



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



	<p>the basis of an externally controllable stimulus (laser).</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<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>
<p>Educational objectives</p>	<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>
<p>Job opportunities</p>	<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.
Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 0 PhD Students
Name of the research directors	Prof. F. Rossi / Prof.ssa M. Maiuri

Contacts	
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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	662.5 €
By number of months	6

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