



PhD in CHIMICA INDUSTRIALE E INGEGNERIA

CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 38th cycle

PNRR_352 Research Field: DEVELOPMENT OF FORMULATED HYDROGELS FOR SPINAL CORD REGENERATION AND ITS PRODUCTION AT INDUSTRIAL SCALE

Monthly net income of PhDscholarship (max 36 months)

€ 1325.0

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

Recent studies in materials science and technology underlined that polymeric biomaterials are able to promote recovery after spinal cord injury and are reviewed in scientific literature. Among them, hydrogels, a hydrophilic three-dimensional polymeric network, are the most promising. They can support stem cell viability *in situ* and can be injected filling the lesion cavity. This is possible thanks to their high elasticity, tunable rheological properties and injectability that is a key point in SCI repair in order to avoid risks caused by surgery, to guarantee minimal invasive treatments. Other advantages reside in the possibility to carry and release hydrophilic molecules (drugs and biomolecules) with controlled kinetics. The ability to treat damaged tissue after spinal cord injury is one of the great challenges in biomaterials and medicine. Successful treatments need advances in optimizing material synthesis and in designing translatable experimental research. Therefore, this PhD project aims to gain basic scientific outcomes to bridge the gap between the bench and bedside developing and optimizing an innovative hydrogel able to load and support *in situ* adipose derived stem cells. Experimental design will take in account the translatability to the clinic maximizing the chances that a good idea becomes a good treatment. This with the final aim to optimize biomaterial therapy as proposed here as a promising and innovative



	<p>approach also for other stem cell therapy in acute degenerative events (e.g. traumatic brain injury). This research activity is set in PNRR-Health sector with the action of strengthening biomedical research.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>Responding to the critical issue of a limited viability and presence of stem cells in the damaged site after spinal cord injury, several studies have suggested associate biopolymeric support for cell delivery, providing localized targeted therapy to maximize the efficacy of these treatments. Loaded hydrogels can remain temporally localized in the spinal cord after implantation delivering factors secreted by stem cells or sustaining structurally them to fill the gap in the damaged site. In addition, the hydrogel preserves the cells from detrimental effects generated from the damaged spinal cord. The delivery strategy proposed in this PhD program aims to achieve new goals: - to localize the cell therapy to maximize the efficacy of the treatment. - to preserve cells and stemness from the detrimental environment generated by the damaged spinal cord.- to deliver factors that are secreted by stem cells and structurally sustain them to fill the gap at the site of damage.- to demonstrate that the approach of stem cells loaded in hydrogels is efficacious in ameliorating the spinal cord injury progression in preclinical rodent models. - to identify new potential working mechanisms underlying the stem cell therapeutic effect supported and maximized by our hydrogel.- to get a rapid clinical transferability to the clinic that will be aided by two different factors: a) the extremely high biocompatibility of the hydrogel, since all its components are already approved for human use and all degradation products are thus well known as highly biocompatible (and this evidence are also confirmed by our previous preclinical investigations; see proposers' papers); b) stem cells can be obtained bed side meeting GCP standards, the safest available today: from a clinical perspective, indeed, these cells can be easily harvested and separated at bed-side during surgery, using several types of already commercially available systems that well serve at this specific purpose, being moreover cheap and easy to use. All these goals, regarding PNRR-Health mission, are</p>



	directed toward the complete exploitation of the opportunities for improving the health offer deriving from the use of technological innovation and from the advancement of research in the medical field. In this framework REGENERA works with the final aim to transfer into clinics technological innovations to solve the problems related to injured spinal cord.
Educational objectives	The student at the end of the PhD project will obtain high formation degree and will develop the following skills: polymer chemistry (hydrogel preparation, formulation and functionalization), materials design, controlled drug delivery systems (application in different medical fields), knowledge of regulatory and industrial scale up.
Job opportunities	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 and medical devices.
Composition of the research group	1 Full Professors 1 Associated Professors 0 Assistant Professors 4 PhD Students
Name of the research directors	Prof. Filippo Rossi

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



National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	REGENERA SA Company that aims to translate into clinics its innovative combined approach for sub-acute spinal cord injury repair.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Università della Svizzera Italiana where the PhD student will perform tests on biocompatibility and pharma-grade devices. This activity will be done in collaboration with Dr. Veglianesse group.
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 (during the 3 years): about 5.400 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 by the regulation.</p>