

Title: III-Nitride Nanowires for Piezoelectric Generation: An alternative way for supplying nomad microelectronic devices

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The development of autonomous micro-devices for sensing, monitoring and nomad electronics requires new competitive integratable electrical energy sources. These sources must generate sufficient power to supply the micro-devices without increasing their size and weight. From now few years, III-Nitride materials and nanomaterials have emerged as systems of interest to harvest renewable energies for the energy applications. Especially, the nanowires (NWs), presenting piezoelectric properties, are appeared as excellent candidates to fabricate novel ultra-compact and efficient generators harvesting mechanical deformations and vibrations found in the direct vicinity of the devices. Thanks to their superior mechanical properties, higher sensitivity to applied force and higher piezoelectric response over conventional 2D films and bulk materials, the NWs have the potential to fundamentally improve the electrical generator performances.

We demonstrate the high potential of III-Nitride NWs for piezoelectric generation. Based on a systematic multi-scale analysis, going from single wire properties to macroscopic device fabrication and characterization, we establish the relationship between the material properties and the piezo-generation. Thank to this fine understanding of the piezo-conversion mechanisms, we propose efficient piezo-generator designs. The devices integrate GaN NW arrays of several square millimeters in size and deliver a maximum power density of 12.7 mW/cm^3. This value settles the new state of the art for piezo-generators based on III-Nitride NWs. These results offer promising prospects for the use of GaN NWs for high-efficiency ultra-compact energy harvesters, since the generated power density is already interesting for real world applications such as remote wireless transceivers.

Biography

Noelle Gogneau received her Ph.D. degree in Physics in 2004 from the J. Fourier, Grenoble University. After a post-doctoral position at the Laboratory of Physics of Nanostructures (EPFL, Switzerland) from 2004 to 2006, she joined the Center for Nanosciences and Nanotechnologies from the Paris-Saclay University as CNRS scientist in 2006. From 2011, her research activity is mainly centered on the growth of III-nitrides NWs by Plasma-Assisted Molecular Beam Epitaxy for the nano-energy appications. She currently leads the activities on piezo-generators. She is authors and co-authors of more than 75 referred scientific publications, GoogleScholar (H=18).

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