



PhD in INGEGNERIA DEI MATERIALI / MATERIALS ENGINEERING - 40th cycle

**PNRR 629 PA Research Field: NOVEL CELL MEMBRANE-TARGETED
PHOTOTRANSDUCER DRUGS TO INVESTIGATE THE LIGHT-INDUCED
ELECTROPHYSIOLOGICAL MECHANISMS**

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**

Optical technologies for modulating the activity of excitable cells are becoming increasingly important in cell biology, neuroscience and cardiology. In particular, the possibility of inducing or inhibiting the electrical activity of excitable cells and organelles with a high spatiotemporal control it has opened new perspectives for the treatment of neurological and cardiac pathologies.

The use of photoswitches as a drug in photopharmacology is relatively recent but very promising. The approach followed here poses a new paradigm in photopharmacology, because it is based on affinity of the photochromic species with the cell membranes; therefore, it is suitable for generating potentials of action by different cells. The development of these systems and the understanding of the mechanisms of action lay the basis for the treatment of macular degeneration and neurodegenerative diseases such as Parkinson's, epilepsy, and specific pathologies such as atrial and ventricular arrhythmias or for regulate the metabolic response of the cell.

As a case study, the project will contribute to the innovation and competitiveness of national agencies in the medical and pharmaceutical fields, according to the PNRR guidelines for Public Administration (Missione 1 Digitalizzazione, innovazione, competitività e cultura - Componente 1).



<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The research project consists of a experimental work, supported by theoretical modeling, who benefits from complementary knowledge and skills in order to apply new functional materials in the biomedical field. In particular, photochromic switches with affinity for the cellular plasma membrane will be developed and characterized to determine the main optical and photochromic properties. When fed to cell cultures or complex models their action will be investigated, cardiomyocytes and cardiac tissue being the main focus of this project. Results will be rationalized by mathematical modeling aimed at understanding the effect of the molecule on the electrophysiological profile of the cell, incorporating electrophysiologically detailed models of the cardiomyocyte. The effects of photoswitches on membrane capacitance and possible activation of specific ion channels dependent on the deformation of the membrane will be specifically investigated.</p> <p>During the research period at AIFA the doctoral student will gain knowledge and expertise on the regulatory process associated with risk assessment of drugs in the new field of photopharmacology.</p>
<p>Educational objectives</p>	<p>To get familiar with the regulatory process behind new drugs (with a specific focus in photopharmacology). To gain knowledge and expertise in the design and synthesis of new phototransducer drugs. To apply Machine Learning techniques to data extracted from biophysical simulations to uncover mechanistic insights associated with arrhythmogenic behavior of new drugs.</p> <p>The project will be carried out within a broad interdisciplinary collaboration that involves chemists, materials engineers, biologists and bio-engineers.</p>
<p>Job opportunities</p>	<p>At the end of the PhD Programme, the candidate can find job opportunities at regulatory agencies, thanks to the familiarity with the regulatory process behind new drugs. At the academic level, the PhD graduate can access to tenure track in national or international universities or research institutions. Also, the PhD graduate can apply for R&D positions in high tech companies operating in the bio medical and pharmaceutical fields.</p>



Composition of the research group	2 Full Professors 1 Associated Professors 2 Assistant Professors 6 PhD Students
Name of the research directors	Prof.ssa C. Bertarelli, Prof. J. Rodriguez Matas

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	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Agenzia Italiana del farmaco (AIFA) Via del Tritone, 181, 00187 Roma RM https://www.aifa.gov.it
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	To be defined
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<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 (tot. about 5.700 euro): 1st year: 1.900 euro; 2nd year: 1.900 euro; 3rd year: 1.900 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</p>



by the regulation.