products and materials.
<b>Methods and techniques that will be developed and used to carry out the research</b>	The research will be carried out using both experimental and computational facilities. Laboratory-scale apparatus data will be interpreted by suitable mathematical models implemented in computer codes. The use of advanced analytical devices and literature survey will be an essential part of the work.
<b>Educational objectives</b>	The main objective is to give to the student the tools to design and manage chemical synthesis, chemical processes and industrial plants, and to allow him/her to develop in a self-sufficient way new technological applications and to create and characterize new products and services.
<b>Job opportunities</b>	



	The Research Doctors will be able to find a natural location in process companies and both in private and public companies and institutes, operating in the field of research, design, production, formation, control and consultant services.
<b>Composition of the research group</b>	14 Full Professors 33 Associated Professors 6 Assistant Professors 61 PhD Students
<b>Name of the research directors</b>	Carlo Alessandro Cavallotti

<b>Contacts</b>	
carlo.cavallotti@polimi.it (+ 39 022399.3176) www.chem.polimi.it	

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

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	662.5 €
<b>By number of months</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>
<p><i>Web site: <a href="http://phd.chem.polimi.it/">http://phd.chem.polimi.it/</a></i></p> <p><i>Educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student about 5.500 euros.</i></p> <p><i>Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student.</i></p> <p><i>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.</i></p> <p><i>Computer and desk availability</i></p>



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

**INTERDISCIPLINARY Research Field: PLASMONIC CONTROL OF DRUG RELEASE IN  
THERMORESPONSIVE GELS**

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

**€ 1325.0**

In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.

## Context of the research activity

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

Interdisciplinary PhD Grant

The PhD research will be carried out in collaboration with research groups of the PhD programme in "**PHYSICS**". See <https://www.dottorato.polimi.it/?id=422&L=1> for further information.

The development of innovative systems aimed at improving drug administration is a well-known area of research. For the last 30 to 40 years, different materials, both organic and inorganic, have been studied and optimised, leading to the creation of several products on the market. The concept behind it is to guarantee the presence of the drug within its therapeutic range in order to avoid problems of overdose and ensure optimisation of its use. Despite this, considerable improvements can be made by considering external stimuli capable of ensuring better optimisation of release kinetics. In this perspective, our interest is in combining an organic polymer matrix with gold nanoparticles. When properly irradiated, they absorb light and store heat, which they release into the surrounding environment in a so-called plasmonic manner. In the biomedical field, especially in diagnostics, various gold nanoparticles have already demonstrated their high capacity for use. The combination of these two systems would therefore guarantee the creation of a hybrid system capable of releasing its contents, or not, on



	the basis of an externally controllable stimulus (laser).
<b>Methods and techniques that will be developed and used to carry out the research</b>	<p>The student will have to work closely with all the groups involved in chemistry, physics and finally biology field. The first part of the work will focus on the optimisation of the hybrid device following, on one side, the synthesis and characterisation of hydrogel systems and, on the other side, of gold nanoparticles. Their combination will be optimised from both the final mechanical properties and the release mechanisms points of view. The insertion of these nano-systems (depending on shape, functionalisation and concentration) is able to generate a localised temperature increase in the polymer lattice, which is not harmful to biological systems, and which affects the relaxation of the polymer chains, thus regulating the release of the content. In order to understand and optimise this aspect, it will be necessary to work on the photo-induced plasmonic effect in the hybrid material and to be able to characterise and measure it both with laser experimental set-ups of time-resolved optical spectroscopy (at the laboratories of the Department of Physics, under the responsibility of Dr. Margherita Maiuri) and to predict it following mathematical simulations concerning the physics involved. Indeed, pharmacological research has for too long used trial-and-error approaches leading to intense inefficiency of experimentation; we want to avoid this results by proposing our multidisciplinary PhD. The materials obtained will then be tested internally on cell lines in order to verify their biocompatibility and potential efficacy on pathological systems both in vitro and in vivo, also making use of external collaborations.</p>
<b>Educational objectives</b>	<p>The student at the end of the PhD project will develop the following skills: polymer chemistry (hydrogel preparation and functionalization), materials design, controlled drug delivery systems (application in different medical fields), optical technologies and mathematical modeling</p>
<b>Job opportunities</b>	<p>The PhD student at the end of this project can spend his or her skills in different industrials fields. In particular in the industrial sectors related to cosmetics, pharmaceuticals</p>





	and laser technologies.
<b>Composition of the research group</b>	0 Full Professors 1 Associated Professors 1 Assistant Professors 0 PhD Students
<b>Name of the research directors</b>	Prof. F. Rossi / Prof.ssa M. Maiuri

<b>Contacts</b>	
Telephone: +390223993145E mail: filippo.rossi@polimi.it Web-pages of the research group: <a href="https://cfalab.chem.polimi.it">https://cfalab.chem.polimi.it</a>	

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

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	662.5 €
<b>By number of months</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>
<p><b>Educational activities</b> (funding for participation in courses, summer schools, workshops and conferences) - financial aid per PhD student: about 5.500 euros.</p> <p><b>Teaching assistantship:</b> 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>