Postdoctoral subject:

Towards the development of high-performance piezoelectric nano-composites for innovative applications in energy conversion

IMEP-LaHC / MINATEC / Grenoble-France

Keywords:
Nanotechnologies, Nanowires, Piezoelectricity, AFM, Multiphysics simulation, Semiconductor Physics and technology.

Description of the project:

Semiconductor piezoelectric nanowires (NWs) (GaN and ZnO among others) have improved piezoelectric properties compared to thin films and bulk materials, due to their greater flexibility and sensitivity to lower forces. An intrinsic improvement in piezoelectric coefficients has also been identified by recent theoretical and experimental studies [1, 2]. We are interested in the integration of these nanostructures into nanocomposites (formed by NWs embedded in a dielectric matrix). Very recent theoretical studies in our team show that these nanocomposites can feature improved performance compared to thin films [3, 4]. This type of material is therefore very interesting for different innovative applications, especially when integrated into a flexible substrate. In this context we focus mainly on sensor and mechanical energy harvesting applications [5, 6].

The candidate will work in the context of several European projects in collaboration with Italian research institutes and French SMEs among others. He/she will contribute to the technological development to integrate piezoelectric nanowire composites on rigid and flexible substrates, to the electromechanical characterization of manufactured devices using specific characterization benches [7, 8] and to the evaluation of this technology for innovative applications.

Depending on his or her expertise, the candidate will participate in the co-supervision of Master and PhD level students on several activities within the group, including (i) the characterization of nanowires and nanocomposites using AFM (Atomic Force Microscopy) techniques and (ii) the multi-physics simulation of the nanocomposite using commercial FEM simulation software (e. g. COMSOL Multiphysics).

The candidate will acquire expertise in (i) energy conversion using piezoelectric materials, (ii) manufacturing and integrating piezoelectric nanowires into functional devices, (iii) electromechanical characterization of nanowires and associated devices, (iv) the design and simulation of nanocomposites integrating piezoelectric semiconductor nanowires, (v) student supervision.

References:

[1] X. Xu, A. Potié, R. Songmuang, J.W. Lee, T. Baron, B. Salem and L. Montès, Nanotechnology 22 (2011)
[2] H. D. Espinosa, R. A. Bernal, M. Minary-Jolandan, Adv. Mater. 24 (2012)
[3] R. Tao, G. Ardila, L. Montès, M. Mouis Nano Energy 14 (2015)
[4] R. Tao, M. Mouis, G. Ardila, Adv. Elec. Mat. 4 (2018)
[5] S. Lee, R. Hinchet, Y. Lee, Y. Yang, Z. H. Lin, G. Ardila, et al., Adv. Func. Mater. 24 (2014)
[6] R. Hinchet, S. Lee, G. Ardila, L. Montès, M. Mouis, Z. L. Wang Adv. Funct. Mater. 24 (2014)
[7] R. Tao, M. Parmar, G. Ardila, P. Oliveira, D. Marques, L. Montès, M. Mouis Semicond. Sci. Technol. 32 (2017)
[8] D. Menin, M. Parmar, R. Tao, P. Oliveira, M. Mouis, L. Selmi, G. Ardila IEEE Conf. EUROSOI-ULIS (2018)

More information:

Knowledge and skills required:

It is desirable that the candidate has knowledge in one or more of these areas: semiconductor physics, finite element simulation, Atomic Force Microscopy (AFM), clean room techniques and associated characterizations (SEM, etc.).

Location: IMEP-LaHC / Minatec / Grenoble, France
Start of the contract: January/February 2020
Duration of the contract: 1 year, renewable eventually

Advisor:

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About the laboratory:

IMEP-LAHC / MINATEC / Grenoble (http://www.imep-lahc.grenoble-inp.fr)

IMEP-LAHC is located in the Innovation Center Minatec in Grenoble. It works in close partnership with several national and international laboratories and industrial groups, preindustrial institutes and SMEs. The post-doctoral fellow will work in the Micro-Nano Electronics Components team, in the Integrated Nanostructures & Nanosystems group, and will have access to the laboratory's technological (clean room) and characterization platforms.

Contacts:

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