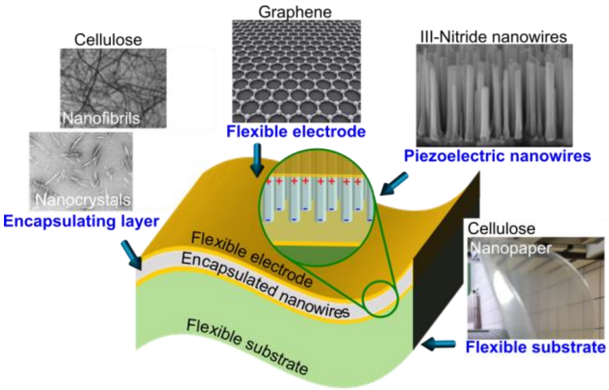
NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2021-2022

III-Nitride nanowire-nanocellulose composites for flexible energy harvesters

General Scope:

A large number of small-scale smart electronics have been progressively integrated into our everyday lives in various sectors (healthcare, energy, security, etc). Such systems require sustainable, maintenance-free, and self-powered devices that can harvest the energy from their surrounding. Lately, there is a significant increasing research interest in piezoelectric nanowire nanogenerators which can scavenge mechanical energy from natural or biomechanical origin to drive small-scale devices. A typical way of fabricating nanowire nanogenerators is to embed the nanowires in synthetic polymers to improve their stability and processability while preserving their mechanical compliance. These encapsulated nanowires are transferred on top of soft materials such as plastic sheets which are easier to be integrated with various surfaces than rigid substrates. The common plastic substrates could cause ecological problems since they are based on non-renewable petrochemical products and cannot be decomposed through biodegradation as organic materials. This work aims at developing inorganic-organic composites for eco-friendly flexible energy harvesters.



Research topic and facilities available:

The targets of the project are (1) to use piezoelectric semiconductor III-Nitride nanowires to convert green energy into usable electrical energy and (2) to replace eco-unfavorable device components with eco-friendly materials, *i.e.* using plant-based cellulose nanopapers instead of plastic substrates and using graphene to substitute metallic electrodes for electrical contacts.

Two internships will participate in the process development of inorganic-organic composite fabrication and characterization. They will intensively explore cellulose nanopapers as a flexible substrate and test the nanowire encapsulation by nanocelluloses in different forms (nanofibrils, nanocrystals). The study also includes the fabrication of graphene electrical contact for nanowire nanogenerator devices on nanopapers. Together with the team, both students will contribute to the large-scale characterization of electrical and electromechanical properties to gain essential information associated with the device's key parameters such as output power, sensitivity, detection limit, linearity, response time, stability, etc. The fabrication process of each component will be readjusted according to the effective output signal. The interns will join regular meetings with the staff involved in the project.

The experiments will be performed at CERMAV and Néel/Grenoble. The students will have an opportunity to access the facilities of both laboratories for necessary experiments such as nanofabrications facilities (metal evaporation, chemical bench, lithography, etc.), characterization tools for electrical, structural, and optical properties (scanning electron microscopy, atomic force microscopy, etc).

Possible collaboration and networking: Nanophysics and semiconductors/ Néel, Quantic electronics, surfaces and spintronics/Néel, Optic and Material/Néel, CTP, and CERMAV

Possible extension as a PhD: No funding is currently available but we support the applications for the grant.

Required skills: Nanofabrications, Semiconductors, Nanomaterials, Solid State Physics, Chemistry

Starting date: February/March 2022 for 4 to 6 months

Contact: SONGMUANG Rudeesun, Institut Néel – CNRS, mail : rudeesun.songmuang@neel.cnrs.fr
More information: http://neel.cnrs.fr, https://cermav.cnrs.fr/en/the-teams/structure-and-properties-of-glycomaterials/

NÉEL institut