Growth and electrical characterizations of ZnO nanowires to design and manufacture piezoelectric generators

Job summary:
GREMAN is opening a postdoc position to focus on the study of the properties of ZnO nanowires (NW) used in the fabrication of piezoelectric generators. The ZnO nanowires will be grown, on rigid or flexible substrates, by hydrothermal process previously developed in the laboratory. The study of the crystaline quality of nanowires will be done using SEM and XRD. The electrical characterizations of the NW will be made using Field Effect Transistors (FET) in order to determine the type of defects and the corresponding intrinsic doping of the semiconducting nanowires. Finally, piezoelectric generators based on ZnO NW will be manufactured using conventional clean room technologies and will be characterized in terms of produced voltage and current. This work will be a part of the H2020-ECSEL “EnSO” project focusing on autonomous micro energy sources.

Job description:
The objective of H2020-ECSEL “EnSO” project is to develop and consolidate a unique European industrial eco system in the field of autonomous micro energy sources (AMES). This eco system will involve all the value chain from key materials and tools needed to reach expected cost and sufficient volume capabilities, to a large number of demonstrators in different fields of application. To achieve this objective, the project will cover a large spectrum of R&D developments through beyond state-of-the-art micro batteries, different generations of energy harvesters, power conditioning and smart integration of these building blocks, to build an adequate form factor. In this context, the main objective at GREMAN is to adapt and develop a non-resonant mechanical energy harvesting technology, according to the AMES specifications provided by EnSO end users. More specifically, we have developed an innovative synthesis method of non-resonant piezoelectric generators based on ZnO nanowires, that should be compatible with industrial scale processes and over large area substrates at low cost. The current hydrothermal synthesis method will be adapted in order to reach a growth rate of 20 nm/min (3 µm in 2.5 hours instead of 15 hours today). The advantages of this chemical bath deposition are: low cost, low reaction temperature, large area growth substrates, environmental friendliness and compatibility with plastic flexible substrates.

During this postdoc position, you will have to:
- Perform the growth of nanowires on different kinds of substrates, rigid or flexible, using hydrothermal synthesis method developed at the laboratory
- Do the structural characterization of the resulting nanowires: crystalline quality, length, diameter, surface density, alignment orthogonally to the substrate using MEB and XRD.
- To manufacture field effect transistors using the laboratory clean room facilities, photolithography and metal deposition. To perform their characterization (voltage-current characteristics) to study the effect of nanowires growth conditions on their electrical properties
in order to determine the type of defects and finally the doping of the semiconducting nanowires. Impedance spectroscopy is also planned for this kind of device to extract piezoelectric and mechanical properties of a single nanowire. These intrinsic properties are crucial for the Finite Element Model study made by a PhD student already present in the laboratory.

- To manufacture the piezoelectric generators using the laboratory clean room facilities (electrodes and polymer matrix deposition, encapsulation) and to make the functional characterization (produced voltage and current) of the device using the test bench present in the laboratory.

- To investigate the possible circuit architectures for the AC to DC conversion in order to see its effect on the really available electrical power.

All the equipment required for this project are available at CERTeM technological platform (http://certem.univ-tours.fr), which is a fully equipped clean room and an electrical/physical/mechanical characterization laboratory, hosted by STMicroelectronics Tours.

**Candidate profile**

You will have a PhD in Microelectronics.

You have a good knowledge of fabrication process commonly used in microelectronics (photolithography, sputtering, e-beam evaporation, ...) and in structural characterization (MEB, XRD...). You have a good general knowledge of piezoelectricity and/or electromechanical converters (piezoelectric or electromagnetic or electrostatic).

An experience in electrical engineering, impedance spectroscopy and use of electronic lithography would be particularly welcome.

**Location** : At GREMAN and on the CERTeM platform. Tours is located at 230 km south from Paris, France.

**Address** : 16 rue Pierre et Marie Curie, 37100 TOUERS, FRANCE

**Working Hours** (hours per week) : 35

**Starting period** : as soon as possible, **for one year with possibility of 1 year extension**

**Salary** : 2050 € net

**How to apply** : e-mail

**Application e-mail** : kevin.nadaud@univ-tours.fr