



PhD in FISICA / PHYSICS - 38th cycle

PARTENARIATO PNRR Research Field: ALD/PVD GROWTH OF DEFECT-TOLERANT MATERIALS FOR PHOTOVOLTAICS

Monthly net income of PhDscholarship (max 36 months)

€ 1350.0

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 success of the recently discovered hybrid lead-halide perovskite absorber materials for photovoltaic (PV) has triggered the quest for similar "defect-tolerant" PV absorbers, with electronic structures similar to those of perovskites but composed of earth-abundant non-toxic elements. Chalcogenide compounds $(A)BX_2$ ($A=Ag/Cu$, $B=Bi/Sb$, $X=S/Se$) are a particularly promising class of semiconductor materials, covering a large spectrum of bandgaps that can address multiple applications such as Power-by-Light systems, automotive and indoor PV, and the challenging and urgent problem of identifying a stable and scalable wide-bandgap semiconductor partner for Silicon tandem solar cells. Chemical Solution Deposition methods are typically used to synthesize these absorber materials in proof of concept devices, although Physical Vapor Deposition (PVD) techniques and Atomic Layer Deposition (ALD) offer better control of stoichiometry and compositional gradients, typically used in state of the art $Cu(In,Ga)(S,Se)_2$ solar cells to obtain distributed heterojunctions and improve carrier selectivity. In the framework of the NFFA-DI project, **PNRR (CUP B53C22004310006)** the Micro and Nano Technology Center of the Politecnico di Milano (Polifab) is acquiring deposition apparatus (ALD, PVD) for the growth of different materials ranging from metal oxides, 2D materials, and Sulfide/Selenide-based materials for emerging applications. The PhD student will participate in the commissioning and operation of the new systems, in particular focusing on the screening of "defect-tolerant" photovoltaic absorbers using selection metrics based on



	<p>detailed-balance analysis. After selection of the most promising absorber material, s/he will fabricate the first generation solar cell, possibly integrated with light-trapping schemes to compensate for potential low minority carrier diffusion lengths that are often encountered in new classes of absorber materials. In the last period of the PhD she/he will be also involved in activities on the new growth system proposed by users of the NFFA-DI infrastructure.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The PhD will carry out the following activities:</p> <ul style="list-style-type: none"> • Commissioning of the new systems • Synthesis of selected ABX_2 material thin films • Optoelectronic and structural characterization of the ABX_2 material thin films (screening and selection) • Fabrication of an ABX_2-based solar cell, possibly integrated with a light-trapping management scheme <p>The activity will be carried out in the framework of the NFFA-DI project at Polifab. A close collaboration with C2N-CNRS and IPVF (Paris) will also provide access to state-of-the-art luminescence characterization techniques (Time-Resolved Cathodoluminescence and Photoluminescence Hyperspectral Imaging).</p>
<p>Educational objectives</p>	<p>Development of interdisciplinary knowledge at the boundary between material science, physics, engineering, nanofabrication, and nanophotonics.</p>
<p>Job opportunities</p>	<p>The PhD will work with a team dedicated to the synthesis and characterization of complex functional materials, as well as the design and (micro/nano)-fabrication of devices (MEMS, sensors, solar cells). This PhD will provide a solid basis for careers both in academia and in the semiconductor industry.</p>
<p>Composition of the research group</p>	<p>1 Full Professors 3 Associated Professors 3 Assistant Professors 6 PhD Students</p>
<p>Name of the research directors</p>	<p>Cattoni; Bertacco</p>

Contacts

andrea.cattoni@polimi.it



riccardo.bertacco@polimi.it
 tel. 0039 02 2399 9663;
<https://www.fisi.polimi.it/en/people/bertacco>

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	675.0 €
By number of months	6

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

Educational activities Educational activities (purchase of books and materials, funding for participation in courses, summer schools, workshops and conferences): financial aid for the PhD student for 3 years: max 5.503,32 euros.

Teaching assistantship: There are various forms of financial aid for teaching support activities. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations

Computer and desk availability: *individual or shared use*