



PhD in FISICA / PHYSICS - 37th cycle

THEMATIC Research Field: FUNCTIONAL CARBON DOTS FOR ENHANCING TOMATO PRODUCTION IN A CIRCULAR ECONOMY SCHEME (FENICE)

Monthly net income of PhDscholarship (max 36 months)

€ 1300.0

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 scholarship is made available in the framework of the research project FENICE, in the field of circular economy. Agricultural sector is going to face enormous challenges in order to feed the 9.6 billion people that are going to inhabit the planet by 2050. This goal has to be achieved in spite of limited availability of arable lands, of increasing need for irrigation water (agriculture consumes 70% of the world's fresh water supply) and of the concomitant, severe impact of climate change. Water plays an important role, due to its use for most human activities and for agriculture in particular. Drought hampers crop production and food security, alters the photosynthetic efficiency and the nutrients uptake, and largely affects the plants efficiency in water use. Here, ***sustainable use of most advanced nanotechnologies is expected to play a key role***. Smart materials, innovative device architectures and digital technologies hold the potential to meet growing global demand for food, while ensuring the sustainability of primary production. However, their use for the monitoring and the improvement of plants functions is still in its infancy. FENICE originally combines the concepts of circular agronomy and circular chemistry, by proposing the *use of environmentally sustainable nanomaterials for increasing plants yields and reducing overall water consumption*. In more detail, the project will combine carbon-based, biocompatible nanomaterials, obtained from vegetal wastes, with the most advanced bio-hybrid devices technologies, to both finely modulate and sense plants physiological processes and to optimize their water and nutrients adsorption. Overall, FENICE



	represents a very first effort towards the integration of innovative, safe-by-design nanomaterials, gene-less and fertilizers-free approaches to modulate plant yields and water/soil consumption, and breakthrough devices for sustainable precision farming.
Methods and techniques that will be developed and used to carry out the research	Adopted techniques include optical and electronic characterization of synthesized nanomaterials, photoelectrochemistry, optical and electronic microscopy, optical spectroscopy and fluorescence imaging. Devices based on carbon nanomaterials (photoactuators and organic transistors) will be characterized both in vitro and in vivo, combined with plant systems.
Educational objectives	The candidate will characterize hybrid interfaces between functional materials and plant cells. He/she will work in a multidisciplinary research team, comprising biologists, biotechnologists, material scientists, physicists and engineers, will have access to state-of-the-art facilities for bio-hybrid interfaces characterization, will be exposed to a highly supradisciplinary, international environment, will be actively involved in cutting-edge research activities. FENICE merges different areas and expertise, from chemical synthesis to biotechnology, from materials science to biophotonics, from electrochemistry to plant biology and agronomy. In every single step, as well as in the project as a whole, the guiding principles of circular economy find application, and the successful applicant will be exposed to several opportunities of training and individual growth on this research theme.
Job opportunities	Professional opportunities include both academic research and industry. Recent PhD graduates were enrolled in top-level European and American research centers, as well as in the industrial sector.
Composition of the research group	1 Full Professors 0 Associated Professors 4 Assistant Professors 4 PhD Students
Name of the research directors	Maria Rosa Antognazza



Contacts

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Additional support - Financial aid per PhD student per year (gross amount)	
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Housing - Foreign Students	--
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Housing - Out-of-town residents (more than 80Km out of Milano)	--
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Scholarship Increase for a period abroad	
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Amount monthly	564.01 €
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By number of months	6
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Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities per year :

1st year: 0

2nd year: 1534 euros per student

3rd year: 1534 euros per student.

or 1022 euros per student for each year.

Teaching assistantship:

There are various forms of financial aid 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 regulations.

Computer and Desk availability: shared use