POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 41st cycle

THEMATIC Research Field: METHODS FOR PRODUCING AND ENGINEERING TWO-DIMENSIONAL MATERIALS IN LOW-ENERGY DEVICES

Monthly net income of PhDscholarship (max 36 months)
1450.0 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	2D materials can be engineered to be configured in electronic device platforms and circuital architectures with the aim to outperform the mainstream technology in terms of low-power solutions. With this general purpose, the main objective of the research activity is the development of novel 2D nanomaterials and/or 2D heterostructures, including the synthesis from bottom-up approaches, the structural characterization to the nano/atomic scale of the grown materials, the functional characterization of device-oriented key-performances, and their reconfiguration and integration into low-power electronic device layouts for device testing. Target devices will encompass electronic devices based on 2D junctions (serving as memristors, IR photodetectors or sensors) either in rigid or flexible platforms. Target materials will include tellurene, silicene, MoS_2 or similar 2D layered materials and related heterostructures in properly designed configurations enabling the transfer to a flexible platform and to a device layout.The research program will span from fundamental science investigations at the materials growth and device levels, to functional characterization of the as-grown materials, and application-oriented activity aimed at integrating and validating the processed materials in a device layout with focus on the development od technology transfer protocols.

Methods and techniques that will be developed and used to carry out the research	Material fabrication will be achieved by physical (molecular beam epitaxy, physical vapour deposition) and/or chemical deposition techniques (chemical vapour deposition) depending on the 2D material in point. Material characterization will be carried out by structural characterization at each process level (via Raman spectroscopy, scanning probe microscopy, and other possible tools available at the CNR unit, Nanolab at Politecnico Milano, and with outsource collaborators), functional characterization (via scanning probe spectroscopies). Upon functional characterization testing, integration into device/circuit layout will be carried out by lithographic processing through device architecture design, contact evaporation, clean-room operations, and testing (via electrical and/or optoelectrical characterization) as final stage. Transfer to flexible platforms will be achieved by developing appropriate configurations and processes for membrane manipulation.
Educational objectives	Education of people to be “launched” in the world of research and technology in the field of physics, nanotechnology and materials engineering, able to manage interdisciplinary issues, design, perform and interpret complex experiments, develop upgraded equipment, and address innovation opportunities.
Job opportunities	Private and public R&D. Highly qualified positions in a wide range of industries related with production, development and use of materials for energy, electronics and other high-tech applications.
Composition of the research group	3 Full Professors 3 Associated Professors 3 Assistant Professors 3 PhD Students
Name of the research directors	Alessandro Molle (CNR); Carlo Casari (POLIMI)

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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	725.0 €
By number of months	6

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

Educational activities:Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is nearly equal to 8% of the annual gross amount, for 3 years. Extra support for dissemination tasks from the external institution (CNR-IMM) will be assessed case by case.

Teaching assistantship:Availability of funding in recognition of supporting teaching activities by the PhD student. 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.

External CNR-IMM association:The PhD student will be associated with the CNR-IMM (which will then appear as a second affiliation) and will be assigned a badge to access the CNR-IMM unit at Agrate Brianza (inside the ST-Microelectronics headquarter) and receive related benefits. *Computer availability:* individual use.*Desk availability:* individual use.