



# PhD in CHIMICA INDUSTRIALE E INGEGNERIA

## CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 40th cycle

**THEMATIC Research Field: SUSTAINABLE ELASTOMER NANOCOMPOSITES**

**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 PhD activity is focused on elastomer nanocomposites, in particular for dynamic-mechanical applications such as the one in tyre compounds. In particular, the elastomer nanocomposites will be used in tyre tread and will be based on nanometric sp<sup>2</sup> carbon allotropes, prevalingly carbon black. One of the main activities will be the functionalization of carbon black and other the sp<sup>2</sup> carbon allotropes, such as such as graphene related materials and carbon nanotubes. The reactions will be mainly performed with biobased substances, in line with the principles of green and sustainable chemistry. Assessment of chemical, physical and structural properties of pristine and functionalized carbon allotropes will be performed. Elastomer nanocomposites will be prepared. Dynamic-mechanical, thermal and electrical properties of the nanocomposites will be investigated, establishing the correlation between properties and structure of the nanocomposite, in particular in view of the application in a tyre compound. All the activities will be inspired to the principles of sustainability.

#### Methods and techniques that will be developed and used to carry out the research

The research will be carried out in cooperation with Pirelli Tyre. Indeed, the thesis will be developed with funding by Pirelli Tyre. The experimental techniques and facilities will be suitable for (i) the functionalization and characterization of sp<sup>2</sup> carbon allotropes, such as carbon



	black, graphene related materials and carbon nanotubes (ii) the preparation and characterization of elastomer nanocomposites. A thorough literature survey will be essential part of the work. Analytical techniques such as nuclear magnetic resonance, infrared, calorimetry, thermogravimetric, and BET analysis will be used. Dynamic mechanical, tensile and thermal characterization of the elastomeric composites will be performed. Swelling and filler networking studies will be carried out.
<b>Educational objectives</b>	Main objective is to give to the student tools to: (i) perform reactions on nanometric sp <sup>2</sup> carbon allotropes as the substrates (ii) characterize the nanometric carbon allotropes (iii) prepare and characterize elastomer nanocomposites (iv) establish structure-property correlations in view of challenging applications, such the one for tire compounds (v) perform a research on materials inspired to the principles of green chemistry and sustainability.
<b>Job opportunities</b>	The Ph. Doctor will be able to find natural location both in private and public companies and institutes active in the field of chemical synthesis, polymeric composite materials, in particular elastomeric materials and in particular in R&D Department. Companies involved in the rubber and tyre fields will be the favourite ones.
<b>Composition of the research group</b>	1 Full Professors 4 Associated Professors 3 Assistant Professors 10 PhD Students
<b>Name of the research directors</b>	Prof. Maurizio Galimberti

<b>Contacts</b>
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<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>	--



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**

**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.

**Educational activities** (funding for participation in courses, summer schools, workshops and conferences) - financial aid per PhD student per year:

1st year: around 1.900 euros

2nd year: around 1.900 euros

3rd year: around 1.900 euros

**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.