POLITECNICO DI MILANO

PhD in INGEGNERIA DEI MATERIALI / MATERIALS ENGINEERING - 39th cycle

THEMATIC Research Field: DESIGN AND SYNTHESIS OF PHOTOACTUATORS FOR OPTO-BACTERIAL STIMULATION

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 electrical potential in bacteria regulates many of their biological functions, including motion and antibiotic tolerance. In recent years, it has been demonstrated that this parameter is dynamic and can be manipulated by external stimuli. The main goal of this research program is to design rationally and synthesize intramembrane switches and conjugated polymer nanoparticles. These materials will be engineered to interact stably with the membranes of both gram-positive and gram-negative bacteria, in order to elicit light-dependent modulation of their electrical potential.
Methods and techniques that will be developed and used to carry out the research	Synthesis of opto-mechanical switches, which can partition into the lipid membrane and at this location can perturb its mechanical properties. The rationale is to elicit opening of mechano-sensitive channels upon light exposure, whose role of bacterial bioenergetics is still largely uncharacterized. Synthesis of push-pull switches, consisting of electron-donating and electron-withdrawing substituents. The rationale is to perturb the surface charge on bacterial cell wall and plasma membrane under illumination. Synthesis of conjugated polymer nanoparticles, which can attach to the bacterial membrane. Here, they can generate exciton and charges (polarons) upon light stimulation, whose can be in turn able to polarize

	stimulation, whose can be in turn able to polarize electrically the membrane and evoke the opening of voltage-gated ion channels.
Educational objectives	To provide a background in chemical synthesis, biophysics and biomaterials science. To provide problem solving skills and teach teamwork. The project will be carried out within a broad interdisciplinary collaboration that involved physicists, microbiologists and bio-engineers.
Job opportunities	R&D positions in high tech companies operating in chemical specialities or in bio medical and pharmaceutical fields.
Composition of the research group	1 Full Professors 0 Associated Professors 4 Assistant Professors 2 PhD Students
Name of the research directors	Dr. G. M. Paternò, Prof.C. Bertarelli

Contacts
Dr. Giuseppe Maria Paternò giuseppemaria.paterno@polimi.it https://www.fisi.polimi.it/ Prof. Chiara Bertarelli chiara.bertarelli@polimi.it https://www.cmic.polimi.it/

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

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Confidentiality (in case of Agreement with company): 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.

Individual budget for research (5.700 euro):1st year: 1.900 euro; 2nd year: 1.900 euro; 3rd year: 1.900 euro

Teaching assistantship (availability of funding in recognition of supporting teaching activities by the PhD student): 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.