POLITECNICO DI MILANO

PhD in FISICA / PHYSICS - 41st cycle

THEMATIC Research Field: EDIBLE BATTERIES

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 emerging field of edible electronics is creating great scientific resonance by envisioning a technology which is safe for ingestion, environmentally friendly, cost-effective, and degraded within the body after performing its function, either digested or even metabolized. Long-term opportunities include smart pharmaceuticals and direct food tagging. Edible Batteries are key to such applications and have strong opportunities for sustainable electronics at large. Our group is leading this activity, which delivered a first edible rechargeable battery indicated by the TIME Magazine as one of the best inventions of 2023; a following chocolate version is being displayed at World Expo in Osaka with the “RoboCake” demonstrator.
Methods and techniques that will be developed and used to carry out the research	The research will be performed within the “Printed and Molecular Electronics” group, led by Mario Caironi in the Center for Nano Science and Technology, of the Istituto Italiano di Tecnologia. The study will require the fabrication and characterization of edible rechargeable batteries, especially targeted to fit smart edible pills. Applications in food will also be explored. Electrochemical characterization methods as well as materials science approaches will be applied.
Educational objectives	Expanding the knowledge in the physics and electrochemistry of edible and sustainable batteries, in the electronic and electrochemical properties of food and food derivatives, learning solution-based fabrication techniques, exploring the toxicological properties of synthetic carbon based materials, developing batteries

	with edible components, working in a multidisciplary field.
Job opportunities	Edible Electronics is new multidisciplinary research field, providing a great opportunity to be exposed to several different environments, from academia to industry. Careers in academia, in industry, industrial R&D and consulting are possible.
Composition of the research group	1 Full Professors 3 Associated Professors 6 Assistant Professors 9 PhD Students
Name of the research directors	Mario Caironi

Contacts
Group head: Dr. Mario Caironi 2014 and 2019 ERC grantee, mario.caironi@iit.it https://www.iit.it/it/web/printed-and-molecular-electronics

Additional support - Financial aid per PhD student per year (gross amount)			
Housing - Foreign Students	**1st year**	**2nd year**	**3rd year**
	1500.0 € per student	1500.0 € per student	1500.0 € per student
	max number of financial aid available: 1, given in order of merit (only for students with scholarship)..		
Housing - Out-of-town residents	**1st year**	**2nd year**	**3rd year**
	1000.0 € per student	1000.0 € per student	1000.0 € per student
	max number of financial aid available: 1, given in order of merit (only for students with scholarship)..		

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
Educational activitiesEducational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences). Financial aid per PhD student per 3 years: max 5.707,20 .euros per student. ***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: individual desk will be provided; no PC or laptop will be provided by default. Special requests will be discussed and carefully considered.