

H2020 Marie Curie Actions- Innovative Training Network

INDEED

Innovative Nanowire DEvicE Design

Job title: Doctoral Research Fellowship (PhD)

Title: Growth of advanced functional heterostructures in III-V nanowires

Location: Centre for Nanoscience and Nanotechnology (C2N)
Marcoussis and Palaiseau, France

Duration: 3 years (subject to the host institution probation period where applicable)

Closing date: 31 October 2017

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Gross Living Allowance: € 41 425 per year plus mobility allowance. Salary is subject to national taxes and employer's costs.

PhD Research project

Semiconductor nanowires, with diameters of a few tens of nanometers and lengths up to several microns, are nowadays commonly fabricated from a large range of semiconductor materials. The remarkable physical properties of these objects open large prospects of original applications, some of which have already been demonstrated. However, their full potential will only be achieved if their physical properties can be precisely tailored. In addition to controlling the geometry, crystal structure and doping of the nanowires, two requirements are essential for most applications: (1) to obtain regular arrays of identical nanowires; (2) to confer novel functionalities to each nanowire by modulating locally its properties. The ultimate aim of the project is to combine these two objectives in the fabrication of arrays of nanowires including advanced functional heterostructures.

The PhD student at C2N will perform research on the growth by molecular beam epitaxy (MBE) of nanowires of III-V semiconductors. An important aspect of the project is to maintain an intimate coupling between experimental investigations and modeling of the nucleation and growth mechanisms, which is a strength of the C2N team.

Specifically, he/she will explore the growth of two kinds of heterostructures. The first one involves a high aspect ratio quantum size insertion of a material different from the rest of the nanowire. The second one consists in a homogeneous nanowire where the spatial modulation of the electronic properties will be achieved not by varying the composition but the diameter of the structure. He/she will aim at fabricating arrays of such structures on a patterned substrate with a high yield of vertical and identical nanowires.

The candidate is expected to develop and perform advanced modeling of the growth of these structures and to investigate experimentally their fabrication. In addition to using a standard MBE setup, investigations could be carried out on a unique instrument, newly developed by our team and combining high resolution transmission electron microscopy and MBE.

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Context

This research fellowship programme (PhD) will be carried out within the context of the INDEED network, a Marie Skłodowska-Curie Actions– *Innovative Training Network* (ITN) – project funded by the European Commission, under their H2020 program. Through the project activities, the Fellows/PhD students will have the opportunity to come in contact and collaborate with some of the best European research groups. English is the official language of the INDEED project. Additional details are available in “*Further particulars*”.

Responsibilities

- (1) Perform high quality research in the bespoke research project under the guidance of the supervisory team.
- (2) Meet the members of the supervisory team on a regular basis.
- (3) Participate in the activities of the Network as specified in the Grant Agreement and/or required by the node coordinator, including secondments in other network nodes and taking part in the network meetings and in the training activities.
- (4) Write up the results of the research activity and present research papers and publications at meetings and conferences, as advised by the supervisors.
- (5) Widen the personal knowledge in the research area and undertake complementary training.
- (6) Keep records of the activities, such as research, training, secondments, visits, leave of absence, etc.

Person Specification

The successful candidates *must satisfy the eligibility criteria* (see below) and have:

- (1) An excellent academic record in physics, engineering, material sciences or related areas.
- (2) A keen interest in pursuing research in nanotechnology, and in particular the science and technology of nanowires
- (3) The ability to work independently and as a member of a research team.
- (4) Excellent interpersonal and communication skills.
- (5) A good command of English language, with excellent oral and written skills.

** Note that female candidates are particularly encouraged to apply.*

Desirable

Any or combination of the following will be a clear advantage.

- A demonstrable ability or potential to produce research published in peer-reviewed journals.
- A good strategic fit with existing research expertise in the host institution and the *INDEED* network
- Knowledge of, or willingness to learn, the language of the host institution (French).

Eligibility Criteria

The candidates must meet all the criteria listed below

- (1) Be in the first four years (full-time equivalent research experience) of his/her research career and not have a doctoral degree at the time of recruitment by the host organisation. Full-Time Equivalent Research Experience is measured from the date when the researcher obtained the degree entitling him/her to embark on a doctorate (either in the country in which the degree was obtained or in the country in which the researcher is recruited, even if a doctorate was never started or envisaged. However, full time spent on non-research related activities may be discounted, where each case is evaluated on its own merit.
- (2) At the time of recruitment by the host organisation, must not have resided or carried out their main activity (work, studies, etc.) in the country of their host organisation for more than 12 months in the 3 years immediately prior to the reference date. Short stays such as holidays and/or compulsory national service are not taken into account.
- (3) Prior to starting their position, the successful fellows must have completed the courses that would have allowed them to enrol in a doctorate program either in the country where they are studying or in the country offering the position.
- (4) Gross living allowance is subject to employment laws and employer costs deduction.
- (5) Mobility Allowance: In addition to the salary, the successful fellows will receive a *mobility allowance* of 7200 Euros per annum. Fellows married at the time of recruitment are also eligible to receive a *family allowance* of 6000 Euros per annum. All of the payments are subject to relevant host country employment laws and deductions of all compulsory contributions for both employer and employee.

Further particulars

The INDEED project

Nanowires (NWs) exhibit unique properties that make them potential building blocks for a variety of next generation NanoElectronics devices. Recent advances have shown that NWs with predefined properties can be grown, offering a new paradigm enabling functional device prototypes including: biosensors, solar cells, transistors, quantum light sources and lasers. The critical mass of scientific knowledge gained now needs to be translated into of NW technologies for industry. FP7-MSCA NanoEmbrace (ITN) and FUNPROB (IRSES) , made substantial contributions to NW research, producing excellent scientific and technological results (> 100 journal papers published) and delivering outstanding training in nanoscience and transferable skills to ESRs.

Despite demonstrable scientific and technological advantages of NWs, NW-based technology concepts have not yet been translated into market-ready products, because

industry and academia have not worked hand-in-hand to commercialize the research findings. Thus, it is essential that NW research is now directed towards customer-oriented scientific R&D; whilst applying innovative industrial design techniques to ensure rapid translation of the basic technologies into commercial devices.

This ambitious challenge requires close collaboration between academia and the nascent NW industry, combining the efforts of scientists and engineers to address market needs. Building upon our previous achievements, a team of leading scientific experts from top institutions in Europe, strengthened by experts in innovative design and industrial partners with an excellent track record of converting cutting edge scientific ideas into market products has formed the INDEED network to address this challenge. To enhance employability, INDEED will train young ESRs to become experts with a unique skill set that includes interdisciplinary scientific techniques, industrial experience through R&D secondments and innovative design skills.

The INDEED consortium

Coordinator: University of Durham, Durham UK.

Academic Beneficiaries (10 including coordinator)

Ecole Polytechnique Fédérale de Lausanne (Switzerland) ; Consiglio Nazionale delle Ricerche (CNR, Italy: *Institute of Microcroelectronics and Microsystems, Rome and Istituto Officina dei Materiali, Trieste*); University of Copenhagen (Denmark); Centre National de la Recherche Scientifique (CNRS, France: *Centre for Nanosciences and Nanotechnology, Paris and Institut supérieur de l'électronique et du numérique, Lille*); Lappeenranta Institute of Technology (Finland); University of Newcastle (UK); Lunds University (Sweden); The University of Liverpool (UK); Université Paris-Sud (France).

Industrial Beneficiaries (2)

Innolume GmbH (Dortmund, Germany); Imina Technogies (Lausanne, Switzerland).

Associate Partners (13)

ITMO University (Russia), PragmatIC Printing (UK), Peratech (UK), Horiba (France), Digital Surf (France), Thundernil (Italy), APE research(Italy), Quantum DX (UK), Microsoft Station Q (Denmark), Semimetrics Ltd (UK), Université Paris-Saclay (France), Höganäs (Sweden), General Electric (Germany), Riber (France).

Data protection

The INDEED Network is committed to respecting the confidentiality of the information provided by the applicant: personal data collected for the present proceeding will be processed for the sole purposes connected with and instrumental to the selection procedure and the eventual management of the job contact, in conformity with the current provisions. The responsible for the Personal Data Handling is the principal investigator at the host institution.