



# PhD in CHIMICA INDUSTRIALE E INGEGNERIA

## CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 39th cycle

**PNRR 118 PA Research Field: INNOVATIVE BIO-BASED NANO-ADDITIVES FOR FOOD PACKAGING**

**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**

The recent changes in the regulatory panorama set new demands for all actors of the food and packaging industries, producers and retailers need sustainable solutions and alternatives for plastic packaging products. Cellulose-based materials are required to provide high barrier in order to substitute existing complex multi-component plastic packaging while securing the same barriers properties, shelf life and food safety. Recently, new coating formulations have raised industry interest to obtain paper and board monomaterials, with improved mechanical and functional properties. Biobased barrier coatings could further increase the environmental benefits, in particular regarding the end of life, in terms of good recyclability, absence of microplastic release and compostability. The development of novel additive and materials for food packaging has to take into account Food Contact Materials (FCM) regulation requirements. At EU level, the legal framework that regulates FCM encounters general dispositions that are applied to all FCM and specific dispositions for particular categories. General dispositions include Regulation 1935/2004/EC which specify general principles of safety and inertia and Regulation 2023/2006/EC that establishes the Good Manufacturing Practices (GMP). Article 3 of Regulation 1935/2004/EC set forth that materials or articles in contact with food do not transfer harmful constituents for human



	<p>health, cause unacceptable change in food composition and deterioration in the organoleptic characteristics. No specific reference to nanomaterials is included in general disposition framework but some references are reported in specific disposition such as Regulation 10/2011/EU for plastic FCM. Regulation (EU) No 10/2011 includes explicit case-by-case EFSA assessment before authorization of nano-substances. The authorization of conventional substance does not apply also to the same substance in nanoform. The aim of this research is to support the legal framework procedure to ensure high level of safety and compliance to market request and consumer/societal expectations, the phenomena of migration of the substances will be investigated in order to develop analytical tools for risk assessment. For this purpose, the performance of additives and functional layers on fibre-based substrates, regarding mechanical and barrier properties will be evaluated, the migration of chemical compounds and the physical phenomena explaining the migration behavior will be considered. A specific study will be focused on cellulose derived additives in nanoform.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>The research will be divided in different activities:</p> <ol style="list-style-type: none"> <li>1. Analysis of the state of art related to both industrial products and academic research about barrier coating additives. Such phase will be aimed to frame the existing solutions as well as cutting edge advancements; moreover, particular attention may be given on existing bio-based, cellulose derived additives in nanoform.</li> <li>2. Analysis of the state of art related to regulation for coated FCM at European and national level and the role of nanoforms in food and food contact legislation.</li> <li>3. Characterization of the additives and coated materials by means of different techniques, such as surface characterization by means of SEM-EDX. Determination of barrier properties to liquids and gases and mechanical properties of coated substrates; study of the physical phenomena explaining the migration behavior, development of modelling of diffusion/migration.</li> </ol> <p>Development of a protocol based on a risk assessment approach to evaluate the hazard and the migration of the novel additives throughout the substrate and into food. In</p>



	<p>order to evaluate the compliance to Art.3 of Regulation 1935/2004/EC, the coated materials containing the novel nanoform additive undergoes on a risk assessment approach by using target and untarget analysis in order to identify possible hazards. GC-MS and HPLC-MS protocols will be developed and carried out to evaluate the substances migration from coating formulation and final manufact. Volatile compound and semi-volatile or non-volatile non-polar compounds will be detected by GC-MS analysis while HPLC-MS will be used to identify semi-volatile or non-volatile polar substances. Moreover, the sensorial aspect will be evaluated by carry out the sensorial analysis in order to investigate the occurring of organoleptic deterioration in food. Finally, in order to modelling migration phenomena of nanoform substances, migration test in food and/or food simulant will be carried out.</p>
<b>Educational objectives</b>	<p>The candidate will become familiar with the characterization of innovative additives for cellulose-based packaging materials, analytical protocols and the regulatory framework. The candidate will present the outcomes of the research in scientific papers, national and international conferences and events.</p>
<b>Job opportunities</b>	<p>The PhD graduate will have high-quality scientific expertise in the field of innovative barrier materials for packaging, with focus on evaluation of food safety and regulatory context. The professional figure of the PhD will allow him/her to best integrate in the Italian industrial sector.</p>
<b>Composition of the research group</b>	<p>2 Full Professors 1 Associated Professors 3 Assistant Professors 3 PhD Students</p>
<b>Name of the research directors</b>	<p>Prof. C. Punta, Prof. L. De Nardo</p>

<b>Contacts</b>
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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)	Innovhub SSI ? Stazioni Sperimentali per l'Industria S.r.l. Via Giuseppe Colombo, 79. 20133 Milano (MI) <a href="https://www.innovhub-ssi.it/">https://www.innovhub-ssi.it/</a>
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><b>Individual budget for research (5.700 euro):</b> 1<sup>st</sup> year: 1.900 euro; 2<sup>nd</sup> year: 1.900 euro; 3<sup>rd</sup> year: 1.900 euro</p> <p><b>Teaching assistantship (availability of funding in recognition of supporting teaching activities by the PhD student):</b> there are various forms of financial 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>	